sjst.scst.edu.ly

Surman **J**ournal for **S**cience and **T**echnology
ISSN: Online (2790-5721) - Print (2790-5713)

مجلة صرمان للعلوم والتقنية
Vol **7**, No.**2**.Jul – Dec. 2025
Pages: 235 ~ 244

Assessing radiation protection practices among radiological workers

Fathi A. Awushah [1], Rajab.B. Yousef [2], Maryem M. Alswehly[3]

The higher Institute of Medical Technology, Subrataha, Libya[1]

Faculty of Medical Technology, Zawia, Libya[2,3]

Fathe.oushah@yahoo.com [1], r.benyousef@zu.edu.ly [2]

Abstract

Radiologic technologists represent a special group at the forefront of occupational radiation exposure. In Libyan hospitals and diagnostic centers, it is observed that radiologic technologists who deal with ionizing radiation on daily basis, show non-compliance to international safety standards of radiation protection regarding use of improperly shielded equipment.

The current study aimed to assess awareness of radiation protection, its implementation and health-related outcomes among radiologic technologists working in various hospitals.

A self-administered 12-item questionnaire was distributed to a cohort of 68 radiologic technologists working in Zawia, Sorman, Sabratha, Trauma Aboslim, Tripoli Central and Tripoli Medical Central Hospitals over the period from July 2022 until August 2022. The schematic questionnaire included sections on department layout, presence of protective devices, individual practice of protection and personal protective practices, instruction issues, monitoring of employees' health and record keeping.

There were low compliance rates with radiation protection standards, use of dosimeters (15%) and training (26%). At a departmental level, major design problems were noted by 64% of respondents and only half (52%) reported that protective equipment was widely available.

The study demonstrates significant gaps for radiation protection infrastructure, monitoring and training, among Libyan R.Ts. This underscores the urgent need for regulation, proper training and enforcement of protective measures.

Submitted: 03/11/2025 *Accepted: 02/12/2025*

Introduction

Protection from radiation in the health field is an important part of job safety, especially for radiology workers who often face ionizing rays [(1)]. The rules of radiation safety are based on reducing unneeded exposure, improving protective steps, and keeping radiation levels as low as can be fairly done (ALARA rule).

Even with the presence of world rules and safety tools, holes in knowing, following, and system rule making stay common in lots of health care systems [2].

Radiology workers, as first line users of scan tools, have a key job in keeping both patient and self-safe during scan tasks.

But, in many areas—mostly in poor countries—lack of resources, not enough training courses and missing checking tools have caused big work health dangers.

These dangers are made worse by poor safety habits, old tools, and uneven following of rules [3].

This write-up joins new research that looks at how well people know about protecting from radiation, their thoughts, and what they do in jobs with x-rays in various nations [4]

By looking at and matching these results with the recent study done in Libya, this paper aims to show worldwide patterns find shared problems and offer doable advice. The mix of such info is key for policy makers hospital heads and training schools to create focused actions that deal with both knowledge holes and system blocks [5].

The studies further reveal that, even when radiation safety information is generally circulated, adherence stays disappointingly low because of missing elements—namely, substandard protective gear, too infrequent dose checks, and fully absent disciplinary protocols [6]. This observation makes it clear that isolated training is not enough; integrated solutions that couple robust learning opportunities with better facilities and sustained career-wide training must be deployed. Though ionizing radiation remains indispensable for imaging and therapy in contemporary medicine, it presents predictable dangers for professionals, translating into escalated risks of malignancies, ocular opacity, and reproductive morbidity [7]. Within this dynamic, radiologic technologist bear the heaviest burden, routinely standing at the equipment's front li0ne.

The International Commission on Radiological Protection (ICRP) continues to stress three core protective principles—justification, optimization, and dose limitation—through the widely acknowledged ALARA (As Low As Reasonably Achievable) paradigm [8]. However, implementation of these principles in Libya is uneven, as recent reviews have documented [9]. Facilities surveyed earlier revealed serious gaps, including poor radiation shielding, deficient personal protective equipment (PPE), and the absence of regular, specialized training (10). This investigation, therefore, seeks to characterize the level of radiation safety knowledge and practice among radiologic technologists specifically in the western region of Libya, in order to provide comprehensive baseline data.

1. 1. Some of Principles of Radiation Safety:

1. 1. 1. Increase in distance between source and personnel. Increasing the distance between an ionizing radiation source and the worker remains the quickest, most effective method of dose reduction: tripling the distance can effectively reduce exposure to an eighth of its original level. When feasible, employ tongs, forceps, and repositioning trays to extend the distance. Technologists should be positioned within a shielding booth, behind a protective screen, or at a minimum of six feet from the source during an exposure. No extremity or other body part should enter the path of the primary beam.

1. 1. 2. Use of protective barriers. Radiological barriers are designed to attenuate scatter radiation rather than the primary beam. When selecting and positioning barriers, the technologist must ensure that the barrier material meets the specific shielding requirements for anticipated scatter, and that the geometric configuration minimizes the contribution from the primary beam that may inadvertently strike the barrier at oblique angles. Each facility must regularly review wall and mobile barrier integrity and replace components that exhibit radiation damage, corrosion, or structural failure.

A. Aprons: Ensure a minimum lead equivalence of 0.25 mm. Always store aprons flat; folding compromises inner layers. Always hang from a rack to prevent lead separation. Use only approved storage. B. Gloves and Goggles: Gloves must exhibit 0.33 mm lead equivalence. Inspect for hidden cracks using radiography; visual checks may overlook subtle defects. Use leaded goggles during fluoroscopy to shield lenses from scatter. C. X-Ray Room and Equipment: Locate the X-Ray room away from hallways and guest areas. Regularly survey the unit for scatter and tube leakage; ensure room walls and ceiling have appropriate lead thickness to prevent escape. Seal gaps and conduct a further leak check. Post clear caution signage on room entrance gates and on the door, lamped.

1. 1. 3. Use of Radiation Monitoring Devices: Personnel must wear a film badge continuously during shifts. Position one at belt height and another at collar line. Collars measure neck and head dose. Opt for additional dosimeters as pocket, finger, and wrist devices for supplementary monitoring, especially during high-intervention games. Send badges for processing monthly.

1.1.4. Age and Sex of Personnel Involved: Individuals younger than 18 should be excluded from any radiography tasks due to ongoing development of radiosensitive organs and tissues. Likewise, radiography personnel known to be or suspected of being pregnant must be omitted, since exposure to ionizing radiation poses pronounced risks to embryos and fetuses, particularly at critical gestational periods (11).

1.2. Safety Precautions and Guidelines:

● Always obtain authorization and complete your training from the radiation supervisor before using any analytical x-ray equipment.

● Place the personal dosimeter between collar and pelvic level, positioned on the radiation source side to accurately record exposure.

● Confirm any newly installed x-ray instrument is scanned and documented for radiation leaks, both before initial operation and after any modifications for research.

● Visually inspect the shielded housing for integrity every time; assume nothing about safe status from the previous user.

● Restrict access to only those individuals whose tasks or training require presence in the x-ray room during active exposure.

● When radiation sources are engaged, personnel must be appropriately shielded using:

A. a lead apron of suitable thickness

B. lead safety goggles

C. a thyroid shield.

Radiation exposure time must be kept as brief as possible, particularly in fluoroscopic exams. Combine this step with strict procedural protocols to avoid needless repeats. Personnel ordinarily should not physically hold patients. Whenever locking devices are impractical, use holders that stabilize either the patient or the image receptor. Failure of that option means relying on an accompanying relative or guardian wearing a lead apron along with gloves.

The lead protection directive first issued in 1994 advised that minimizing delivered dose relies primarily on solid clinical decision-making, properly calibrated machines, and technique finesse, not on apron use. The reaffirmation in the 2001 guidance reiterated: a patient in a dental setting should, as a matter of principle, never be routinely draped with lead apron. When aid is indispensable, any caregiver supporting the patient must be garbed in at least 0.25 mm lead equivalence apron. Aprons, once issued, must be suspended vertically on designated storage devices, never laminated or bent; their fabric integrity is to be documented through visual checks at least once a year(12).

The goal of this study was to assess radiological safety and occupational exposure of radiography staff in selected Libyan hospitals to identify procedural and technical errors.

Literature Review:

Recent Surveys on Radiation Safety Proficiency of Radiology Technicians This section briefly summarizes selected investigations, covering knowledge, attitudes, and practical adherence to radiation protection norms.

1. Mesfin et al. (2020) – Ethiopia

Source: BMC Research Notes.

Details:

The study was conducted in Addis Ababa and included both public and private hospitals employing radiology staff. A cross-sectional design was used with questionnaires distributed among radiologic technologists to assess adherence to radiation protection standards such as the use of lead aprons and gloves. Results showed that more than 60% of participants did not receive adequate radiation protection training, and compliance with protective clothing use was low.

Conclusion: Lack of training and absence of a strong radiation safety culture were key issues (13).

2. Aly & El-Sayed (2021) – Saudi Arabia

Source: Egyptian Journal of Hospital Medicine.

Details:

This cross-sectional study included radiologic technologists from different public hospitals in Saudi Arabia. Questionnaires were distributed to measure knowledge,

attitude, and practice (KAP) of radiation protection. The study revealed that about 70% of participants had basic knowledge of radiation safety principles. However, safety practices were significantly lacking, as most participants did not use protective glasses or lead shields.
Conclusion: A gap exists between knowledge and practice, highlighting the need for regular workshops and departmental training [14].

3. Mohamed & Osman (2018) – Sudan
Source: The International Journal of Medical Imaging.
Details:
The study was conducted in hospitals across Khartoum, using a descriptive cross-sectional design. Questionnaires and surveys showed that more than 50% of radiology staff had no knowledge of the annual occupational dose limits recommended by ICRP. Additionally, most workers had not received in-service training on radiation protection.
Conclusion: Poor knowledge and lack of training worsened occupational health risks.[15]

4. Ogunleye et al. (2023) – Sub-Saharan Africa
Source: Radiation Protection Dosimetry.
Details:
A regional multi-center survey that recruited radiologic technologists from several Sub-Saharan African countries. Findings revealed that many facilities had insufficient protective equipment and most workers did not receive formal post-employment training.
Conclusion: Infrastructure limitations and financial constraints remain the main barriers to improving radiation safety. [16]

Methodology

Study Design and Setting: A cross-sectional study, which was carried out in six major health facilities located in western Libya including Zawia hospital, Sorman hospital; Sabratha hospital; Trauma Aboslim medical center; Tripoli central hospital and Tripoli Medical Central during one-month period from the 1st of July to the 1st of August 2022.
Study population: Radiologic technologists currently working in participating facilities. Questionnaires were completed by 68 participants in total.
Validated questionnaire: A structured 12-item questionnaire was designed to assess the compliance of departments with radiation protection standards, the availability of protective devices and PPEs, radiation safety training, proper adherence to safety protocols; health monitoring, dosimetry practices, nature of work assignments; fertility issues; dose documentation; promoting healthy meals.

Findings Data Analysis: Summary responses were categorized, and presented using descriptive statistics (frequencies/percentages) Table 2. Results: Results are tabulated and graphically represented.

Results

The findings underscore major issues of radiation safety in radiological workers.

1- Radiation standards 36% (A - The department as an operating unit meets the radiation) in favor of the safety standards, while 64% opposed.

2. Lead protection devices were reported as available by only 48% of the respondents.

3. Only 42% always wore lead coats during examinations, which represents alarming non-compliance with regards to the use of personal protection.

4. Procedures used in the Control Room: 80% verified the doors to their exams were closed.

5. Radiation Protection Training: Only 26% received formal training, highlighting a critical gap.

6. Compliance: 40% of respondents believed the rules were consistently adhered to in the workplace.

7. Health monitoring: 24% of workers received some form of regular health assessment.

8. Use of dosimeters: A huge 85% did not use dosimeter.

9. The rate of working in multiple X-ray locations was 58 %; the percentage for mammography facilities and other radiological sub-specialties were 41% and 34%, consecutively. locations.

10. Other: Problems with Fertility and Childbearing only 6% of people collected this data

11. Documentation of Radiation Dosage 14% mentioned that records regarding radiation dosages were maintained were maintained.

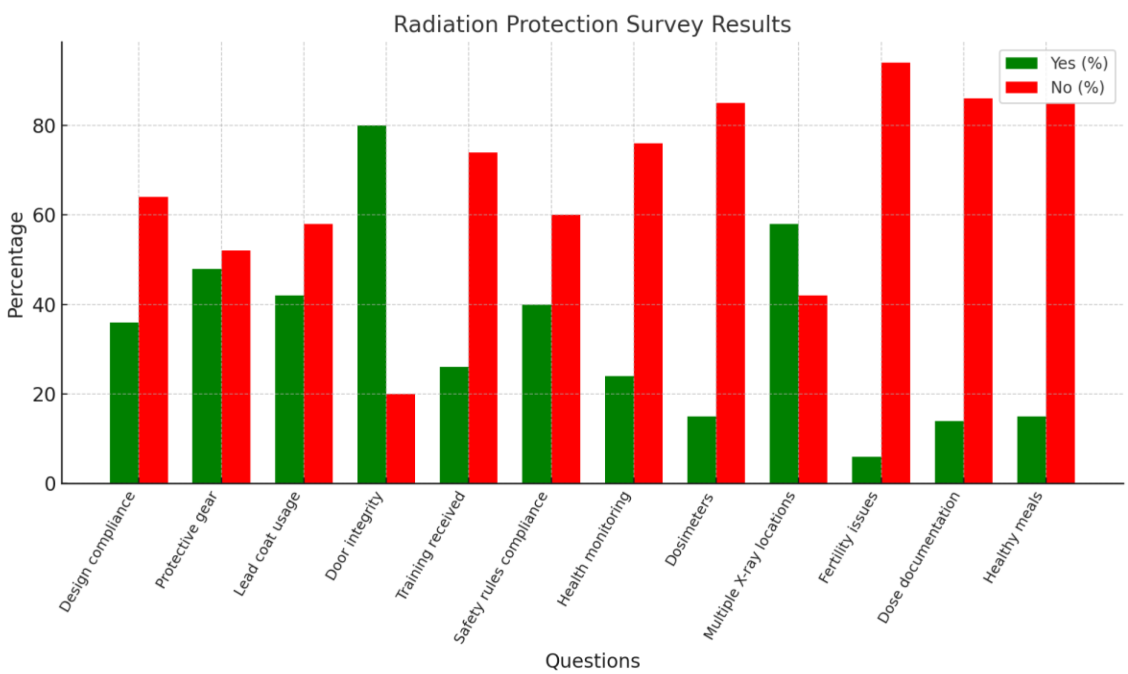
12. Healthy Meals: 15% said healthy meals were a possibility during their shifts.

Table 1. Questionnaire of radiological worker

	THE QUESTION	YES	%	NO	%
1	-Do you think that the departmentin which you work meets the standards of radiation protection in terms of design	24	36%	44	64%
2	-Is the department equipped with radiation protection devices such as lead pieces to protect the organs, especially the genitals?	32	48%	36	52%
3	-Do you wear a lead coat while 0performing radiological examinations	28	42%	40	58%
4	Are the doors tightly closed during the examination and presence in the control room?	55	80%	13	20%
5	Have you received courses in radiation protection?	18	27%	50	73%
6	-Are the rules followed by employees?	27	40%	41	60%

7	Are all employees subject to health monitoring periodically?	16	24%	52	76%
8	-Do you use dosimeters for workers such as Film Bag or TLD	10	15%	58	85%
9	-Do you work in different x-ray locations?	39	58%	29	42%
10	-Do you suffer from any problems relatedto fertility and childbearing	4	6%	64	94%
11	Are there suitable records for documenting radiation dose measurements?	9	14%	59	86%
12	Are there healthy meals for the employeesof the department during work?	10	15%	58	85%

The following chart illustrates the percentage of 'Yes' and 'No' responses for each question:



Discussion

Findings in this study demonstrate significant shortcomings in the practice of radiation safety among radiologic technologists. Just 26% of (formal radiation protection training), less than internationally benchmarked. The lack of personal dosimeters in 85% of the study population is particularly alarming, as dosimetry is a cornerstone of radiation monitoring. Similarly, 52% of departments not having protective devices (lead shields for syringe disposal) and 64% not following departmental design are indicators of infrastructural weakness overall. This lone positive result is not enough to compensate for the overall poor safety culture, even if other SRP staff mentioned that control room doors were normally tightly closed during examinations (80% of respondents).

The results are in line with previous research from Libya and suggest that voluntary compliance will continue to fall short unless the regulations are enforced. These health risks—both immediate and long-term—are exacerbated by evidence of little to no clinical radiation monitoring and poor dose record keeping.

Conclusion

This study shows certain substantial limitations in radiation protection knowledge, facilities and practice among radiologic technologists in western Libya. Addressing these gaps requires:

1. Conducting radiation safety education programmes on a compulsory basis.
2. Delivering personal dosimeters to each of the radiologic staff.
3. Improving departmental infrastructure to comply with safety regulations.
4. Subjecting the product to strict regulations and periodic checks
5. Development of standardized radiation dose documentation devices.

Service providers of health in Libya can take into count the above-listed actions to minimize risks for all healthcare workers and to enhance their occupational safety.

References

1. Seeram E. Radiation protection in diagnostic radiology: a practical approach. 1st ed. Cham: Springer; 2016.

2. Rehani MM, Vano E, Ciraj-Bjelac O, Kleiman NJ. Radiation protection of patients and staff in medical imaging: status and challenges. Br J Radiol. 2021;94(1120):20201485.

3. Akpochafor MO, Omojola AD, Adeneye SO, Eze CU, Farotimi AA. Assessment of compliance with radiation safety measures among radiographers in Lagos, Nigeria. J Clin Diagn Res. 2017;11(2):TC01–4.

4. Garcia DV, Vilar-Palop J, Vano E, Gonzalez L, Ten JI. Radiation protection training for radiology professionals in Europe: survey results. Insights Imaging. 2019;10(1):45.

5. United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR). Sources and effects of ionizing radiation: UNSCEAR 2020 report. New York: United Nations; 2020.

6. Patel DR, Dodiya H, Gupta D. Radiation safety compliance among radiology staff in tertiary care hospitals. Indian J Radiol Imaging. 2018;28(4):501–7.

7 -Shore RE. Radiation-induced skin cancer in humans. Med Pediatr Oncol. 2001;36(5):549–54.

8 - International Commission on Radiological Protection (ICRP). The 2007 Recommendations of the International Commission on Radiological Protection. ICRP publication 103. Ann ICRP. 2007;37(2-4):1–332.
9 - Elshaikh YA, Eltayeb EA, Babikir EM. Assessment of radiation protection in diagnostic radiology departments in Libya. Sudan J Med Sci. 2018;13(3):148–56.
10 - Ali NA, Hassan WM. Awareness and practice of radiation protection among radiographers in Khartoum State, Sudan. Int J Sci Res. 2014;3(6):2085–90

11- .International Commission on Radiological Protection (ICRP) (2007)

Radiation Protection in Medicine. ICRP Publication 105. Oxford: Pergamon Press .
12- International Atomic Energy Agency (IAEA) (2006). Radiation Protection in the .Design of Radiology Facilities. Safety Reports Series No. 47. Vienna: IAEA
13- Mesfin N, et al. Assessment of Radiation Protection Practices among Radiology Staffs in Ethiopia. BMC Res Notes. 2020;13(1):138.
14- Aly NM, El-Sayed AA. Knowledge, attitude and practice of radiation protection among radiographers in Saudi Arabia. Egypt J Hosp Med. 2021;82(3):600–607.
15- Mohamed EA, Osman W. Awareness of Radiation Protection among Radiology Staff in Khartoum Hospitals. Int J Med Imaging. 2018;6(2):23–29.
16- Ogunleye OO, et al. Radiation Protection Practices among Radiologic Technologists in Sub-Saharan Africa. Radiat Prot Dosimetry. 2023;199(3):325–333.