# Research on the Radiological Safety Conditions at Different Hospitals in Nepal.


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## ABSTRACT


Nepal has a long history of medical radiology; but we still do not have any radiation protection infrastructure to control the use of ionizing radiations in the various fields. Recently Nepal is part of the IAEA and this will certainly support and speed up the creation of appropriate conditions.

The aim of this study was an assessment of the radiation protection in medical field. In this study, measurements were performed to assess the status of radiation protection barriers and general conditions in the same radiological centers. Questionnaire for radiation workers were used; radiation dose levels were measured and made an inventory of equipment. Another aim of the study was to create awareness in the workers aware on possible radiation health hazard and risk. It was also important to gain an inside of the level of understanding of the personnel in order to initiate steps towards the establishment of code of radiological practice.

Altogether, 33 radiological and radiotherapy facilities at different hospitals/institutions were monitored. The professionals who completed the questionnaire represent more than 65% working in this field in Nepal. Almost all diagnostic radiology working areas are safe. Radiation dose level around radiotherapy centers shows are within safe limit and are built according to protection criteria. Around 65% of the radiation workers are not monitored for radiation. There is neither quality control program except radiotherapy nor training program in radiation protection. The basic radiation protection principles of Justification and Optimization should be taken into consideration in this period of rapid increase of investigation following the availability of new equipment.


## INTRODUCTION

Recently, a tremendous development has taken place in the field of x-ray diagnostic imaging at Nepal. Newer modalities are being applied in major hospitals and latest radiological equipment are being imported; at the same time small x-ray "set-ups" are being established on a day-by-day basis. This quantitative increase may have a positive impact on the health service system of the country; but the lack of control is a serious problem.

For the time being there are 4 tele-cobalt machines, 3 linear accelerators, 3 simulators, 3 high dose rate (HDR) brachytherapy, 2 gamma camera (SPECT), 9 MRI, around 30 CT and about 800 x-ray equipment in the country. There are more than 300 qualified professionals including radiologists, radiation oncologists, medical physicists, radiographers, radiation therapists, nuclear medicine physicians and nuclear medicine technologists)

Due to lack of radiation protection laws/regulations and infrastructures, there is no legislative body or any radiation Act to set standards for radiation protection.

## OBJECTIVES

The main objective of the study is to carry out a survey of radiation level.

1. To study about the structural shielding design for radiation in different rooms of radiology and radiotherapy department and to identify the relatively more radiation hazardous locations around the occupancy area.
2. To calculate weekly equivalent dose received by the radiation workers as recommended by ICRP [4,5].
3. To make the radiation workers aware about the possible radiation health hazard and to know their view and knowledge on radiation protection.
4. To make an inventory of availability of equipment of the surveyed hospitals.
5. To initiate steps towards establishment of Nepalese code of radiological practice and to develop radiation safety culture to benefit Nepalese People.

**Limitations of the study:**

The study area covers only major hospitals, zonal, regional and sub-regional hospitals and its generalization may not be valid for all other hospitals in remote areas of Nepal. It is doubtful about whether the given mA or kV are actually the correct as there is no quality control program. The workloads that we have taken form DIN standard based on German workloads might be different than workloads at hospitals in Nepal.

## MATERIALS & METHODS

Three ways were applied to assess the status of radiation protection:

1.Questionnaire for radiation workers
2.Radiation level measurement
3.Inventory of radiation-emitting equipment at surveyed hospitals.

The questionnaire consists on twenty-five questions seeking information regarding professional responsibility, protection training, personnel dose monitoring, institutional and self-motivation towards radiation safety, etc. In addition, the questionnaire gives also some information about the general understanding of radiation protection.

*Radiation Level Calculation (Radiology)*

To measure radiation level, six specific locations were selected.

A scattering medium was used & measurement behind the chest stand wall was done without a patient or a phantom.

The radiation level at each point is calculated through the workload (mA.min/week). The workload in each unit

$$Workload = \sum_i (\mathrm{mA}\cdot\mathrm{min})_i \cdot N_i$$

where $N_i$ is examination number of kind i and $(\mathrm{mA.min})_i$ used techniques for examination kind i

For general x-ray unit: 160 mA.min/week; for fluoroscopy: 1200 mA.min/week; for mammography unit: 2000 mA.min/week and for CT unit: 5000 mA.min/week[6]. Then in each area is

$$H_w = \dot{L}\cdot\frac{1}{I_m}\cdot Workload$$

where $H_w$ is the equivalent radiation level mSv/week

$\dot{L}$ is the equivalent dose rate level readings in air at each point mSv/min and to measure it the higher voltage ($kV_p$) and intensity ($I_m$) in mA are used and so as long time ($t$) to avoid dead time of the survey meter and *Workload* is units of mA.min/week.

## ANALYSIS OF QUESTIONNARE

• Twenty-five questions seeking information regarding professional responsibility, protection training, personnel dose monitoring, institutional and self-motivation towards radiation safety was asking to fill it by radiation workers.

•Altogether 203 radiation workers including radiologist, radiographer, dark room assistant, radiotechnicians, radiation oncologists, radiology residents, radiotherapy residents, B.Sc (RT) students, bio-medical engineers and medical physicists answered the questionnaire representing the different hospitals of the country.

•To evaluate the questionnaire different software were used such as SPSS 17©, PHSTAT2© and EXCEL©, and Z test for proportion, descriptive statistics and diagrams are used to interpret data.

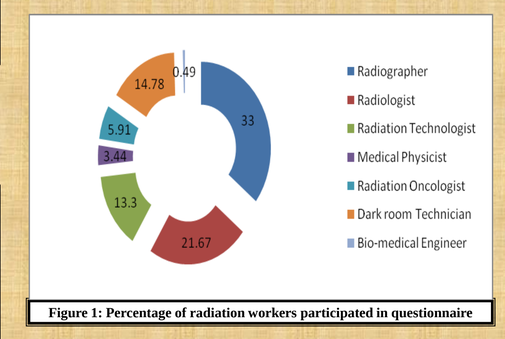


Figure 1: Percentage of radiation workers participated in questionnaire

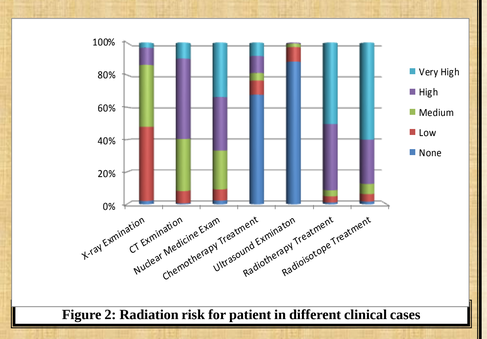


Figure 2: Radiation risk for patient in different clinical cases

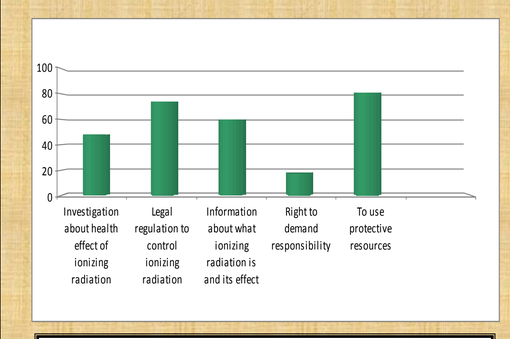


Figure 3: Options feeling safe from radiation to public.

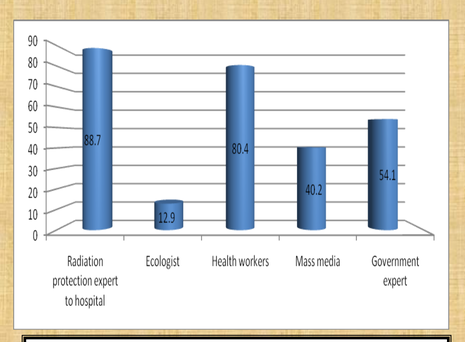


Figure 4: Responsibility to inform radiation risks

| | None | Low | Medium | High | Very High |
|---|---|---|---|---|---|
| Evaluation of exposure & doses | 0.6 | 5.1 | 7.4 | 43.4 | 43.4 |
| Evaluation of mortality | 16.4 | 40.6 | 23.6 | 16.4 | 3 |
| Evaluation of morbidity | 8.9 | 27.4 | 45.2 | 15.5 | 3 |
| Evaluation of cost benefit | 19 | 37.4 | 28.2 | 14.1 | 1.2 |
| Evaluation of Damage/health | 1.1 | 7.9 | 10.7 | 29.4 | 50.8 |

Table 1: Evaluation of Radiation risks in percentage.

## ANALYSIS OF RADIATION SURVEY

Radiation survey was done in 33 different hospitals, which include 44 x-ray equipment, 10 CT scans, 2 mammographs and 2 catheterization laboratory, 3 tele-cobalt machines, 2 HDR brachytherapy, 3 linear accelerators and 2 simulators.

- There is not automatic exposure control in most of the x-rays.
- There were a window at the x-ray room and no lead protected door at some hospitals outside the Kathmandu.
- Also found that a door and a window near to the x-ray tube were not protected.
- Some unqualified persons were exposing the patient because of the lack of the radiation workers.
- There is no quality control program in hospitals with only diagnostic radiology facility but there is a quality control program in Radiotherapy facility centers.
- There is only a maintenance contract with the company at few hospitals with diagnostic radiology facility.

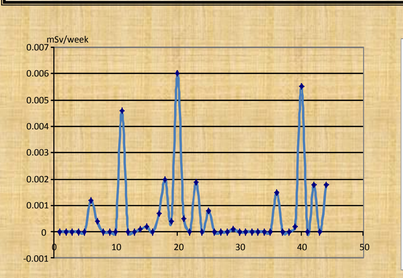


Figure 5: Dose level at Control console

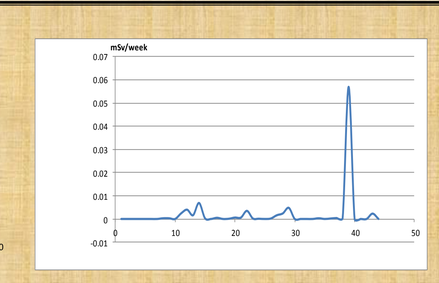


Figure 6: Dose level at outside treatment room (at door)

## CONCLUSIONS

- 33 different hospitals/institutions were monitored.
- Radiation survey was done in 44 x-ray equipment, 10 CT scans, 2 Mammographs and 2 catheterization laboratory in diagnostic radiology.
- In radiotherapy, 3 tele-cobalt units, 2 HDR brachytherapy, 3 linear accelerators and 2 simulators were surveyed.
- 203 radiation staff were participated in questionnaire.
- 70% of the radiation workers are aware on radiation safety issue.
- Almost all x-ray and CT working areas are safe. Radiation survey around the mammogram unit shows that all the area are safe and built according to protection criteria.
- Radiation dose levels at 5 radiotherapy centers show that a all the reference points are within safe limit.
- The result shows that around 65% of radiation workers are not monitored for radiation.
- There is a great need for rules, regulation and radiation Act in the field of radiation in medical field.
- There is no QA program in diagnostic radiology but is a maintenance contract with the company at few centers. But there is a QC program in Radiotherapy centers.
- There must be regular quality control parallel to maintenance program for the x-ray equipment at regular intervals. The basic radiation protection principles of Justification and Optimization should be taken into consideration in this period of rapid increase of investigation.
- The detailed evaluation of the answers given by the personnel might provide good indication about the strategy to adopt in designing training program, very much needed.
- Through proper education and training and regularly organized seminars, conferences people are becoming more and more aware about radiation, its uses in medicine. In addition, national infrastructures include certain essential services, such as personal dosimetry, calibration and inter-comparison of radiation measuring equipment as well as external audit.
- By establishing basic safety standard and radiation control authority, rules and regulations can be enforced in the country effectively and efficiently.

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