Occupational Radiation Exposure in Health Care Facilities

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ABSTRACT

Background

Radiation, which is used extensively to diagnose and treat human diseases, poses an occupational health risk for the concerned health workers. Personal dosimetry is an important tool to monitor occupational radiation exposures.

Objective

This study was conducted to reveal and to describe the situation of occupational radiation exposure monitoring among staffs in different health care facilities in Nepal.

Methods

A cross-sectional study was performed among the 35 Health Care Facilities. Information about types and number of X-ray procedures performed, types and number of personnel involved, workload and the availability of personal dosimetry service were collected.

Results

Six Health Care Facilities had personal dosimetry service available for a total of 149 personnel. Of a total of nearly one million X-ray procedures performed in the 35 Health Care Facilities in 2007, 76 % was performed by non-monitored personnel. The majority of the facilities performing high dose procedures, like catheterisation, angiography and intestinal barium procedures did not offer personal dosimetry for the involved personnel.

Conclusion

There are a limited number of personnel being monitored with personal dosimetry. There are no regulatory dose limits for occupationally exposed staff. Thus, there is an urgent need to establish a national radiation protection authority to regulate the use of radiation in Nepal.

KEY WORDS

Dosimetry, monitoring, occupational radiation exposure, radiology, radiotherapy

INTRODUCTION

Medical radiation is responsible for the largest man-made source of exposure to human population world-wide.[1] Although radiation can be of great benefits, a potential health hazard with its use is generally accepted. Occupational exposure is the result of radiation exposure at work and personal dosimetry is an important tool to ensure compliance with regulatory or generally accepted dose limits.[2,3] There are 207 hospitals in Nepal; both public and private.[4] Moreover, the hospitals in rural areas are few and with limited resources. The information about radiology, nuclear medicine and radiotherapy services is limited and the extent of personal dosimetry is also unknown.[5-11] Nepal has insufficiently regulated medical radiological practices.[10] Furthermore, it has no radiation protection authority or regulations regarding the use of radiation in any sector.[10-13] The country became a member of the International Atomic

Energy Agency (IAEA) in 2008.[14] In such a background, the aim of this study was to document the existing situation regarding occupational radiation exposure monitoring in the Nepalese health care facilities.

METHODS

This cross sectional study was carried out in selected Health Care Facilities (HCFs) in Nepal during May and June 2008. First of all, preliminary information regarding the type, level and location of HCFs were obtained from the website of the Ministry of Health and Population, the Government of Nepal and Nepal Yellow Pages.[15,16]

A total of 35 HCFs with radiological and nuclear medicine services were selected for the study. The sampling of the HCFs was partly simple random and partly strategic. This method for sampling was done to make the selection more representative for the different regions and health care levels in the country. The stategic selection was done to cover all six HCFs with radiation therapy and nuclear medicine services across the country. The random selection of public hospitals, teaching hospitals, private hospitals and X-ray clinics was done, and 29 HCFs were selected. The inclusion criterion was made so as to select public HCFs of district level or above, and private hospitals/clinics offering at least X-ray service. Similarly, the HCFs without X-ray service were excluded from the study.

All information was collected by telephone and personal interviews. One personnel from the radiological or nuclear medicine services of each HCF was conveniently selected. Informed consent was taken from each informant before interviewing them to obtain relevant information through a structured questionnaire and personal communication. The questionnaire, consisting of closed and open-ended questions, was designed to collect data about different types and number of procedures performed, number of different types of personnel involved in clinical radiation services, workload and availability of personal dosimetry service. The interviews were performed in Nepali language by three radiological technologists and later translated, entered and analysed in English. Additionally, information regarding different types of health personnel working with radiation throughout the country was obtained from Nepal Radiological Society and Nepal Radiologists' Association. The data were entered in the Easyresearch software (Easyresearch Scandinavia AB, Stockholm, Sweden), and descriptive analyses were performed using the Microsoft office Excel 2003.

RESULTS

A total of 372 radiological personnel are found to be registered in their professional organizations, and of them, the largest group is of radiographers (table 1).[17] Of the 35 respondents in our study, 21 were radiographers, five assistant radiographers, five dark room assistants, two radiologists and two medical physicists. Most of the respondents (n=32) were employed in radiology departments, and the others in radiotherapy departments. All HCFs had conventional X-ray equipments, and five of them had radiotherapy equipments. Twelve HCFs used fluoroscopy in operating theatres and one HCF used only Computed Tomography (CT) scanner. There was only one nuclear medicine centre using Gamma camera (SPECT).

Table 1. Overview of personnel in radiation medicine in Nepal.

Health personnel	Total number (n=372)	Personnel per million inhabitants*
Radiographers**	250	8.65
Radiologists	100	3.46
Medical physicists	10	0.35
Radiation oncologists	9	0.31
Nuclear medicine physicians	3	< 0.1

*Calculated as per the population of 2007 (Inhabitants 26.4 million).[24]
**Includes both radiological technologists (3-year B.Sc. education) and radiographers (1.5-year proficiency certificate level education).

Table 2. Different type of radiological procedures performed at the 35 HCFs and the HCFs providing personal dosimetry service.

Type of procedures	HCFs performing procedure*	HCFs providing personal dosimetry service
Thorax X-ray	34	4
Skeleton X-ray	34	4
Intestinal barium	20	4
CT procedures	13	4
Angiography/ catheterization	6	2
Radiation therapy	5	3
Nuclear medicine	1	1

HCFs: Health Care Facilities, CT Scan: Computed Tomography
*One HCF solely performed CT Scan

The activity in the HCFs varied from 360 to 126,000 procedures per year (2007), with an average of 28,884. Altogether, the 35 HCFs performed nearly one million radiological procedures (n=929,940) in 2007. Plain thorax and skeleton X-rays were the most common procedures, while other procedures included intestinal barium procedures, CT procedures, angiography and catheterisation, radiation therapy and nuclear medicine (table 2).

In the 35 HCFs, a total of 393 personnel were involved in radiological services (both diagnostic and therapeutic including radiation therapy procedures); 344 (87.5 %) worked in radiology, 46 (11.7 %) in therapy and three (0.8 %) in nuclear medicine. Six HCFs had personal dosimetry service covering 149 personnel who performed 226,640 procedures constituting 24% of all procedures recorded for this study.

For those six HCFs with personal dosimetry, the service had existed 4-9 years and the dosimetry was performed with Thermo Luminescent Dosimeters (TLDs), supplied by

Bhabha Atomic Research Centre, Mumbai, India. The TLD wearing period in all the HCFs was three months and the dosimetry information of the personnel was maintained in the hospitals' record. Ninety-one percent of the respondents emphasized that establishment of a radiation protection authority is the most urgent need for medical radiological practice.

DISCUSSION

Though the first X-ray facility was started in 1923, no official information about number and type of radiological/X-ray facilities, number of radiation workers and their qualifications, working conditions is available so far.[10,12] There are few published data available about the utilization, competence and praxis in radiological service in Nepal.[10-12] One study reports number of operational radiological equipments; one gamma camera, three brachytherapy equipments, three linear accelerators, three simulators, four Co-60 machines, 11 computed radiography units, 12 mammography units, 30 CTs, and > 900 X-ray machines.[12] World Health Organisation provided radiation monitoring film badges to radiologists and radiographers in 1978, however, dose monitoring was not done routinely.[11] Our study showed that only 149 personnel were monitored for their occupational doses. Non-monitored personnel performed 76 % of the X-ray(s) procedures covered in this study for the year 2007. To perform plain X-ray(s) without being monitored, in some cases, could be justified if shielding devices are applied adequetly. Notably, four of the six departments performing angiography and catheterisation procedures, and 16 of 20 departments performing intestinal barium procedures did not have any personal dosimetry. In addition, there were two of five HCFs with radiation therapy services that also lacked the dosimetry.

The most vulnerable group was found to be personnel working with catheterisation and angiography. Other high-risk personnel could be those working with barium intestinal studies, fluoroscopic guided procedures, Cobalt-60 teletherapy and brachytherapy sources. The catheterisation procedures have a significant risk of receiving high personnel doses.[18,19] A chronic exposure to eye lenses might cause cataract, if radiation protection measures are compromised.[19,20] A recent survey carried among 86 radiation workers in 15 hospitals identified that none of the workers had personal dosimetry system, and most of the radiation workers even lack the knowledge of dose limits.[10] A personal dosimeter can also be an important tool for evaluating and optimising radiation protection. A dosimeter worn outside the lead apron can also serve as a screening device for working technique, and in addition, it gives an indication for lens and finger doses.[21]

The resources in terms of qualified radiological work force and equipment available are limited in Nepal.[12,22] The number of medical radiation workers, as reported in our study (table 1), is comparable with a study by Adhikari et al.[12] Some of the personnel doing X-ray procedures (except radiological graduates) do not have any formal education and training in radiation protection.[10] Medical physicists, who are primarily responsible for an overall radiological safety issues, are very few.[12,23] In such a situation, qualified technologists or radiographers could play an instrumental role in imparting basic radiation protection and safety education to untrained personnel. The membership of the IAEA could be instrumental to establish a national radiation protection authority in the near future.

CONCLUSION

A gross disparity between the number of medical radiation personnel and inhabitants exists in Nepal. There are a limited personnel being monitored with personal dosimetry; and for the others, the occupational exposure is unknown. Therefore, a majority of personnel lack an important tool for evaluation and optimisation of radiation protection. There is an urgent need to establish a national radiation protection authority that oversees the issues of radiation use and protection.

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