TRENDS IN OCCUPATIONAL RADIATION EXPOSURES AT IRNUM (2000-2008)

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ABSTRACT

OBJECTIVES: To evaluate the radiation exposure of the radiation workers and to study the exposure trends in the institute by calculating average annual effective doses and annual collective effective doses using film badge dosimetry technique. RESULTS: The results show that in the reported period three radiation workers had received more than annual dose limit while all other workers involved in radiation oriented practices are in the range of 1 mSv to 1.5 mSv. The annual average effective dose of all the radiation workers falls in the range of 0.320-4.421 mSv. The highest annual average effective dose 4.421 mSv was found in nuclear medicine department. CONCLUSION: The personnel dosimetry results indicate that two radiation workers in the year 2001 while one radiation worker in the year 2006 received radiation dose more than the annual dose limit. However the rest of the radiation workers doses are within the annual dose limit, reflecting safe radiation oriented practices in the institute and compliance to the regulatory requirements. The average collective effective doses are higher in radiotherapy group followed by nuclear medicine, maintenance, radioimunoassay, diagnostic radiology, and nursing groups.

Keywords: Radiation dosimetry; personal dosimetry; ionizing radiation.

INTRODUCTION

The use of ionizing radiations and radioisotopes in medicine has increased dramatically since last 5-6 decades due to both in its breadth of application and technological improvements in diagnosis and treatment modalities. The International Commission on Radiation Protection (ICRP) and International Atomic Energy Agency (IAEA) had been working since long for the promotion of the radiation protection system in medicine.1,2 The occupational radiation exposure of the workers carrying out ionizing radiation oriented practices in medicine had become more important and regulatory bodies all over the world are more concerned about its monitoring and record keeping. Therefore the radiation exposures of the occupational personnel involved in radiation oriented practices are monitored and assessed throughout the world.3-8 The Institute of Radiotherapy & Nuclear Medicine (IRNUM) is one of the major cancer hospitals in the north west of Pakistan since 1975. The institute is a licensee of the Pakistan Nuclear Regulatory Authority (PNRA)9 and has well established radiation protection programme that addresses the radiation protection aspects of the workers, patients and general public. The whole body occupational radiation exposure monitoring is carried out by the monthly film badge services provided by the health physics division, Pakistan Institute of Science & Technology (PINSTECH), Islamabad. The reported work presents the initial statistics on personal dose equivalent to ionizing radiation of IRNUM radiation workers for the period 2000-2008 and provides a source of data for epidemiological investigation and dose trends observed within the institute.

METHODOLOGY

The film badge dosimeters used consist of personal monitoring film in a film holder. Each badge contained one film. The film badge had five filters which provided a detailed analysis of the radiation exposure. Radiation workers were provided the film dosimeter on monthly
basis. The radiation workers were divided into five categories according to their job description in the institute. The films were processed and analyzed at health physics division PINSTECH and the results were communicated to the Institute on monthly basis. The radiation workers registry contains dose information of 548 workers for the period 2000-2008. The collective effective dose \( S \) was determined according to expression.\(^{1,2}\)

\[
S = \sum_{i=1}^{N} E_i
\]

Where \( E_i \) is the annual effective dose received by the \( i \)th worker and \( N \) is the total number of workers. The average annual effective dose \( E \) is equal to \( S/N \).

**Results**

The reported results show occupational radiation exposures of workers involved in ionizing radiation oriented practices of the Institute. The minimum detectable limit is 0.1mSv and the annual dose limit is 20 mSv averaged over five years. The result in the (Tab.1) show that three radiation workers had received more than annual dose limit while all other workers involved in radiation oriented practices are in the range of 1mSv to 1.5 mSv.

The annual average effective dose of all the radiation workers falls in the range of 0.320-4.421mSv. The highest annual average effective dose 4.421mSv was found in nuclear medicine department in the year 2006 (Tab.2). The range of annual total collective effective dose was found to be 0.97-66.31 man Sv.

**Table-1**: Trend in occupational exposures in IRNUM hospital from 2000-2008.
The personnel dosimetry results for the period 2000 to 2008 indicate that two radiation workers in the year 2001 while one radiation worker in the year 2006 received radiation dose more than the annual dose limit. However the rest of the radiation workers doses are within the annual dose limit (Fig.1). The nuclear medicine and radiotherapy form the largest number of radiation worker groups in the hospital. The results of the collective effective doses are schematically presented in (Fig.2). The average collective effective doses are higher in radiotherapy group followed by nuclear medicine, maintenance, radioimmunoassay, diagnostic radiology, and nursing groups which are 31.77, 29.75, 9.24, 8.88, 8.24 and 7.1 manSv respectively. This study provided an opportunity to understand the trends in the occupational radiation doses, the working environment and the compliance to the regulatory requirements of PNRA.

<table>
<thead>
<tr>
<th>Occupational Group</th>
<th>Year</th>
<th>Total Number of Workers</th>
<th>Annual total collective effective dose (man Sv)</th>
<th>Annual average effective dose (mSv)</th>
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<tr>
<td>RIA Laboratory</td>
<td>2000</td>
<td>7</td>
<td>11.28</td>
<td>1.611</td>
</tr>
<tr>
<td></td>
<td>2001</td>
<td>7</td>
<td>11.28</td>
<td>1.611</td>
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<tr>
<td></td>
<td>2002</td>
<td>7</td>
<td>9.20</td>
<td>1.314</td>
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<tr>
<td></td>
<td>2003</td>
<td>7</td>
<td>11.39</td>
<td>1.627</td>
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<td></td>
<td>2004</td>
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<td></td>
<td>2005</td>
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<td>7.47</td>
<td>1.245</td>
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<td>4.28</td>
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**Table-2: Film Badge Dosimetry Results.**

**References**


