Journal of Scientific Research & Reports

17(4): 1-6, 2017; Article no.JSRR.38837
ISSN: 2320-0227

Evaluation of Personnel Radiation Monitoring in Selected Hospitals in South – South and South – East Region of Nigeria

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Authors' contributions

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

Article Information

DOI: 10.9734/JSRR/2017/38837
Editor(s):
(1) Karl Kingsley, University of Nevada, Las Vegas - School of Dental Medicine, USA.
Reviewers:
(1) Sainudeen Pattazhy, University of Kerala, India.
(2) Nilmara Almeida Guimarães, Instituto Federal do Rio de Janeiro, Brazil.
(3) Namaitijiang Maimaiti, Ankara Yildirim Biyazit University, Turkey.
(4) Franco Cervellati, University of Ferrara, Italy.
Complete Peer review History: http://www.sciencedomain.org/review-history/22792

Original Research Article

Received 26th October 2017
Accepted 9th January 2018
Published 19th January 2018

ABSTRACT

Background: The use of radiation in hospitals is of great benefit to patients. However scattered radiation that is associated with its use is of great risk to staff and the general public that come in contact with it. The need, therefore, arises that staff be monitored to ensure that they are not exposed to radiation levels higher than the allowed safety limits.
Aim: The aim of this study is to evaluate personnel radiation monitoring and availability of personal protective equipment in some tertiary hospitals in South-South and South – East of Nigeria to ensure that they comply with international regulations.
Methods: A survey that targeted the staff of the radiology department of five selected hospitals in South-South and South – East Region of Nigeria was conducted. The data collection instrument was a twenty – two item semi-structured self – completion questionnaire. Convenience sampling

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was used to select the hospitals and a total of 79 staff were sampled. The data was analyzed using Microsoft Excel 2010.

Results: The percentage of personnel monitored ranged between 45% and 89%. Availability of five personal protective equipment (PPEs) was considered: lead apron, gonad shield, thyroid shield, gloves and glasses. The lead apron was readily available in all the hospitals, 90% and above in all the hospitals, while the gonad shield was almost nonexistent, 11% and below. The knowledge of basic definitions and principles of radiation safety was a little above average. Dosimetric records were not considered important during staff recruitment.

Conclusion: Radiation monitoring of staff of the five selected hospitals was below the expected 100% required by international standards. Personal protective equipment required were not sufficiently available. Therefore the management of the hospitals should ensure that all necessary equipment is available to achieve occupational radiation safety.

Keywords: ALARA; monitoring; radiation; PPEs.

1. INTRODUCTION

The discovery of X – rays led to a revolution in medicine and medical care. Diagnostic and experimental radiation exposure revealed the deterministic effects of radiation such as erythema and radiation burns. Guidelines on the safety of workers handling patients for diagnostic X-ray were introduced for the first time [1]. The use of radiation in the health sector has increased and so the risks. The risk from X-ray in radiology is well established and is a known human carcinogen [2].

Humans have learned to use radiation for many beneficial purposes; such purposes may at times create potential hazard situations for personnel that work within the hospital. One of the hazards of working in a department of nuclear medicine or diagnostic radiology is the possibility of long-term exposure to low-level radiation and the associated effects [3]. Monitoring of radiation doses received by staff in radiology departments is of great importance to the radiographers in their effort to protect themselves, patients and the general public from the risks associated with excessive radiation. It is therefore sensible for those involved in the use of ionizing radiation in diagnostic radiology to have an appreciation of the possible risks involved. For radiology staff, the measurement of radiation doses received at periodic intervals represents a way of monitoring doses to ensure that they are within safe occupational limits [4].

The importance of personnel radiation monitoring cannot be overemphasized. It does not in itself provide protection against ionizing radiation. Its main purpose is to measure radiation doses received by radiology personnel, which is then used to ensure that radiation dose to staff are not exceeded, but are within the permissible limits. They are also used to verify that facilities for radiation protection are adequate and that radiation techniques are acceptable [4].

The annual per capital effective dose has doubled worldwide over the past decade due to the daily increase in diagnostic procedures [5]. Due to the detrimental effects of X – rays, it, therefore, becomes necessary to keep all radiation exposures and hence radiation doses to staff, patients and the public as low as reasonably achievable (ALARA) or practicable (ALARP) [6]. This can only be achieved if there is strict adherence to all regulations that pertain to the use of X – rays both on the users and recipients.

Film badges, thermoluminescent dosimeters and pocket ionization dosimeters are recommended radiation measuring devices for use by staff of radiology departments to monitor the amount of radiation received [7]. Every staff that works in the radiology department is expected to wear their personal dosimeter always as they perform procedures [8]. This is very important in order to reduce radiation risks.

The dose records of the staff are very important and are recorded for the purpose of evaluating their radiation history and possible risks. At the Washington state university, employees who have never been monitored must apply for and receive a monitoring badge before starting work, while those who have worked elsewhere are required to present their radiation exposure history [9]. It is, therefore, necessary to keep the dose records of staff to enable the monitoring of radiation levels and their related risks.

2. MATERIALS AND METHODS

2.1 Study Area

The study area is parts of South-South and South-East region of Nigeria. The following hospitals were selected for this study.

1. University of Port Harcourt Teaching Hospital, Rivers State (UPTH).
2. Braithwaite Memorial Specialist Hospital Port Harcourt, Rivers State (BMSH).
3. Federal Medical Centre Owerri, Imo State (FMCO).
4. Federal Medical Centre Umuahia, Abia State (FMCU).
5. University of Uyo Teaching Hospital Uyo, Akwa Ibom State (UUTH).

This study was conducted in the radiology department of the five selected hospitals in parts of South-South and South – East Nigeria.

The hospitals were chosen because they are tertiary and referral hospitals and attend to a large number of patients. This implies that the staff will be exposed to greater levels of radiation since they attend too many patients in a short space of time. This translates to greater risks and greater need to determine their radiological status. Convenience sampling was used for this study.

A cross-sectional prospective survey was used to obtain data.

A twenty-two item self-filling semi-structured questionnaire adapted from that used by Okaro et al. [4] with minor changes in line with objectives of the study was distributed to a total of 79 staff of the five hospitals. The questionnaire sought information on the provision of personal dosimeters, availability of five personal protective equipment (PPEs) and the importance of dosimetric records of the staff was determined. The questionnaires were distributed to consenting staff which is about 83% of the total number of staff. Completed questionnaires were collected and analyzed using Microsoft Excel 2010.

2.2 Ethics

In accordance with the requirements of the ethical committees of the five hospitals, approval for the study was applied for and was granted. Participants were given the right to take part in the survey or to decline. Only willing participants took part in this study.

Some of the staff were not willing and this affected the results of the study.

3. RESULTS

Table 1, shows the availability of personnel radiation monitoring equipment in the five selected hospitals. The results show that the following percentage of staff were monitored; BMSH – 45%, UPTH – 70%, UUTH – 41%, FMCO – 89% and FMCU – 50%.

Table 2, shows the availability of personal protective equipment (PPE). Five different types of equipment were considered.

Table 3, shows the knowledge of basic definitions and principles of radiation safety. The staff were asked to define the full meaning of ALARA, which is a basic principle used in radiation safety. The results showed that more than fifty percent of the staff in all the hospitals got the answer correctly. While less than 50% percent of the workers in all the hospitals except one knew the full meaning of ICRP which is one the commissions that see to radiation protection issues.

The knowledge of the workers on basic radiation safety principles was not very encouraging. Three of the hospitals scored below 50%. While Table 4, shows that most of the hospitals did not request for the dose records of staff at the point of employment. Further results of the analysis are presented in Fig. 1.

Table 1. Availability of personnel radiation monitoring equipment in the hospitals

S/N	Hospitals	BMSH	UPTH	UUTH	FMCO	FMCU
1	Number of radiology staff	21	20	27	9	2
2	Number of staff monitored	9 (45%)	14(70%)	11(41%)	8(89%)	1(50%)

Table 2. Availability of personal protective equipment (PPE)

S/N	Hospitals	BMSH	UPTH	UUTH	FMCO	FMCU
1	Lead Apron	100%	90%	93%	100%	100%
2	Thyroid Shield	43%	15%	70%	22%	0%
3	Gloves	52%	45%	74%	22%	50%
4	Glasses	29%	0%	48%	11%	0%
5	Gonad shield	0%	0%	7%	11%	0%

Table 3. Knowledge of basic definitions and principles of radiation safety

S/N	Hospitals	BMSH	UPTH	UUTH	FMCO	FMCU
1	ALARA	100%	65%	96%	100%	50%
2	ICRP	33%	30%	89%	33%	0%
3	Basics of radiation safety	48%	20%	59%	56%	0%

Table 4. Dosimetric records

S/N	Hospitals	BMSH	UPTH	UUTH	FMCO	FMCU
1	Records not asked for	87.5%	100%	95%	100%	100%

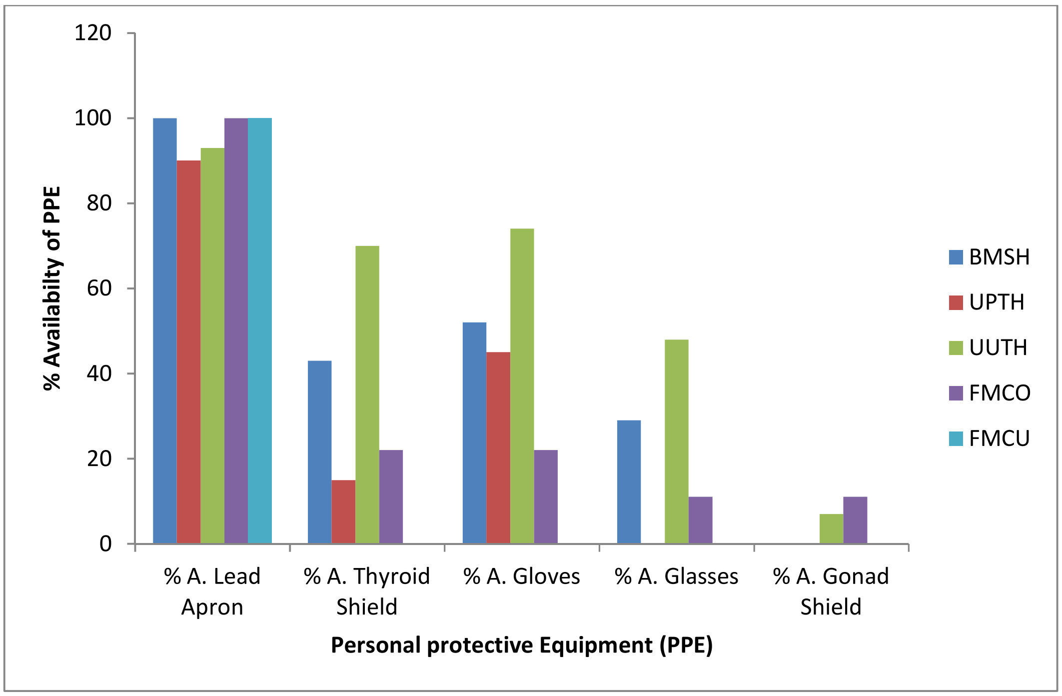

Fig. 1. Comparison of the percentage availability of PPE

4. DISCUSSION

The results of the survey show that personnel monitoring is available in all the hospitals selected for this study, but does not cover all the radiographers on employment. The percentage of staff monitored ranged from 41% to 89%. This is similar to the results from the study done by Okaro et al. [4] in South – Eastern Nigeria and also from a study done by Botwe et al. [10] in Ghana. Studies by Salama et al. [11], also shows personal radiation monitoring of 80% of staff.

This result is contrary to the IAEA [12] safety guidelines that require that every occupationally exposed worker must have a personal radiation monitoring device. This noncompliance might be attributed to the cost of monitoring and the staff not insisting on their right to be monitored.

Although personnel dose records keeping is vital for dose assessment, it was observed that current employers did not demand the dose history of most of the previously monitored correspondents. Less than 20% of personnel were asked to present their dose records. This suggests a lack of enforcement of standard regulations on the employment of radiation workers as required by IAEA [12]. This is very important as it helps to assess the radiation morbidity risk associated with the new employee.

These findings are not acceptable, due to the importance of radiation monitoring in radiography practice. Determining the radiation dose received by personnel will ensure reduction of negative biological radiation effects. Higher radiation exposures in medical practice are usually accidental and protection is required to reduce stochastic effects. The most important stochastic effect is cancer induction. The token spent on regular personnel radiation monitoring would be far less than the huge amount that would be required to manage cancers resulting from radiation.

The results also show that personal protective equipment is inadequate.

The use of lead apron gives an average of 75% to 80% protection of the red marrow [13]. This work showed that all five hospitals had over 90% availability of lead aprons, which is quite encouraging and is close to 99% gotten from the study carried out by Salama, et al. [11]. The ideal case should be 100% availability because any slight negligence in protection principles can increase the exposure of staff to doses higher than the standard level.

Shielding the gonads can significantly reduce the radiation dose, and absorption by the gonads typically constitutes 20% of the overall absorption dose to the body [14]. These organs appear to be extremely sensitive to radiation, and prevention of hereditary effects of ionizing radiation is not possible without them. Therefore gonad shields must be routinely used by radiology staff [14]. This study showed that all five hospitals had less than 11% availability of the gonad shield which is not optimal. This is because studies have shown that radiation exposure may have been a contributory factor to the onset of posterior subcapsular cataracts among radiology technologists [10]. Studies have also shown that radiology technologists had a significant increase in female breast cancer in the United States of America [15]. Personal radiation monitoring protective equipment is essential to reduce exposure during imaging procedures. It is therefore very important that radiology workers are monitored and provided with suitable and adequate personal protective equipment (PPE) which meets relevant regulations and international standards.

The results from the question on the full meaning of ALARA showed that for the five hospitals, the percentage of correct answers ranged from 50% to 100%. This result is higher than the 38% of correct values from the study conducted by Fatali and colleagues [14] and 12.3% reported by Rahimi and colleagues [16]. A good knowledge of this concept is essential for the protection of staff, patient and the environment.

5. CONCLUSION

The evaluation of personnel radiation monitoring in the selected hospitals shows that radiation monitoring is available in the government tertiary hospitals, though not all of the staff are monitored. The absence of staff dose history needs to be visited to enable the monitoring of radiation risk to staff. While the knowledge of staff on some radiation principles is above the average.

The reluctance of some of the staff to participate in the survey may also have contributed to the results obtained. Some of the results may not correctly represent exact conditions in the studied hospitals since only 83% of staff participated in the study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history/22792