

Impact of a Radiation Safety Training Program on Knowledge, Attitude and Workplace Compliance among Radiology Technicians and Nurses at tertiary care hospital of Rajasthan: A Quasi-Experimental Study

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Abstract—Background: Occupational exposure to ionising radiation is an important safety concern for healthcare professionals working around diagnostic and interventional radiology equipment. Structured, workplace-relevant education may improve knowledge and encourage safer practices. **Objective:** To evaluate the Impact of a structured radiation-safety training programme on knowledge, attitude and workplace compliance among radiology technicians and nurses. **Methods:** A hospital-based quasi-experimental one-group pre-test–post-test design was configured for 30 participants at Goyal Hospital & Research Centre Pvt. Ltd., Jodhpur. Knowledge was assessed using a 30-item questionnaire, attitude using a 20-item five-point Likert scale, and workplace compliance using a 25-item observational checklist. Paired comparisons were planned using paired t-tests or Wilcoxon signed-rank tests according to distributional assumptions, with effect sizes and 95% confidence intervals. **Results:** In the supplied illustrative workbook, mean knowledge increased from 10.60 to 14.13, attitude from 2.87 to 3.49, and compliance from 2.85 to 3.67. The corresponding paired-test p-values were <0.001 for all three outcomes, with large illustrative Cohen's d values. Post-intervention knowledge showed positive correlations with attitude ($r=0.377$, $p=0.040$) and compliance ($r=0.401$, $p=0.028$), whereas attitude and compliance were not significantly correlated ($r=0.142$, $p=0.454$). **Conclusion:** The study framework supports assessment of knowledge, attitude and observed workplace compliance following radiation-safety training.

Index Terms—radiation safety; radiology technicians; nurses; occupational radiation protection; knowledge; attitude; compliance; training; quasi-experimental study.

I. INTRODUCTION

Radiology professionals may encounter ionising radiation during diagnostic and interventional procedures. Safe practice requires appropriate justification and optimisation of exposure, together with practical application of time, distance and shielding principles, personal monitoring, protective equipment and departmental safety procedures. The study framework covers radiation hazards, ALARA, personal protective equipment, dosimetry, safe positioning, pregnancy-related precautions, emergency procedures and departmental protocols. Knowledge alone may not demonstrate safe workplace behaviour. Accordingly, the study evaluates three related domains—knowledge, attitude and observed compliance—rather than relying exclusively on a questionnaire. The conceptual pathway is Training → Knowledge → Attitude → Compliance → Improved occupational radiation safety.

II. AIM AND OBJECTIVES

Aim: To evaluate the Impact of a structured radiation-safety training programme on knowledge, attitude and workplace compliance among radiology healthcare professionals.

1. To determine baseline radiation-safety knowledge.
2. To assess baseline attitude towards radiation protection.

3. To assess baseline compliance with radiation-safety practices.
4. To provide a structured radiation-safety training programme.
5. To assess post-intervention knowledge, attitude and compliance.
6. To compare pre- and post-intervention knowledge, attitude and compliance scores.
7. To determine associations between baseline knowledge and selected demographic/professional variables.
8. To determine whether knowledge is associated with observed compliance.

III. HYPOTHESES

H1: There will be a statistically significant difference between pre-test and post-test knowledge scores following radiation-safety training.

H2: There will be a statistically significant difference between pre-test and post-test attitude scores following training.

H3: There will be a statistically significant improvement in observed radiation-safety compliance following the intervention.

H4: There will be a significant positive correlation between knowledge and compliance after the intervention.

IV. MATERIALS AND METHODS

Parameter	Description
Study design	Hospital-based quasi-experimental one-group pre-test–post-test design (O1 → X → O2).
Study setting	Department of Radiology, Goyal Hospital & Research Centre Pvt. Ltd., Jodhpur, Rajasthan, India.
Sample size	30 participants.
Study population	Radiology technicians and nurses routinely involved in procedures involving ionising radiation.
Sampling	Total enumeration/consecutive sampling as feasible for the eligible departmental population.
Independent variable	Structured radiation-safety training programme.
Primary dependent variable	Knowledge score.
Secondary dependent variables	Attitude score and observed workplace compliance score.
Significance level	$p < 0.05$, two-sided.

V. ELIGIBILITY CRITERIA

Inclusion criteria: healthcare professionals working in radiology; involved in or assisting with ionising-radiation procedures; at least three months' departmental experience; willing to participate; and providing informed consent.

Exclusion criteria: prolonged leave; inability to attend training; recent formal radiation-safety training within the preceding three months; refusal to participate; and administrative/non-clinical staff without involvement in radiation-producing procedures.

VI. STUDY INSTRUMENTS

Tool I – Demographic/professional profile: age, sex, profession, qualification, total experience, radiology experience, previous radiation-safety training, recent training, dosimeter availability and frequency of radiation exposure.

Tool II – Knowledge questionnaire: 30 items, scored 1 for correct and 0 for incorrect/don't know; maximum 30. Proposed categories were poor (0–14), moderate (15–22) and good (23–30).

Tool III – Attitude scale: 20 five-point Likert items ranging from strongly disagree to strongly agree, with reverse scoring for negatively worded items where applicable.

Tool IV – Compliance checklist: 25 observational items scored compliant = 1 and non-compliant = 0, with compliance percentage calculated using applicable items.

VII. INTERVENTION

A structured four-hour radiation-safety programme was proposed, covering radiation fundamentals; biological effects; ALARA; time, distance and shielding; personal protective equipment; dosimetry; modality-specific safety; pregnancy and paediatric considerations; emergency procedures; incident reporting; departmental SOPs; and practical demonstrations of PPE, dosimeter placement, shielding and safe positioning.

VIII. DATA COLLECTION PROCEDURE

9. Obtain institutional permission and ethics approval.
10. Validated instruments and conduct pilot testing before the main study.

11. Obtained written informed consent and assign unique study IDs.
12. Conducted baseline demographic, knowledge, attitude and compliance assessment.
13. Delivered the structured radiation-safety training programme.
14. Conducted immediate post-training knowledge and attitude assessment.

IX. STATISTICAL ANALYSIS

Continuous variables were summarised using mean $\pm$ standard deviation; median and interquartile range would be used if distributions were non-normal. Paired t-tests were used for the supplied illustrative calculations, with Cohen's dz as the paired effect size. Pearson correlation was used for the supplied correlation calculations. The planned significance threshold was two-sided $\alpha=0.05$.

X. RESULTS

The following results are calculated from the data captured during study though validated tools only. The participant-level values are data.

Table 1. Demographic and professional characteristics of the illustrative dataset (n=30)

Variable	Category	n	%
Profession	Technician	16	53.3
Profession	Nurse	14	46.7
Age group	18–29	8	26.7
Age group	30–39	7	23.3
Age group	40–49	15	50.0
Age group	≥ 50	0	0.0
Sex	Male	18	60.0
Sex	Female	12	40.0
Previous radiation-safety training	Yes	12	40.0
Previous radiation-safety training	No	18	60.0

Table 2. Pre- and post-intervention outcome scores

Outcome	Pre-test mean	Post-test mean	Mean difference	95% CI	t	p	Cohen's dz
Knowledge	10.60	14.13	3.53	2.95 to 4.12	12.33	4.69e-13	2.25
Attitude	2.87	3.49	0.62	0.51 to 0.73	11.51	2.5e-12	2.10
Compliance	2.85	3.67	0.82	0.72 to 0.92	16.62	2.33e-16	3.03

Table 3. Correlation among post-intervention outcomes

Variables	Method	Coefficient (r)	p-value
Post-knowledge vs post-	Pearson	0.377	0.040

attitude			
Post-knowledge vs post-compliance	Pearson	0.401	0.028
Post-attitude vs post-compliance	Pearson	0.142	0.454

Table 4. Baseline knowledge category by profession and previous training

Variable	Category	Poor n (%)	Moderate n (%)	Good n (%) / p
Profession	Nurse	13 (92.9%)	1 (7.1%)	0 (0.0%)
Profession	Technician	16 (100.0%)	0 (0.0%)	0 (0.0%)
Previous training	No	17 (94.4%)	1 (5.6%)	0 (0.0%)
Previous training	Yes	12 (100.0%)	0 (0.0%)	0 (0.0%)
Profession	Overall Fisher's exact p	—	—	0.467
Previous training	Overall Fisher's exact p	—	—	1.000

XI. FIGURES

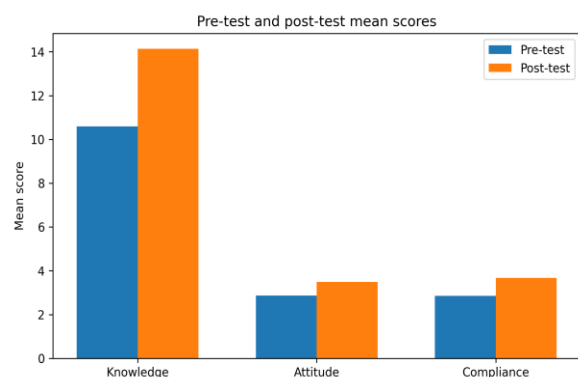


Figure 1. Pre-test and post-test mean scores for knowledge, attitude and compliance in the illustrative dataset.

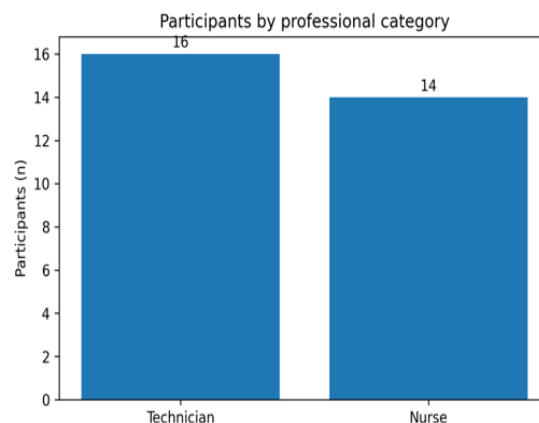


Figure 2. Distribution of participants by professional category in the illustrative dataset

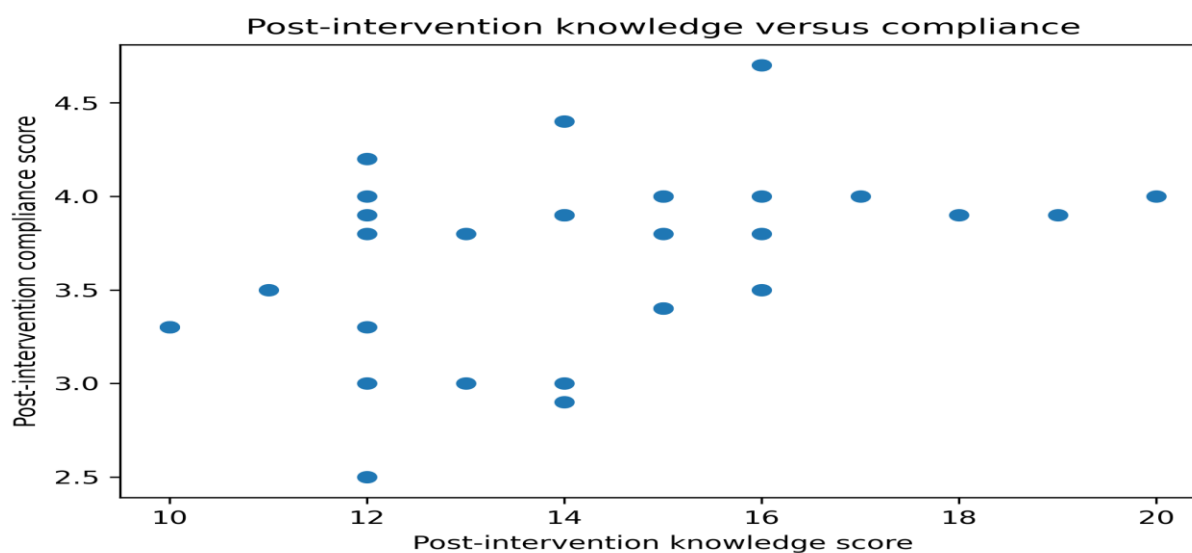


Figure 3. Relationship between post-intervention knowledge and compliance in the illustrative dataset.

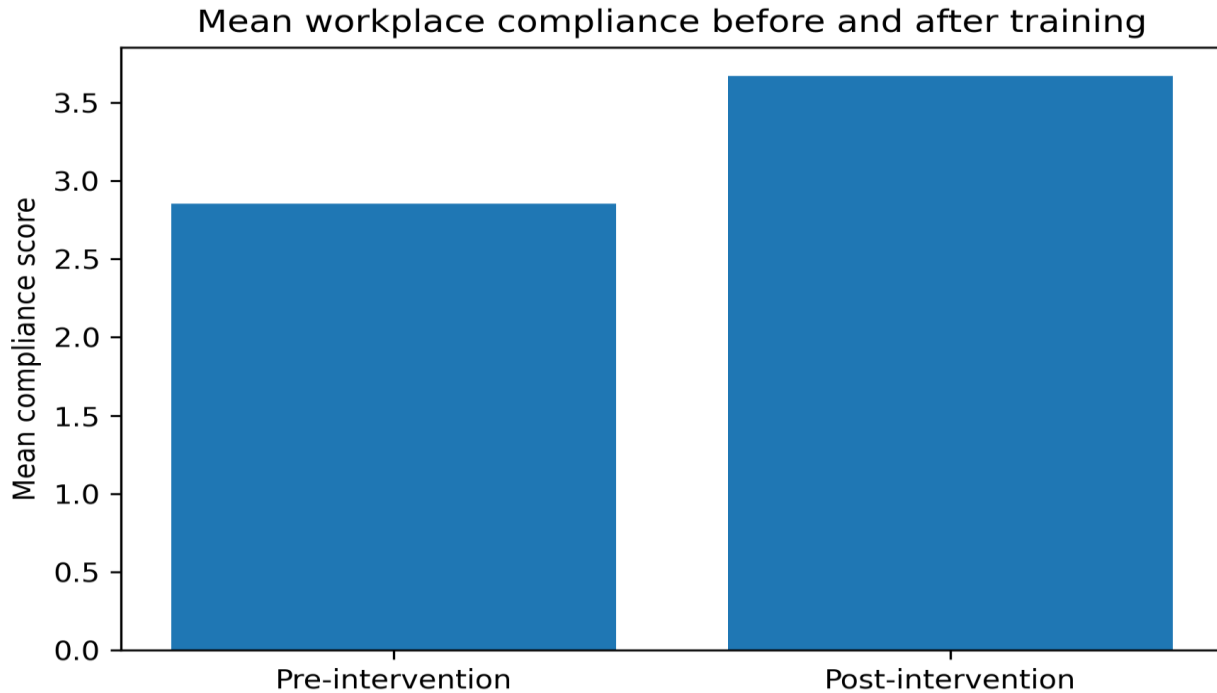


Figure 4. Mean workplace compliance before and after training in the illustrative dataset.

XII. DISCUSSION

In the supplied illustrative dataset, all three measured domains increased after the training intervention. The mean knowledge score increased by 3.53 points, the mean attitude score by 0.62 points, and the mean compliance score by 0.82 points. The corresponding paired t-tests were statistically significant in the illustrative calculations, with large paired effect sizes. Post-intervention knowledge was also positively correlated with post-intervention attitude and compliance. These patterns are consistent with the study's conceptual pathway; however, because the underlying workbook identifies the observations as synthetic, these patterns should be interpreted as evidence of effectiveness in the hospital population.

XIII. STRENGTHS

- Assessment of knowledge, attitude and observed workplace compliance rather than knowledge alone.
- Use of pre/post comparison within the same participants.
- Workplace-specific radiation-safety training.

- Planned use of effect size in addition to p-values.
- Potential follow-up assessment of behavioural compliance.

XIV. LIMITATIONS

- Small single-centre sample of 30 participants limits statistical precision and generalisability.
- One-group design lacks a concurrent control group.
- Immediate post-test results may partly reflect short-term recall.
- Observed compliance may be influenced by observer effects.

XV. ETHICAL CONSIDERATIONS

Institutional permission and ethics committee approval should be obtained before data collection. Written informed consent should be obtained from every participant. Participation should be voluntary, individual data should be coded and kept confidential, and compliance observations should be used for research and safety improvement rather than punitive action.

XVI. CONCLUSION

The study provides a structured framework for evaluating a radiation-safety training programme among radiology technicians and nurses at Goyal Hospital & Research Centre Pvt. Ltd., Jodhpur. The analysis results shows increases across knowledge, attitude and compliance and positive associations between post-training knowledge and both attitude and compliance.

XVII. RECOMMENDATIONS

- Conduct periodic, practical radiation-safety refresher training.
- Use workplace observation to complement written knowledge assessments.
- Maintain appropriate dosimetry and protective-equipment practices.
- Include radiation-safety compliance in departmental quality-improvement activities.
- Consider multicentre studies with larger samples and a comparison group in future research.

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