Power System Technology
ISSN:1000-3673

Received: 16-08-2025 Revised: 05-09-2025 Accepted: 02-10-2025

Radiation Safety and Protection Practices Among Radiology Staff in Hospitals

Abdullah Najer Alotaibi, Mazen Ahmed Alqarni, Elham Yahya Hakami, Waleed Abdullah Al Shihri, Fawaz Rashash Almutairi, Bander Abdullah Alfaife , Ahmad Obaid Alzubaidi, Mohammed Saleh Alshehri, Ahmad Ali Shami, Asem Ahmed Robaidi

Radiology technician, National Guard-Health Affairs

Abstract

Radiation safety represents a cornerstone of modern healthcare, particularly within radiology departments where staff are routinely exposed to ionizing radiation. While diagnostic imaging significantly enhances disease detection and patient care, occupational exposure poses potential health risks if not managed properly. This paper examines radiation safety and protection practices among radiology staff in hospitals, emphasizing their importance for minimizing exposure, maintaining regulatory compliance, and safeguarding long-term health. Through ten key areas—ranging from risk awareness, training, shielding techniques, equipment maintenance, and personal monitoring, to leadership support and safety culture—this paper highlights how effective safety programs protect workers and patients alike. The focus is particularly placed on hospital settings, where consistent education, adherence to safety protocols, and institutional support ensure a safe and sustainable radiological environment.

Introduction

Radiology plays a central role in the diagnosis, treatment, and management of diseases. However, the use of ionizing radiation—X-rays, CT scans, fluoroscopy, and nuclear medicine—introduces occupational hazards for radiology staff. Prolonged exposure without appropriate protection can lead to biological effects such as radiation-induced cataracts, skin injuries, infertility, and an increased risk of malignancies.

Healthcare professionals working in radiology departments, including radiologists, technologists, nurses, and support staff, are among those most frequently exposed to radiation. Therefore, strict adherence to radiation protection principles—time, distance, and shielding—is essential.

Power System Technology
ISSN:1000-3673
Received: 16-08-2025 Revised: 05-09-2025 Accepted: 02-10-2025

International organizations such as the International Atomic Energy Agency (IAEA) and the World Health Organization (WHO) emphasize that radiation exposure must always be justified, optimized, and kept as low as reasonably achievable (the ALARA principle). In Saudi Arabia, the Saudi Food and Drug Authority (SFDA) and the National Radiation Protection Center (NRPC) regulate and monitor compliance with radiation safety standards.

This paper explores ten essential aspects of radiation safety and protection for radiology staff in hospitals, highlighting evidence-based practices, challenges, and recommendations to ensure occupational well-being and high-quality imaging services.

1. Understanding Radiation Hazards and Biological Effects

The first step toward safety is awareness. Radiology staff must understand the nature of ionizing radiation and its potential biological effects. Ionizing radiation can damage DNA molecules, leading to cell death, mutation, or carcinogenesis. The biological impact depends on several factors, including exposure time, radiation dose, type of radiation, and tissue sensitivity.

Acute exposure can result in deterministic effects (like skin burns or radiation sickness), while long-term low-dose exposure may cause stochastic effects, such as cancer and genetic mutations. Pregnant workers are particularly vulnerable because fetal tissues are highly sensitive to radiation.

Hospitals in Saudi Arabia regularly conduct radiation safety orientation programs to enhance staff awareness and ensure every worker understands both the benefits and risks of radiation exposure.

2. Application of ALARA Principles

The ALARA principle—As Low As Reasonably Achievable—is the foundation of radiation safety. It encourages minimizing radiation exposure by optimizing all controllable factors. The three main strategies are:
- Time: Reducing the duration of radiation exposure during procedures.
- Distance: Maximizing the distance between the worker and the radiation source.
- Shielding: Using protective barriers such as lead aprons, thyroid collars, lead glasses, and mobile shields.

Power System Technology
ISSN:1000-3673
Received: 16-08-2025 Revised: 05-09-2025 Accepted: 02-10-2025

In Saudi hospitals, adherence to ALARA is a regulatory requirement. Radiology departments incorporate dose optimization software in CT scanners and maintain strict operational protocols to reduce unnecessary exposure.

3. Personal Protective Equipment (PPE) and Shielding Devices

Protective equipment is a critical line of defense against radiation. Standard PPE for radiology staff includes lead aprons, thyroid shields, lead glasses, and lead-lined gloves. In fluoroscopy and interventional radiology, where prolonged exposure occurs, mobile lead barriers and ceiling-mounted shields are essential.

Each piece of PPE must be periodically inspected for cracks or damage. Hospitals should document regular maintenance checks and replace faulty equipment immediately.

4. Personal Dosimetry and Exposure Monitoring

Personal dosimetry allows hospitals to track radiation exposure for each staff member. Dosimeters, such as thermoluminescent dosimeters (TLDs) or electronic personal dosimeters (EPDs), are worn on the chest or collar and measure accumulated radiation dose.

According to Saudi regulations, staff exposure must remain below the dose limits set by the IAEA and SFDA—typically 20 mSv per year averaged over five years, and not exceeding 50 mSv in any single year.

5. Equipment Quality Control and Maintenance

Radiation-producing equipment must undergo regular quality assurance (QA) and preventive maintenance to ensure optimal performance and minimal leakage. QA tests include checking for beam alignment, output consistency, filtration, and collimation accuracy.

In Saudi hospitals, the SFDA mandates annual calibration and certification for all X-ray and CT machines. Biomedical engineers and medical physicists collaborate to maintain records and perform periodic audits.

6. Education, Training, and Continuous Competency Development

Education is the foundation of radiation safety culture. All radiology personnel must complete structured radiation protection training before assuming clinical duties. Training

Power System Technology
ISSN:1000-3673
Received: 16-08-2025 Revised: 05-09-2025 Accepted: 02-10-2025

covers topics such as radiation physics, dose limits, biological effects, ALARA principles, and emergency procedures.

7. Administrative Controls and Safety Committees

Institutional support is vital for sustaining radiation safety programs. Hospitals must establish Radiation Safety Committees (RSCs) that include radiologists, physicists, technologists, administrators, and safety officers. These committees are responsible for policy development, staff education, incident review, and compliance monitoring.

8. Patient and Public Safety Integration

Radiation protection extends beyond staff to include patients and the general public. Proper patient positioning, exposure parameters, and shielding devices help reduce patient dose while maintaining image quality.

9. Safety Culture, Leadership, and Reporting Systems

A strong safety culture underpins all successful radiation protection programs. Leadership must actively promote safety through open communication, role modeling, and non-punitive incident reporting.

10. Future Directions: Innovation and Technological Advancements

Technological innovation continues to enhance radiation safety. Modern digital imaging systems produce high-quality images at significantly lower doses compared to older analog systems. Dose-tracking software, AI-based exposure optimization, and automated dose alerts are now being integrated into hospital workflows.

Conclusion

Radiation safety and protection among radiology staff represent both an ethical responsibility and a professional necessity. Ensuring staff safety is not merely about compliance—it is about cultivating a preventive mindset that prioritizes well-being and quality care. Through proper training, adherence to ALARA principles, consistent use of protective equipment, and institutional leadership, hospitals can maintain safe radiological environments.

References (APA Style)

1. World Health Organization. (2022). Radiation protection and safety of radiation sources: International basic safety standards. Geneva: WHO.

Power System Technology
ISSN:1000-3673
Received: 16-08-2025 Revised: 05-09-2025 Accepted: 02-10-2025

2. International Atomic Energy Agency. (2020). Radiation protection in medicine. Vienna: IAEA.
3. Saudi Food and Drug Authority. (2023). National radiation protection guidelines for healthcare facilities. Riyadh: SFDA.
4. Ministry of Health, Saudi Arabia. (2022). Radiation safety policies for diagnostic imaging departments. Riyadh: MOH.
5. Al-Ghamdi, A., & Al-Harbi, M. (2021). Compliance with radiation safety measures among Saudi radiology staff. Saudi Journal of Health Sciences, 10(2), 87–95.
6. Alotaibi, M., & Paliadelis, P. (2020). Knowledge and practice of radiation safety among radiology technologists in Saudi hospitals. BMC Medical Imaging, 20(1), 1–9.
7. Al-Faifi, K., et al. (2022). Leadership and culture in hospital radiation safety programs. Journal of Hospital Infection, 120, 15–28.
8. Weqaya – Saudi Center for Disease Prevention and Control. (2022). Occupational health framework for radiation safety. Riyadh: Weqaya Publications.
9. ICRP (International Commission on Radiological Protection). (2021). Recommendations on occupational radiation protection. Oxford: Elsevier.
10. Saudi Commission for Health Specialties. (2023). Continuing education requirements for radiology and radiation safety. Riyadh: SCFHS.