

Public exposure from I-131 hospitalized isolated patients in NIMRA Jamshoro Pakistan

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Abstract

Purpose/ Background: To treat the cancerous tissues the unsealed radioisotopes are being in clinical practice since 7 decades. From these unsealed sources, I-131 is the choice of treatment for the treating thyroid cancers. Orally administered I-131 patients are to be kept isolated in hospital for some period until captured activity in the body reaches to national and international limits for the avoidance of unacceptably high radiation exposures to patients' family members and the general public to keep ALARA (as low as reasonably achievable) principal in mind. The main rationale of this study was to calculate the exposure/dose of the general public. **Material and Methods:** This work presents the exposure rate and dose to the general public in the corridor and the non-radioactive patients admitted in adjacent room from I-131 administered isolated patients treated at NIMRA (Nuclear Institute of Medicine and Radiotherapy) Jamshoro Pakistan. In this study exposure from 23 thyroid cancer patients treated with different activities of I-131 (50 to 200 mCi) from January 2011 to December 2012 were included. **Results:** The average exposure rate in the corridor was about 5.17 $\mu\text{Sv/hr}$ (2.14 $\mu\text{Sv/hr}$ to 8.15 $\mu\text{Sv/hr}$) and the cumulative dose to nonradioactive patients residing in an adjacent room was 0.647 mSv (0.192 mSv to 1.664 mSv). **Conclusion:** This study concludes that the exposure rate to the general public especially the admitted non-radioactive patient in the adjacent room is almost within the limits of 1 mSv as specified in national and international standards.

Keywords: Unsealed Source; Isolation Room; ALARA; Radioiodine; Exposure Rate

Introduction

Radioiodine (I-131) is primarily β -emitting radionuclide with 610 keV energy followed by a 364 keV photon.¹⁻⁵ β ray emitted from radioiodine contributes the major radiation dose to the thyroid tissue and the gamma ray photon may give rise the potential radiation hazard to others.^{1, 2} After first usage of I-131 by Saul Hertz and Arthur Roberts in January 1941⁶, it becomes an admired treatment option for patients with thyroid cancer. Obviously the Patients administered I-131 therapeutic dosages are sources of undesir-

able high radiation exposure to close family members and the general public.

Usually the patients are to be hospitalized until the exposure rate from the patient's body surface at one meter falls to acceptable levels of 1 mSv⁷⁻⁹ according to national and international standard⁹⁻¹¹ and ALARA principal.¹² The main aim of this study was to record and calculate the exposure rate/dose to general public especially patients admitted in an adjacent room at Nuclear Institute of Medicine and Radiotherapy (NIMRA) Jamshoro Pakistan.

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Methods and Materials

Exposure rate measurement is a key factor in radioiodine administered patients. The aim of the measurement of exposure rate is to maintain the radiation exposure/dose of the general public as low as reasonably achievable.^{12, 13} If the administered activity to the patient is more than 30 mCi,

hospitalization of patient is necessarily in a special isolation room is required until the achievement of captured activity to less than 30 mCi or the drop off of exposure rate to less than 50 $\mu\text{Sv}/\text{hour}$.^{12, 14} Twenty three radioiodine administered patients at NIMRA Jamshoro Pakistan with ages ranged from 17 to 68 years and administered I-131 activities ranged from 50 mCi to 200 mCi were included in this study. Patients' data such as age, sex, administered activity, date and time of administration were recorded.¹⁵⁻¹⁷ Initial exposure measurement for each of patient was recorded at the time of administration of activity with twice daily exposure rate measurement in corridor and adjacent room to isolation room were noted with calibrated LAMSE RM1001-RD survey meter (**Figure 1**). The procedure was briefed to the each patient and oral & written instructions regarding isolation of patient were given to patient in order to keep the dose to family members and general public minimum.^{9, 10, 16, 18-20, 26} The instructions were i) keeping the patient alone during hospital stay in a special isolated room; ii) allowing caregivers/family members to present meals and water to the patient for very short periods; iii) ensuring plenty of liquids intake; iv) chewing lemon/orange candies for minimizing salivary glands' dose; v) strongly advising lactating mothers to stop breast feeding to their babies immediately to prevent radioiodine ingestion through breast milk to the babies; vi) recommending pregnancy avoidance for a period of 4 - 6 months after I-131 administration; vii) instructing the patients for maintaining safe distance between themselves and their family members & general public, ensuring separate arrangements of sleeping, avoiding public transport travel and avoiding visit of public places such as shopping centers, restaurants, theatres & public events; viii) for reduction of dose to caregivers/close family members, patients and their caregivers instructed for complying the same instructions at home after discharge from hospital for one to two weeks as maintained in isolation room.



FIG. 1: LAMSE RM1001-RD survey meter.

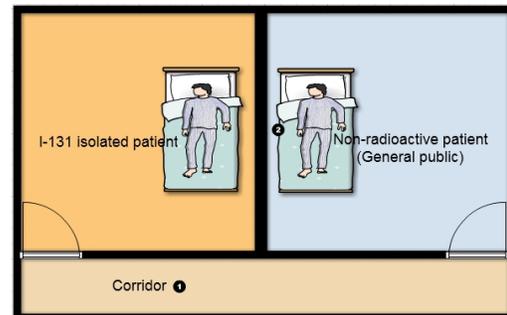


FIG. 2: Room setting of I-131 isolated and nonradioactive patients with points of exposure rate/ dose measurements.

Figure 2 shows the room setting of I-131 isolated and nonradioactive patients with points of exposure rate/dose measurements. It was ensured that no same patient in adjacent room received doses from the different patients. Every time of isolation of I-131 administered patients, different patient was admitted in adjacent room and there was no permanent occupancy in corridor as it was used as passage/pathway in the ward. The doses to nonradioactive patients in adjacent room were calculated from the readings of survey meter and the time duration of admission of I-131 isolated patients.

IAEA (International Atomic Energy Agency) mentioned in its documents²¹ that the majority of patients, excreted 50 - 60% of the administered activity in the first 24 hours and different studies^{2, 22 - 25} revealed that the percentage of clearance of I-131 activity from patients is rapid (more than 80%) in first 48 hours whereas Driver and Packer¹⁵ and Memon SA *et al.*²⁶ reported that this clearance of magnitude of (65 - 68) %. This indicated that the isolation period of isolated patients in ward is short so the public dose may be minor.

Results

The data of exposure rates in corridor and dose to patients admitted in adjacent room is presented in **Table 1**. The recorded average exposure rates from isolated patients in corridor is ranged from 2.14 $\mu\text{Sv}/\text{hr}$ to 8.15 $\mu\text{Sv}/\text{hr}$ (average of 5.17 $\mu\text{Sv}/\text{hr}$) and the cumulative doses to nonradioactive patients admitted adjacent room as indicated in **Table 1** is ranges from 0.192 mSv to 1.664 mSv with an average of 0.647 mSv. 91% ($n = 21$) of patients in adjacent room received less dose than allowable limit of 1 mSv⁹⁻¹¹ as shown in **Figure 3**. Only 2 (9%) patients contribute some higher doses to non-radioactive patients admitted in adjacent room due to longer stay in isolation room than other patients.

The results of this study pointed out that the exposure to family members of patients and the general public can be minimized with i) sufficient radiation safety precautions and measurements. ii) abiding the instructions by I-131 administered patients.

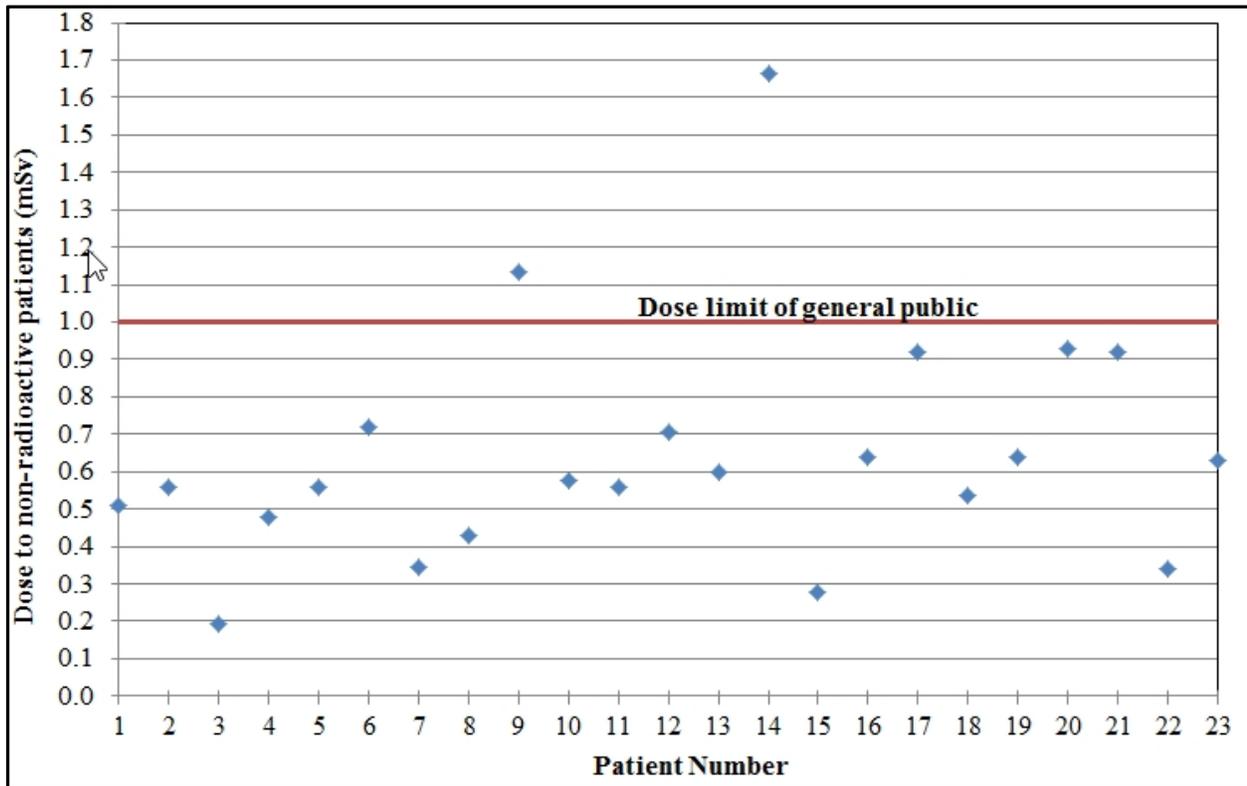


FIG. 3: Graphical representation of patient dose in adjacent room to I-131 isolated patient room with allowable limit (1 mSv) indication.

TABLE 1: Average exposure rate in corridor and dose in adjacent room.

Patient #	Activity (mCi)	Average exposure rate in Corridor ($\mu\text{Sv/hr}$)	Dose in adjacent room (mSv)
1	85	4.000	0.512
2	100	5.926	0.560
3	50	2.222	0.192
4	100	4.444	0.480
5	120	5.185	0.560
6	185	8.148	0.720
7	155	4.000	0.344
8	105	3.844	0.429
9	145	6.994	1.133
10	150	6.889	0.576
11	90	5.185	0.560
12	175	7.556	0.704
13	100	5.556	0.600
14	150	4.667	1.664
15	95	3.333	0.280
16	100	6.667	0.640
17	150	3.889	0.920
18	100	6.778	0.536
19	150	7.778	0.640
20	200	5.000	0.930
21	150	5.772	0.919
22	160	2.135	0.341
23	100	2.828	0.632

Discussion

Along with family members/caregivers, the general public/non-radioactive patient admitted in adjacent room are also at risk from I-131 administered patients isolated in ward but through proper radiation protection measurements it can be effectively managed.²⁷ The exposure rate/dose of the general public from patients administered with I-131 during stay at hospital needs some considerations. The comparison of current study is not possible due to non-availability of data on this study topic.

Although many studies^{14, 17, 26, 28-34} have been conducted on the dose to caregivers/family members of the patients as summarized in **Table 2** but no data was found for exposure rate/dose to the general public from the I-131 therapeutic patients. As **Table 2** showed that the doses to caregivers/family members of the patients are within acceptable limits, which pointed out that the dose to the general public, will also be in the allowable limits and the patients treated with radioiodine do not contribute a significant radiation dose to the public.³⁵

TABLE 2: Different studies for dose to caregivers/family members of I-131 administered patients.

Study	Dose to caregivers/family members (mSv)
Grigsby <i>et al.</i> ¹⁴	0.01 to 1.09
Willegaignon <i>et al.</i> ¹⁷	< 1
Memon <i>et al.</i> ²⁶	0.0321 to 0.235
AlMaskery and Bererhi ²⁸	< 1
Rutar <i>et al.</i> ²⁹	0.17 to 4.09
Tonnonchiang <i>et al.</i> ³⁰	< 1
Marriott <i>et al.</i> ³¹	0.283
Sapienza MT <i>et al.</i> ³²	< 1
Reiners and Lasmann ³³	< 1
Cappelen <i>et al.</i> ³⁴	< 1

The studies done by Thompson MA ², Driver and Packer ¹⁵, IAEA ²¹, Pacilio *et al.* ²², Tavakoli ²³, Parthasarathy and Crawford ²⁴, Tuntawiroon *et al.* ²⁵, and Memon SA *et al.* ²⁶ reported that the most of activity cleared from patient in first 24 hours which confirmed that the public dose will not be significant due to short isolation period of patients in ward.

Due to deficiency in research on the current topic, the comparison is impossible but the studies ^{2, 15, 21-26} vigorously supported the result of the current study.

Conclusion

The current study indicates that the exposure rate in corridor is within acceptable limits and most of data for dose to non-radioactive patients in adjacent room is also within tolerable limits. As there is no previous data available due to lack of research on the current topic so authors suggest that more studies may be conducted on subject to compare the dose to the general public and for the authentication of current study.

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Conflict of interest

The authors declare that they have no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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