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Assessment of Knowledge about Radiation Hazards and Radiation Protection among Health Workers in Bharatpur Hospital, Nepal

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ABSTRACT

Background

Since ionising radiation is used for both diagnosis and treatment by radiology, orthopaedic surgeons, urologists, and others, hospital staff of different layers and different departments are regularly exposed to radiation. To keep the radiation level low and staff protected, it is necessary to have knowledge of radiation hazards and protection. Thus, this aims to assess knowledge of healthcare workers about radiation hazards and radiation protection.

Methods

Cross-section study conducted over 260 participants through structured questionnaire of 17 questions. Knowledge level was scored and then categorised as good and poor. Descriptive Statistics was calculated and association was verified by Chi-Squared test and Fisher's exact test.

Results

There were 57% staff who had good level of knowledge. There were 21.92% staff who were trained about radiation hazards and only 24.23% used TLD badge. Majority (40.38%) were exposed in fluoroscopy. There was association of predicting variables with outcome variable knowledge level.

Conclusions

Although the radiation at work place is sensitive issue, knowledge level is poor among many staff. Training should be provided not only to radiology staff but to staff of all the layers and all the departments who are exposed to radiation. They all should be registered for TLD badge as well.

Keywords: knowledge assessment; radiation hazards; radiation protection.

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INTRODUCTION

Due to the advancement of medical imaging technology, the use of ionizing radiation has been increasing rapidly in medicine for the diagnosis and for the treatment of diseases. While Radiology uses ionizing radiation for diagnosis, operative procedures of modern orthopaedic, and urology rely heavily on intraoperative fluoroscopy that involves ionizing radiation.[1,2] As a result, hospital staff of different layers and different departments are regularly exposed to the ionizing radiation. Ample studies published previously have stated that exposure to ionizing radiation increases the chances of bone marrow suppression, cataract, infertility, congenital anomalies, birth deformities, and various types of cancers.[3-5] However, the risk of ionizing radiation can be decreased by wisely using time, distance, and shielding.[6]

In line, International Commission on Radiological protection has suggested to keep the radiation dose as low as reasonably achievable (ALARA) by following three general principles of radiation protection which are justification, dose limitation, and optimisation.[7] Nevertheless, studies have highlighted that ionizing radiation has carcinogenic potential even at low dose.[8-10] Therefore, it is imperative that the operation of the medical equipment producing ionizing radiation should be done by qualified and registered radiographers only so that it can be used effectively with optimized dose of radiation. However, due to the lack of trained qualified radiographers and lack of policy, the machines are not always operated by the registered radiographers in Nepal. Additionally, health workers of all the departments at all the layers participating in medical procedures involving radiation should have good knowledge of radiation hazards and radiation protection.

Assessment of knowledge about radiation hazards have been done previously in Nepal but that was done among radiology personnel only. There is clear gap of evidence related the assessment of knowledge of radiation hazards among all the health workers who are exposed to radiation during medical procedures. This has also been suggested as gap in limitation section of the study done in Nepal.[11]

Assessment of knowledge of radiation hazards and radiation protection of health workers associated with radiation is important. This would help generate the evidence for need of trainings for the staff, need of the resource allocation for protective and monitoring device, underlying evidence for the management and decision-making stakeholders to modify policies, and prepare guidelines to strengthen clinical governance. Hence, objectives of this study are to evaluate the existing knowledge of healthcare workers about radiation hazards and radiation protection and its association with other predicting variables of healthcare workers in Bharatpur Hospital, Nepal.

METHODS

Study Design

A hospital-based descriptive cross-sectional study was conducted using a structured questionnaire-based survey from June to September 2025.

Study Setting/Area

The study was conducted at Bharatpur Hospital, Bharatpur, Nepal, a major government tertiary hospital providing diagnostic and therapeutic services involving ionizing radiation.

Study Population

The study population comprised salaried healthcare workers involved in radiation-based diagnostic or therapeutic procedures, including doctors, nurses, radiographers, radiology assistants, anaesthesia assistants, and other radiation-exposed healthcare workers. Students and interns were excluded

Sample Size

A total of 260 healthcare workers participated in the study.

Sampling Technique

A census sampling technique was employed by including all eligible healthcare workers involved in radiation-related procedures at Bharatpur Hospital.

Data Collection Tools and Technique

Data were collected using a structured questionnaire adapted from previously validated and published instruments. The questionnaire consisted of 17 items in three sections: baseline characteristics (7 items), knowledge of radiation hazards (5 items), and knowledge of radiation protection (5 items). Each knowledge question had four response options with one correct answer. Correct responses were scored as one and incorrect responses as zero.

Variables/Measurements

The dependent variable was the level of knowledge regarding radiation hazards and protection, categorized as good knowledge (score ≥ mean score of 7) and poor knowledge (score <7). Independent variables included participants' sociodemographic and professional characteristics.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using STATA version 15.1. Descriptive statistics were summarized using frequencies, percentages, means, medians, and standard deviations. Associations were examined using the chi-square test or Fisher's exact test as appropriate. A p-value <0.05 was considered statistically significant. The reliability of the questionnaire was assessed using Cronbach's alpha.

Ethical Consideration

Ethical approval was obtained from the Bharatpur Hospital Institutional Review Committee (Ref: 081/82-071) on 9 June 2025. Verbal informed consent was obtained from all participants before data collection, and confidentiality and anonymity were maintained throughout the study.

RESULTS

The total participants were 260 with average age of 34.38 years and that composed almost 53% male and 47% female. Percentage of radiographers were only 16.92% while the greatest section (35%) was other staff such as radiology assistant, anaesthesia assistant etc. Doctors (Radiologists, orthopaedics, urologists etc) included approximately 28%. Experience staff with more than 5years of experience was maximum in percent with 41.54%. The number of staff not trained for radiation protection was four times greater than those trained for the protection. Result shows only 24.23% used radiation monitoring device Thermo-Luminescence Dosimetry (TLD) and majority of the workers were exposed to radiation while working in fluoroscopy (Table 1).

Table 1. Baseline Characters of participants exposed to radiation. (n=260)

Variables	Frequency (%)
Age in years (mean±SD) =34.38±7.91	
Knowledge Score (mean±SD) =7±2.49	
Sex	
Female	123(47.31)
Male	137(52.69)
Job role	
Radiographer	44(16.92)
Doctor	73(28.08)
Nurse	52(20)
Others	91(35)
Experience	
< 1 year	12(4.62)
1-3 years	62(23.85)
3-5 years	78(30)
> 5 years	108(41.54)
Trained for radiation protection	
No	203(78.08)
Yes	57(21.92)
TLD use	
No	197(75.77)
Yes	63(24.23)
Area of work	
Fluoroscopy	105(40.38)
General X-ray	73(28.08)
CT scan	58(22.31)
Dental X-ray	24(9.23)

The internal consistency of the questions was acceptable with Cronbach's alpha 0.765. The percentage of respondents giving correct response was more than those giving incorrect response for all the questions except the one question. The number of participants giving incorrect answer to the question "where on your person do you place TLD or dosimeter badge?" were greater than those giving correct answer.

The statistics for the association by the chi-square and Fisher's exact test has shown that all the selected independent variables of this study were associated with the outcome variable "knowledge level" having strong evidence (p-value<0.005).

Table 2. Questions related to knowledge of radiation hazards and radiation protection.

Questions	Incorrect n(%)	Correct n(%)
Deterministic effects of radiation.	92 (35.38)	168 (64.62)
Radiosensitive organ	59 (22.69)	2017.31)
Stochastic effect of radiation	101(38.85)	159 (61.15)
Effective dose	84 (32.31)	176(67.69)
Cause radiation hazards	11 (4.23)	249 (95.77)
ALARA principle stands	48 (18.46)	212 (81.54)
Lead aprons typically have a lead equivalency	97 (37.31)	163 (62.69)
Recommended annual dose limit for occupational radiation exposure	104 (40)	156 (60)
Best practice to reduce radiation exposure is	50 (19.31)	209 (80.69)
Person do place TLD or dosimeter badge	137 (52.69)	123 (47.31)

DISCUSSION

The primary objective of this study is to assess the knowledge of healthcare workers who are exposed to medical radiation at their duty. We found that almost 57% of the participants had good knowledge of radiation hazards and radiation protection while 43% had poor knowledge. A similar study conducted in Nepal found that almost 69% of the participants had adequate knowledge of radiation awareness.[16] One of other studies conducted in Iraq also found that almost 88% had average or good knowledge of radiation hazards.[11]

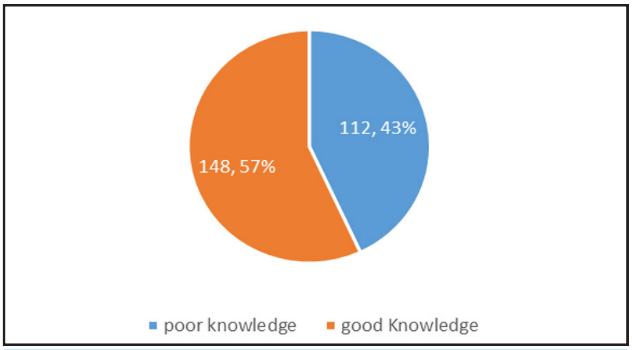

Figure 1. Knowledge level of the health workers.

Table 3. Association of independent variables with outcome variable. (n=260)

Variables	Knowledge category		p-value
	Poor (n)	Good (n)	
Sex			
Female	72	51	<0.001
Male	40	97	
job role*			
Radiographer	2	42	<0.001
Doctor	10	63	
Nurse	21	31	
Others	79	12	
Experience*			
less than 1 yr	1	11	0.048
1 to 3 years	29	33	
3 to 5 years	38	40	
more than 5 years	44	64	
Trained for radiation protection			
No	104	99	<0.001
Yes	8	49	
TLD use			
No	102	95	<0.001
Yes	20	53	
Area of work			
Fluoroscopy	56	49	<0.001
General X-ray	34	39	
CT scan	9	49	
Dental X-ray	13	11	

The possible reasons that they got greater percentage of participants with good knowledge are many. First, they conducted study over formally trained staff of radiology department such as student radiographers, registered radiographers and radiologists, while we conducted this study over all the healthcare workers who are exposed to radiation at work due to radiation based diagnostic or therapeutic procedures. Second, they had small sample size like 165 participants in study of Iraq and only 35 participants in the study of Nepal, while we had larger sample size of 260 participants making our results more robust.[11, 16] Third, they made three categories of knowledge level viz; poor, average and good, while we made two categories with mean score being cut-off value between poor knowledge and good knowledge. This pulled the reference score of good knowledge. Acceptance of high knowledge score should be the plausible value because 100% knowledge is expected. This is because every radiation must be justified and every effort should be made to keep it at lowest.

Unlike other studies which included only formally trained radiology personnel such as radiographer, we included other healthcare workers (orthopaedic surgeons, urologists, anaesthesiologist, anaesthesia assistant, radiology assistant, nurses) involving in radiation exposure during medical procedure along with radiology personnel such as radiologists and radiographers. Therefore, we found that almost 78% staff had no training of radiation protection. This is also a reason that only 24% participants used TLD radiation monitoring device. Highest percentage of staff exposed to radiation was through fluoroscopy. This means majority of the staff were from operation theatre, interventional radiology. Since, they are not of radiology department, they do not possess formal radiation hazards and protection training and they do not have TLD badge for radiation monitoring. Like this study, a previous study conducted over 214 participants of anaesthesia personnel and surgical subspecialists in Thailand has similar level of knowledge of radiation hazards and they also found that almost 70% participants wanted trainings about radiation protection.[17] This appeals for attention of management and policy makers because our study found the association of knowledge level with job role, training of the staff, and area of work with significant p-value <0.05.

Strengths and Limitations: The strength of this study was that we included all the staff who were prone to radiation exposure. We had appreciably large sample size unlike other studies conducted previously with small sample size. We used mean knowledge score as cut-off for good and poor knowledge for better internal comparability rather than using unvalidated standard. The weakness of the study was that some of the questions of attitude and practice were dropped. Also, some highly technical questions of radiation hazards were dropped because participants were not only from formal radiology profession but also from other departments.

CONCLUSIONS

Good level of knowledge about radiation hazards and protection was seen among small percentage of staff. Percentage of trained staff was less compared to percentage of untrained staff about radiation hazards and protection. The TLD users were 3 times less than non-users and majority of the staff were exposed in fluoroscopy.

Recommendation: It is recommended that training should be provided to all the staff who are subjected to radiation exposure at work place. All those staff should be registered as a radiation worker and TLD badge should be made available.

Conflicts of Interest: The authors declare that they have no conflict of interest.

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Availability of data and materials: The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

Authors' Contributions

Conceptualization: Keshab Paudel, Surya Prakash Sapkota, Samikshya Paudel,
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Methodology: Keshab Paudel, Samikshya Paudel,
Supervision: Keshab Paudel
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Writing- review & editing: Keshab Paudel, Surya Prakash Sapkota, Samikshya Paudel,

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