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Original Research Article

Evaluation of Radiation Protection Measures in a Reference Hospital in Mali

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Abstract: ***Objectives*:** The aim of this study was to evaluate the organization of radiation protection in the radiology and radiotherapy departments. ***Methods*:** this was a descriptive cross-sectional study conducted in the radiotherapy and radiology departments of the Mali hospital over a period from December 14, 2014 to March 14, 2015. Data were collected from a questionnaire and an evaluation grid sent to the staff. The evaluation was done using an observation grid and a questionnaire addressed to the staff working in the radiotherapy and radiology departments. The variables studied were: knowledge of the categorization of personnel and work areas, application of the basic principles of radiation protection by the personnel, use of individual dosimeters, and dosimetric monitoring of the premises. The data was analyzed in Excel 2010 and Word 2010. ***Results:*** The irradiation technique used was external radiotherapy (ETR). 80.95% did not have any additional training in radiation protection, 80.95% of the respondents recognized the usefulness of the triad of fundamental principles of radiation protection applied in their profession (justification, optimization and dose limitation). 60% believe that the doses tolerated by radiation exposure are regulated at the HDM. In 57% of cases, pregnant women are reassigned to another position in the department during their pregnancy, 76% of examinations are performed under the supervision of radiologists. The design of the rooms, the marking of radioactivity with the yellow cloverleaf and of regulatory zones with appropriate signs, the zoning and the security of sources were verified by the Malian radiation protection agency. Dosimetric monitoring of workers was assured in 90.47% of cases. The plan of the structure was not displayed, the majority of workers used lead aprons to protect themselves (90%), dosimetric monitoring was carried out in 90.47% of cases, and medical surveillance of users was carried out by the occupational physician. The shortcomings that we noted were the lack of periodic and regular training of workers in radiation protection. ***Conclusion:*** Compliance with the principles of justification, optimization and limitation of radiological exposure is essential in radiotherapy and radiology. The establishment of a radiation safety culture is fundamental to protect not only workers, but also patients and the public. Insufficient control does not encourage employers to make technical corrections which are perceived as additional economic constraints.

Key words: Radiation, Risks, Prevention, Hospital, Exposure to ionizing radiation.

INTRODUCTION

Nuclear and radiological materials for industrial, military, medical and research purposes pose a great threat to national and global security wherever they are susceptible to theft or unauthorized access. This risk is particularly high in countries where insecurity is becoming a major concern. Radiation protection is a set of measures intended to ensure the protection of man and his environment against the harmful effects of ionizing radiation while allowing its use [1]. The aim of radiation protection is to prevent or reduce the risks associated with ionizing radiation. Radiation protection is based on fundamental principles: justification of exposures, optimization of practices and dose limitation. These principles must be applied to all uses of equipment emitting ionizing radiation in the medical environment, taking into account international recommendations. Throughout the world, various institutions or authorities have been

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created with a common objective: the protection of man and the environment from the risk of exposure to ionizing radiation [3]. In Mali, the Agence Malienne de Radioprotection (AMARAP) develops regulations and continuously monitors the proper application of the radiation protection system on behalf of the state. In the absence of data on the radiation protection of personnel working with ionizing radiation, we conducted a study to evaluate compliance with radiation protection measures in radiology and radiotherapy departments in order to promote greater safety in the use of X-rays in hospitals in Mali.

MATERIAL AND METHOD

We conducted a descriptive cross-sectional study in the radiotherapy and medical imaging departments of Mali Hospital over a period from December 14, 2014 to March 14, 2015. Were included in the study the voluntary health professionals working under ionizing radiation in the radiotherapy and radiology department of the Mali hospital. The non-inclusion criteria were health professionals in the radiotherapy and radiology departments of Mali Hospital not working under ionizing radiation. Data collection was based on survey forms sent to the staff of both departments. The parameters studied were sociodemographic data, working conditions, medical surveillance, radiology and radiotherapy facilities, and technical and administrative standards of the premises and equipment. Computer processing of the data was performed using Word 2010 and Excel.

RESULTS

Socio-professional characteristics of our study population A total of 21 people were included in the study, seven (7) doctors, fourteen (14) paramedics. The participation rate was 100%. The sex ratio was 3.2 in favor of males. 60% of the personnel were in radiology and 40% in the radiotherapy department (Table I). In the group of paramedics, there were 11 men and 03 women.

Table I: Socio-professional characteristics of our study population

	Workforce	Percentage %
Sex		
Female	05	23,80
Male	16	76,20
Professional qualification		
Manipulator	14	66,66
Radiologist	03	14,28
Radiotherapist	04	19,06
Place of practice Mali Hospital		

A. Results on radiation protection knowledge

Table II: Basic principles of radiation protection for personnel and the public

Basic principles of radiation protection	Staff interviewed	Percentage %
Justification	10	47,62
Optimization	8	38,10
Dose limitation	3	14,28
Total	21	100

47.62% (n=10) of the respondents have a satisfactory knowledge of the justification principle, 52.38% (n=11) knew the usefulness of the triad of fundamental principles of radiation protection.

Knowledge of passive dosimetric monitoring and what to do if the dose is exceeded 52.38% of the workers wore a passive dosimeter. 47.62% did not believe in the regulatory restriction of not wearing a dosimeter. Among the staff of the radiotherapy and radiology departments who participated in our work, only 33.33% (n = 07) did not know that in the event of a dose overrun accident, the occupational physician or a competent person in radiation protection should be contacted.

Interest in taking radiation safety training: Five (05) people (23.80%) were not interested in radiation safety training. Women seemed to express more interest in radiation safety training than men (76.20%). All women expressed the need for radiation safety training. 71.19% of the respondents were interested in radiation protection training.

Collective protection: for 50% of the staff, the design of the work premises probably meets the recommended radiation protection standards.

Personal protection: the majority of respondents (90%) use a lead apron for personal protection. Other means of protection (leaded glasses and leaded gloves) are known but less used.....% at the Mali hospital. 57% of pregnant women are reassigned to another position, 33% to another department, and 10% remain at their position.

Monitoring and control methods: 70% of the staff wore passive dosimeters during working hours. The dosimeter is exchanged monthly and quarterly in 100% of cases.

Table III: Level of radiation protection in the facility

	Weak	Average	Satisfactory	Very satisfaying
Level of radiation protection in the establishment	0%	43%	57%	0%

57% of respondents consider the level of radiation protection in the establishment to be satisfactory.

DISCUSSION

Characteristics of the healthcare professionals participating in the survey A total of twenty-one (21) people were included in our study, including seven (7) physicians and sixteen (16). Our study involved 21 staff assigned to radiology and radiotherapy departments using X-rays in their daily activity. The professionals who participated in the study were divided into two categories: radiologists and radiotherapists, and electroradiology technicians. The electroradiology manipulator profile is the most representative in this sector of activity with 66.67%, followed by physicians with 33.33%. This finding was noted by the study of Dr L. Rahhaoui and Dr I. Zahraoui, published in 2011 [4]. It seems that this meets the legal obligations because in the national and international regulations [5], the handling of ionizing radiation sources for medical purposes by non-medical staff can be done by the technicians in electroradiology [6]. In our work, the level of knowledge of doctors was significantly higher than that of paramedical staff. All workers considered X-rays to be a risk to pregnancy and considered that they should stop work during pregnancies [7].

B. Knowledge of radiation protection

52.38% of the respondents recognize the usefulness of the triad of fundamental principles of radiation protection applied in their profession (justification, optimization and dose limitation), this percentage remains below the ambitions of the recommendations that have been defined by the ICRP [8 - 9]. (The International Commission on Radiological Protection) and included in the regulations of various countries, including Mali. This discrepancy is probably explained by the rare publications on this subject by C. Lefaure, G. Abadia and B. Aubert in 1993 [10]. Aubert in 1993 [10]. In the study by I. Marzouk Moussa [11], who evaluated and compared the levels of radiation knowledge in radiology, orthopedics and cardiology departments, the level of knowledge of the medical staff was globally average in the three departments. Several publications have reported a similar result and have reported that the level of knowledge was low to average [9, 10], sometimes good [11] even when the questionnaires used were different. Our study showed that 80.95% of the respondents knew the triad of fundamental principles of radiation protection applied in their profession (justification, optimization and dose limitation), this percentage is in accordance with the recommendations that have been defined by the ICRP (International Commission on Radiological Protection): recommendation 2007 of the International Commission on Radiological Protection, ICRP Publication 103 [12-14].

For people who work around radiology facilities, the categories most concerned are students, support staff, nurses and stretcher bearers. We believe that this category of people should be made aware of the first time they access the exposure areas of the IR facilities so that they have protective means at their disposal [15, 16]. We found that in 57% of cases, pregnant women were reassigned to another position in the department during their pregnancy, 33% were relocated to another department in the institution and in the remaining 10% of cases, they were kept at their position. These data are in line with the study by N'kama Tol'mata [17-19]. Our study has shown the existence of internal rules of RP applicable to the hospital in Mali as stipulated by the regulations in force, this same finding was raised in the work of Jouad Smani [17, 18].

The results of the study show us that 76% of the examinations are performed under the supervision of the radiologists, which means that 24% of the examinations are performed without any supervision. Our results are close to those of Rahhaoui and Zahraoui [20] which are respectively 63% and 37%. Our study has shown the absence of internal radiation protection regulations applicable in our establishment as stipulated by the regulations in force. This same observation was raised in the work of Rahhaoui and Zahraoui. Similarly, our study revealed that 71% of respondents stated that there was no departmental plan specifying the circulation areas and the location of sources; this has no impact on the staff working in the same place. However, for any outsider, this situation could be a problem [18-20].

C. Training in radiation protection

In the field of radiation protection, the awareness and training of users on the radiation risk is crucial. It is important to draw the attention of professionals to adopt safe behaviors [20]. 80.95% of professionals stated that they have not received any additional training since the basic training This figure remains.

This figure is worrying and leads us to state that this situation remains an exception to be avoided, especially since the national regulations oblige all

operators to provide training in radiation protection adapted to the risk incurred [9], which for 17% is a risk of radiation-induced cancer. Rahhaoui and Zahraoui [20] found that 71% had received basic training and that 29% of the professionals carried out their activity without being trained in radiation protection measures. In our study, the interest in training was requested by the majority of the respondents. In the study by Marzouk *et al*., [11], 83% of the personnel interviewed were interested in taking radiation protection training.

Limitations and Perspectives

The small size of our study is a limitation of this study. However, this work is a draft of a planned multicenter study evaluating compliance with radiation protection rules and the understanding of radiation risk. The shortcomings found and inadequate monitoring could explain the decisions to stop work during pregnancy by staff working in the treatment rooms. Better training in radiation protection and more rigorous monitoring of x-ray emitting equipment, as well as regular dosimetric monitoring, could avoid work stoppages for female staff and allow better compliance with radiation protection rules.

CONCLUSION

The assessment of working conditions revealed certain shortcomings in radiation protection equipment (leaded gowns, thyroid covers, leaded glasses, leaded screens). The low level of application of certain requirements is the result of a lack of safety culture. This culture must be shared by all those involved in radiation protection. The implementation of a corrective strategy is necessary in conjunction with the awareness and training of hospital staff concerning the health effects of ionizing radiation and the means of protection.

Declaration of interest: The authors declare that they have no interest.

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