

# Radioprotection compliance rules study in Dakar's hospitals, Senegal

## Abstract

This work aims to promote greater safety in the use of X-rays in our hospitals. The effects of radiation have continued to arouse keen interest mixed with concern. Due to their ionizing power, these radiations lead to cascades of reactions in the body causing genetic mutations, cancer phenomena and even cell death, among others. We thus distinguish between threshold effects (deterministic) and random effects (stochastic). This work is a quantitative study based on a questionnaire intended for majors in radiology services in Dakar.

This study was carried out in the Dakar region over a period of two (02) months from July 15, 2022 to September 15, 2022. By analyzing the results, we've noted that standard radiography and computed tomography are the two most frequently performed radiological examinations in all the services studied with respectively 60.9 o/o and 30.4 o/o of the radiological examinations carried out daily. It is appeared that radiation protection in radiology departments has limits. It is therefore urgent to overcome them and to encourage the development of radiation protection in parallel with the evolution of the technical platform. Compliance with the rules and regulations constitutes a requirement for the protection of people exposed to ionizing radiation. The national radiation protection authority should take steps to harmonize the control protocols for radiology department equipment for optimal monitoring of radiation protection measures. It would be important to install a maintenance unit in each health structure with a radiology department which would be under the responsibility of the national authority responsible for radiation protection.

Sanctions are provided for in the event of breaches of laws and regulations by the Senegalese authorities.

Keywords: X-rays, ionizing power, radiology, radiation protection

## 1. Introduction

Since the discovery of X-rays by Wilhelm Konrad Röntgen in 1895, the effects of radiation have continued to arouse keen interest mixed with concern [1]. Due to their ionizing power, these radiations lead to cascades of reactions in the body causing genetic mutations, cancer phenomena and even cell death, among others. We thus distinguish between threshold effects (deterministic) and random effects (stochastic). This is why, in a desire for optimal and secure exploitation of this ionizing radiation, Senegal has a regulatory framework which is an essential safety policy tool for radiation protection, namely the Senegalese Radiation Protection and Nuclear Safety Authority. (ARSN) [2]. The ARSN works in collaboration with international organizations (International Atomic Energy Agency, European Atomic Energy Community, United Nations Scientific Committee for the Study of the Effects of Ionizing Radiation), to achieve compliance with principles of justifying activities, optimizing protection and limiting exposure [3].

Knowing that the risks of exposure to ionizing radiation arise essentially from non-compliance with radioprotection measures by users, we initiated the present study to evaluate the level of application of radioprotection rules and measures in the radiology departments of public health establishments in Dakar. This work aims to promote greater safety in the use of X-rays in our hospitals.

## 2. Materials and methods

Il s'agit d'une enquête sur le personnel de radiologie sur cinq sites. Des questionnaires ont été adressés pour apprécier les variables suivantes : qualification et expérience professionnelle, durée au poste, surveillance médicale des travailleurs, contrôle de l'exposition professionnelle, visite des lieux de travail, moyens de protection, contrôle technique des locaux, des installations et données réglementaires actuelles sur la radioprotection

This is a quantitative study based on a questionnaire intended for radiology staff, particularly service majors at the survey sites. This study was carried out in the Dakar region over a period of two (02) months from July 15, 2022 to September 15, 2022. It concerned the Radiology departments of the eight (8) largest Public Health Establishments (MAIN Hospital of Dakar, ARISTIDE LE-DANTEC Hospital, FANN University Hospital Center, ABASS NDAO Hospital Center, PIKINE National Hospital Center, DALAL DIAM Hospital, Idrissa POUYE General Hospital, OUAJAKAM Military Hospital). All of the establishments mentioned fall within the framework of the Dakar University Hospital Center

The study focused on the rules and measures of radiation protection in radiology departments based on data collected from department majors due to their dual technical and administrative roles.

#### - **Data collection**

Data collection was carried out through a questionnaire, inspired by the regulatory framework for radiation protection in force in Senegal, in relation to current technical means of radiation protection. The different items focused on: identification of radiation sources, human resources management, technical and material aspects, patient reception and data verification, decision-making and quality control of equipment. We chose to speak directly with the staff participating in the survey, immediately reading the questionnaire and collecting the responses directly.

#### - **Data analysis**

Data processing from the questionnaire was carried out using the Epi-info version 3.5.3 software. Data analysis The processing of questionnaire data was carried out using Epi-info software version 3.5.3. Then, we entered the data and then analyzed the statistics

### **3. Results**

#### - **Identification of Radiation Sources and Use**

All the 08 radiology departments that we studied only had X-ray sources for diagnostic radiology or interventional radiology purposes.

#### - **Main imaging examinations and overall distribution of radiological examinations**

Seven hundred and forty-nine (749) radiological examinations were carried out per working day in the 08 establishments studied. Standard radiography was by far the most common type of examination performed, accounting for 60.9 o/o of radiological examinations, followed by computed tomography (CT) with 30.4 o/o; finally mammography, panoramic dental radiography and special examinations respectively concerned 3.2 o/o, 1.3 o/o, 4.1 o/o of daily radiology examinations. Thus, 456 standard radiographs were carried out daily in the 8 establishments studied. The following proportions were found: 20% at HOGIP, 17% at the Main hospital and 15% at the Pikine hospital center. Likewise, 228 tomographic examinations (CT) were carried out daily in the eight establishments studied. The one at the main hospital was by far the one that performed the most, concentrating 31% of the scans performed per working day.

#### - **Administrative measures for the organization of work**

- The provision of Competent Person in Radiation Protection (PCR): It was found in 02 departments out of eight 08, or 25% of radiology departments.

- Updating knowledge in radiation protection for their staff: This was observed in 1 out of 8 departments, or 12.5% of radiology departments.

- Staff categorization: It was observed in 02 out of 08 departments, or 25% of radiology departments.

- Staff leave: This measure was adopted in 7 out of 8 services, or 87.5% of the services studied.

- Existence of protocols for managing inappropriate irradiation: This concept was found in 1 out of eight departments, or 12.5 o/o of the radiology departments studied.

#### - **Technical means of protecting workers against radiation**

- Wearing a dosimeter was adopted and applied in 4 out of 8 departments, or 50% of the radiology departments studied.

- Radiation protection glasses or visors in 5 out of 8 services, or 62.5% of the services studied.

- Protective screens and radiation protection aprons existed in the 8 radiology departments studied, i.e. (100%).

- The delimitation and zoning of spaces were adopted and applied in 4 out of 8 departments, or 50% of the radiology departments studied.

- In controls, the search for radiation leaks was adopted and applied in 3 out of 8 services, or 37.5% of the services studied.

#### - **Radiation protection measures for patients**

- Reception of patients: In all the radiology departments studied, reception of patients and verification of examination slips was ensured by secretarial staff. However, in 12.5% of services, i.e. one service out of the eight studied, reception is provided jointly by secretarial staff and radiology technicians.
- Decision-making: Decision-making regarding authorization to perform the examination was ensured in 50 o/o of the services studied by the radiologist, in 25 o/o of the services by the manipulating technicians and in 25 o/o services remaining randomly between the radiographers and the radiologist.

#### - **Equipment quality control**

Equipment quality control was carried out in all the radiology departments studied. Either by external maintenance for 50 o/o of the services studied, internal maintenance for 12.5 o/o of the services and jointly by internal and external maintenance for 37.5 o/o of the services.

### **4. Discussion**

#### - **Identification of radiation sources**

By analyzing the results we note that standard radiography and computed tomography are the two most frequently performed radiological examinations in all the services studied with respectively 60.9 o/o and 30.4 o/o of the radiological examinations carried out daily, this only reinforces the findings of the B. NDONG et al study [1]. It is at HOGIP where the largest number of standard radiographs is carried out, reaching 20 o/o of the daily standard radiography examinations in Dakar. The volume of activity in traumatology would be an explanation, especially since this structure has long been the reference center for traumatology in Senegal. CT scans are more frequent at the Dakar Main Hospital. They constitute the most irradiating source of radiation in radiology. Hence the interest in emphasizing compliance with radiation protection measures in such a center and strengthening the knowledge of TDM prescribers, especially since the Badiane et al study revealed the ignorance of these Senegalese prescribers. the level of exposure of patients as well as the risks [2].

#### - **Administrative measures for the organization of work**

When reading our results, it appears that there is an absence of a Competent Person in Radiation Protection in most of the services studied, i.e. in 75 o/o. This only reinforces a trend identified by other studies in sub-Saharan Africa. The studies of T.L. TAPSOBA et al showed an absence of PCR in 95 o/o of the radiology departments of Ouagadougou [3] in the same vein as the work of ABDILLAHIL BILAL et al. in Cotonou [4]. This contrasts with North Africa where studies carried out by Khaled et al found a good presence of PCR in 50% of imaging centers [5]. The observed shortage of Competent Person in Radiation Protection (PCR) who can guide and supervise the teams in the departments may be at the origin of the shortcomings observed in respecting the rules and measures of radiation protection in the radiology departments. We can cite, among other things, the absence of updating of radiation protection knowledge among practitioners, the absence of categorization of personnel, the absence of radiation management protocols. PCR plays a major role in protecting staff and patients. He is responsible for risk assessment, proposes a work organization (job analysis, zoning), carries out quality checks on the devices, participates in optimization, carrying out irradiating procedures and examinations and takes care of the dosimetry.

The Radiation Protection and Nuclear Safety Authority could therefore work to organize short training courses open to radiology department staff. This training should serve as a pretext to require radiology services to designate a person competent in radiation protection in accordance with Senegalese law [2]. Concerning leave, it is only granted in 62.5 o/o of the services. The B. NDONG et al study revealed that 79.77% of radiology department workers had never benefited from radiation leave [1]. These radiation holidays allow the reduction of exposure time to ionizing radiation. Its effectiveness requires the involvement of the administrative authorities of hospital structures, the Ministry of Health, the Ministry of Employment and Labor and the authorities of the medical imaging service.

#### - **Means of protection for workers against radiation**

When reading the data, it appears that certain means of protection such as protective screens, leaded walls and radiation protection aprons were present in all the services studied. This result is not isolated.

It is consistent with the work of TAPSOBA et al carried out in Burkina Faso [3]. Note the disparity in the availability of protection tools apart from screens and lead aprons. We can cite radiation protection glasses or visors, dosimeters, radiation leak detectors. This situation is almost constant in both sub-Saharan and North African Africa, as revealed by several studies. [2,5,6,7,8,9]. Note also a lack of culture of radiation protection, safety and control. This situation is not unique to Senegal, it is common to most countries in Sub-Saharan Africa [10].

#### - **Radiation protection for patients**

An act of imaging examinations must be justified by an exchange between the applicant and the director. This justification must specify the reason and the purpose; special circumstances, particularly in the event of pregnancy, previous examinations and procedures. Optimization which consists of carrying out a radiological irradiating procedure for better diagnostic or therapeutic performance with the lowest possible dose. It applies to all patients and especially to children due to their greater radiosensitivity. The varied profile of the staff responsible for welcoming patients and verifying data on examination prescription slips in the departments studied does not contribute to good management of patient radiation protection. Especially since the majority have no training in radiation protection.

#### - **Decision-making**

Concerning decision-making, it is carried out by the radiologist in concert with the radiologist technician in most of the services studied. The radiologist in principle has better knowledge of the rules and measures of radiation protection [10]. This thus creates greater safety in carrying out the procedure while respecting the "ALARA" principle, allowing for optimization of patient protection. The reception of patients requiring radiological examinations as well as the decision-making authorizing the examinations are not standardized and thus expose them to risks.

#### - **Quality control of equipment**

Quality control of radiology equipment is essential. It allows the calibration of equipment and the search for radiation leaks to strengthen the protection of health workers. This control is carried out in all the services studied but the frequency, the control body and the existence of a report vary depending on the service studied. Although quality control of equipment is regular in radiology departments, there is no national protocol for managing these controls.

The ARSN monitors nuclear safety and radiation protection in Senegal to protect workers, patients, the public and the environment from the risks linked to nuclear activities. It also contributes to information and awareness raising among citizens. Its collaboration with the International Atomic Energy Agency (IAEA), which developed international standards, should enable it to strengthen its obligations. The IAEA standards are based on the recommendations of the International Commission on Radiological Protection (ICRP) [14].

The national radiation protection authority should take steps to harmonize the control protocols for radiology department equipment for optimal monitoring of radiation protection measures. It would be important to install a maintenance unit in each health structure with a radiology department which would be under the responsibility of the national authority responsible for radiation protection.

### **5. Conclusion**

The development and modernization of the imaging technical platforms of the main Senegalese hospitals leads to an increase in the use of diagnostic and interventional radiology. This situation requires more stringent requirements for compliance with radiation protection rules and measures for healthcare personnel and patients. At the end of this work it appears that radiation protection in radiology departments has limits. It is therefore urgent to overcome them and to encourage the development of radiation protection in parallel with the evolution of the technical platform. Compliance with the rules and regulations constitutes a requirement for the protection of people exposed to ionizing radiation.

#### - **Consent**

We were keen to respect confidentiality through data entry by the researcher and restriction of access to this data to the research team. As per international standards or university standards, Participants' written consent has been collected and preserved by the author(s).

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