RADAR vs. TLD Effective doses to family members of hyperthyroid patients treated with radioiodine

Marina Zdraveska Kochovska, Olivija Vaskova, Venjamin Majstorov, Sonja Kuzmanovska, Biljana Crcareva.

Institute of pathophysiology and nuclear medicine "Akademik Isak S. Tadzer"
Medical Faculty,
University of "Ss Cyril and Methodius"
Skopje, Republic of Macedonia

INTRODUCTION

Many types of cancer and some other non malignant disease can be treated with radiations emitted by radionuclide's. The radionuclide's used for radiopharmaceutical therapy in nuclear medicine are usually relatively short lived beta emitters (e.g. 32P, 89Sr and 90Y) that pose much less risk.

Most of other radionuclide's also emit photons, which usually contribute minimally to the treatment dose, but produce an undesirable radiation field emanating from the patient.

The most frequently used radiopharmaceutical for the treatment of thyroid diseases, such as Thyroid Cancer and Hyperthyroidism is radioactive iodine 131.

INTRODUCTION

Patients undergoing therapeutic medical procedures using radioactive iodine 131 become a radiation source that may expose other individuals, therefore appropriate warrant precautions for limiting doses should be distributed to those individuals.

Individuals most likely to be exposed to a released patient are the patient's family members, or other person caring for or comforting the patient (caregiver), who will be in physical proximity of the patient in the initial days following release.

INTRODUCTION

Doses to other people from patients who have received radioiodine therapy are predominantly as a consequence of:

- External exposure

- Internal exposure as a result of contamination (radioactive urine, saliva, sweat, feces and exhalation)

- It is much less important than controlling external exposure

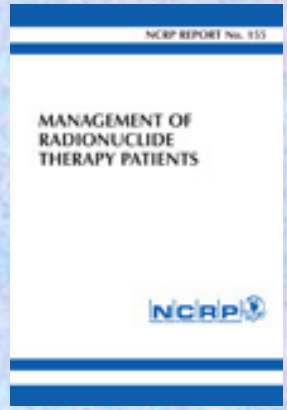
- General environmental pathways

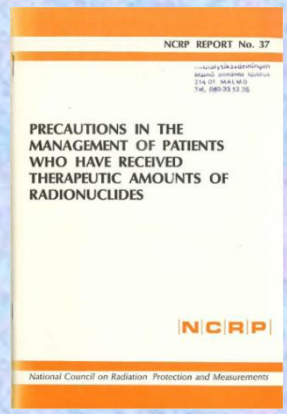
INTRODUCTION

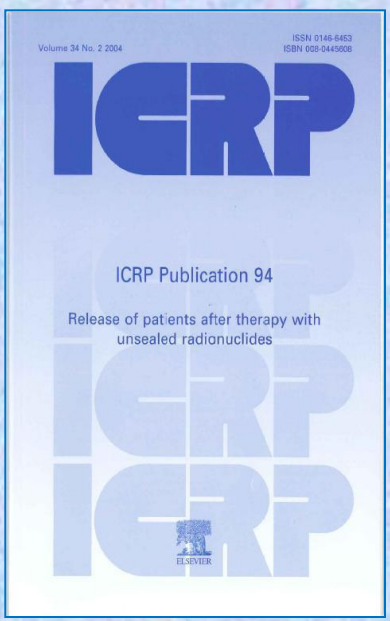
It is very important to avoid contamination of children and pregnant women due to the sensitivity of fetal and child thyroid glands.

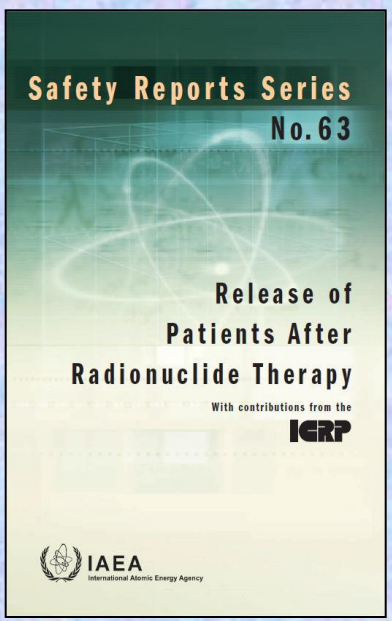
"Contamination of infants and young children with saliva from a treated patient during the first few days after radioiodine therapy could result in significant doses to the child's thyroid, and potentially raise the risk of subsequent radiation-induced thyroid cancer". (ICRP)

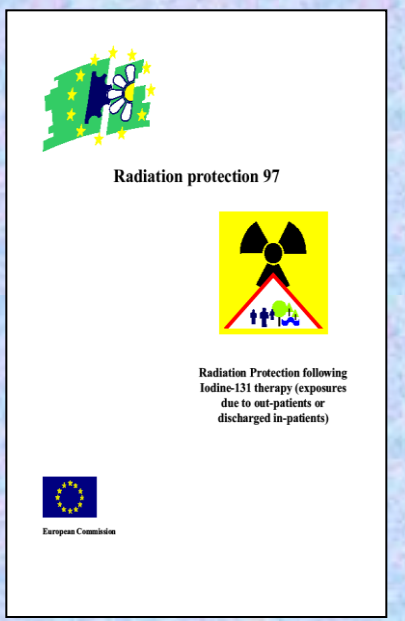
Release of patients after radionuclide therapy











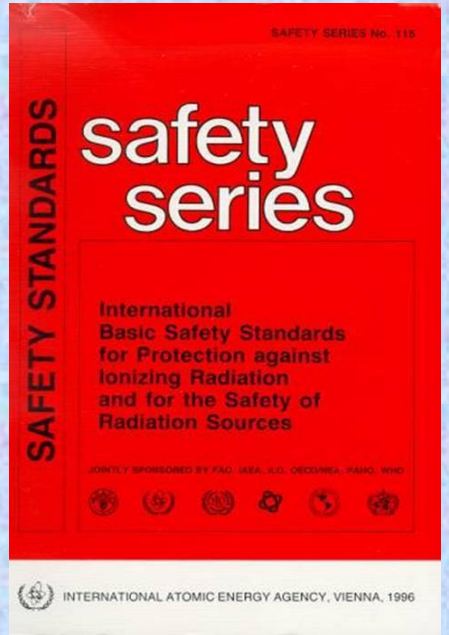
There are a number of European and NCRP publications for dose Constraints: public dose limit 1mSv/y, ICRP, 2004.

Country	Proposed Activity (MBq)
EU	400-600
Germany	75-250
Japan	500
Sweden	600
Australia	600
Finland	800
European thyroid association	800
BSS (IAEA)	1100
USA	No limit

EURATOM BSS 96/29 states that limits the effective dose to 1mSv/year does not apply for *"exposures of individuals, who are knowing and willingly helping other than as part of their Occupation, in the support and comfort of in-patients or outpatients undergoing medical treatment"*
European Union, 1996.

Group of persons	Dose constraint (mSv)
General public	0.3/episode
Children	1
Adults up to 60 years	3
Adults > 60 years	15

European Commission, 1998



IAEA

Atoms for Peace

International Atomic Energy Agency

To
National Liaison Officers of IAEA Member States

In reply please refer to: K9010241

2010-02-23

IAEA POSITION STATEMENT ON RELEASE OF PATIENTS AFTER RADIONUCLIDE THERAPY

The attached position statement was developed by a group of consultants who met at the International Atomic Energy Agency's (IAEA) Headquarters in Vienna, Austria, from 20-22 January 2010. The statements are consistent with the IAEA's Safety Reports Series (SRS) 63 entitled "*Release of Patients After Radionuclide Therapy*". This SRS harmonizes the International Commission on Radiological Protection (ICRP) publication 94 "*Release of Patients after Therapy with Unsealed Radionuclides*" and European Commission publication Radiation Protection 97 "*Radiation Protection following Iodine-131 Therapy (Exposures due to out-patients or discharged in-patients)*", and is also in line with the United States Nuclear Regulatory Commission guidelines of 1997 ("*Release of patients administered radioactive materials*", U.S. Nuclear Regulatory Commission, Regulatory Guide 8.39, April 1997). Thus, it tends to achieve global harmonization, and also leaves scope for individual adaptation by Member States. The approach currently in force in most Member States is different to what is specified here, hence the need to issue this policy statement.

Eliana Amaral
Director
Division of Radiation, Transport and Waste Safety

The latest document received from the IAEA from 2010 concerning this problematic state that the decision to hospitalize or release a patient should be determined on an individual basis.

The ICRP and IAEA have abandoned the use of metrics and now recommend that radiation protection be based upon the principles of justification and optimization as applied to each individual situation.

PURPOSE

The main purpose of this study was to estimate the radiation exposure to family members of patients treated with radioiodine 131 for Hyperthyroidism at Institute of pathophysiology and nuclear medicine.

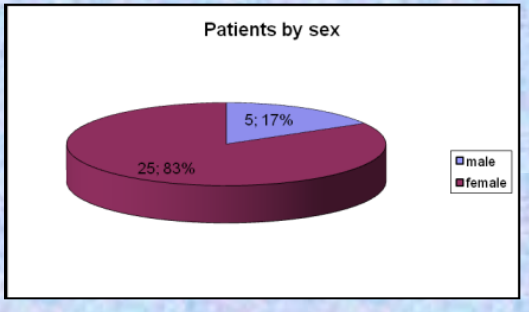
To compare the results estimated with TLD and calculated with RADAR software.

The other purpose was to use the results to identify necessary restrictions to ensure that the recommended dose constraint proposed by ICRP 94 and BSS of IAEA are met.

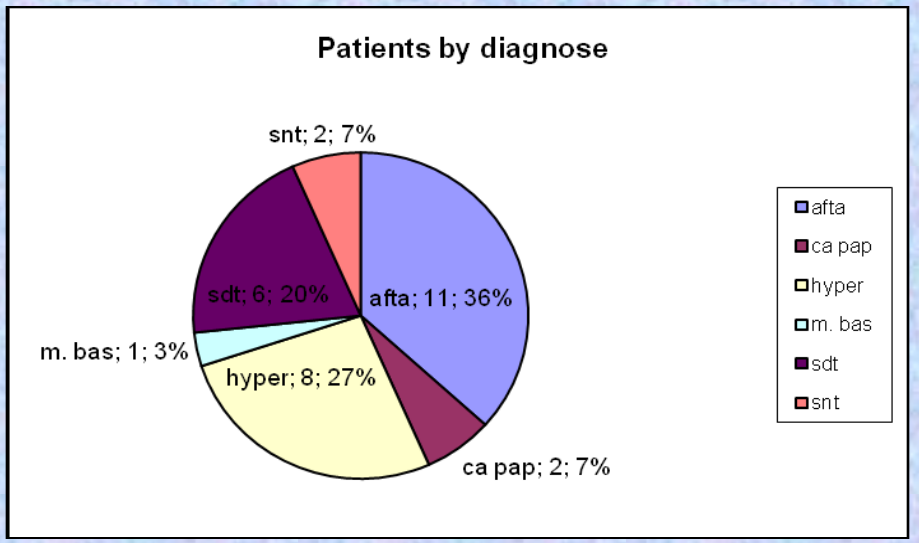
MATERIAL AND METHODS

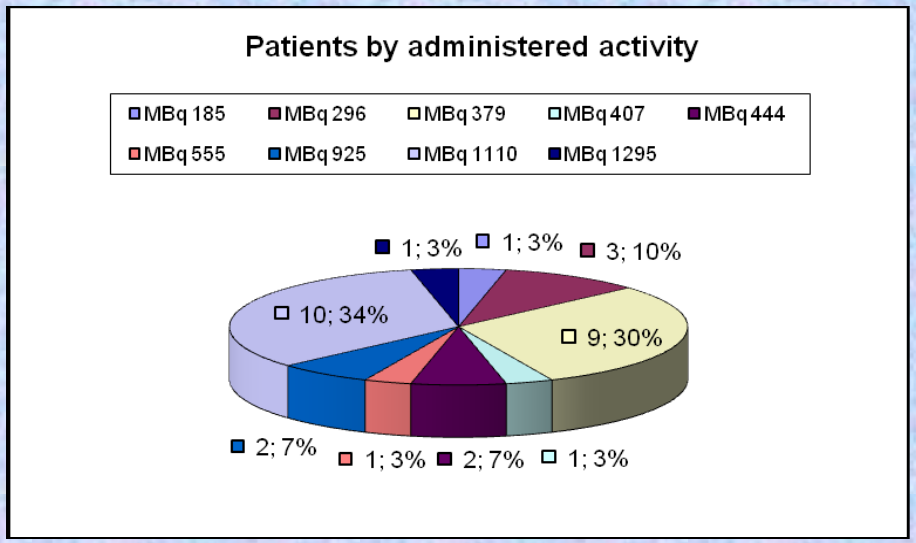
The study population comprised:

- 30 family members of 30 Hyperthyroid patients
- The administered dose ranged from 185 MBq to 1295 MBq (mean 683 MBq)
- The dose rate was measured at the distances of 0.5, 1.0, 1.5 and 2.0 m



Patients were released 15 min after administered dose and the level of dose rate at 2.0 m was ranged from 3 μSv/h to 20 μSv/h (mean 10 μSv/h)

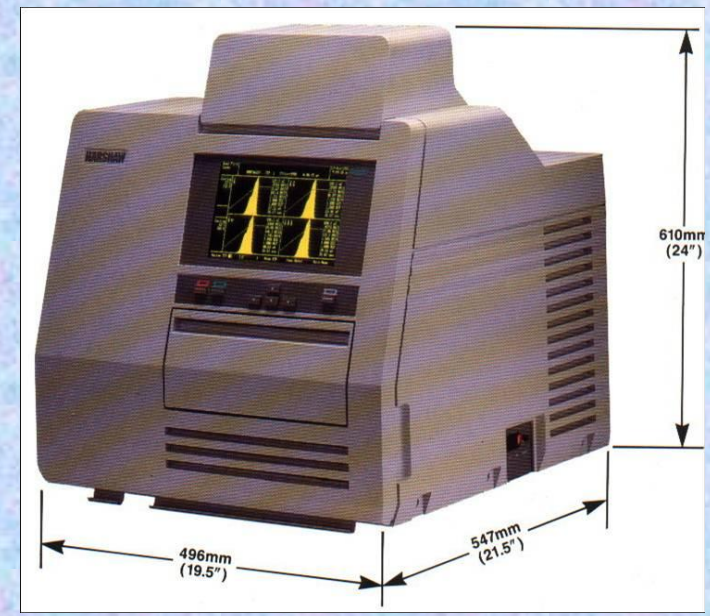




MATERIAL AND METHODS

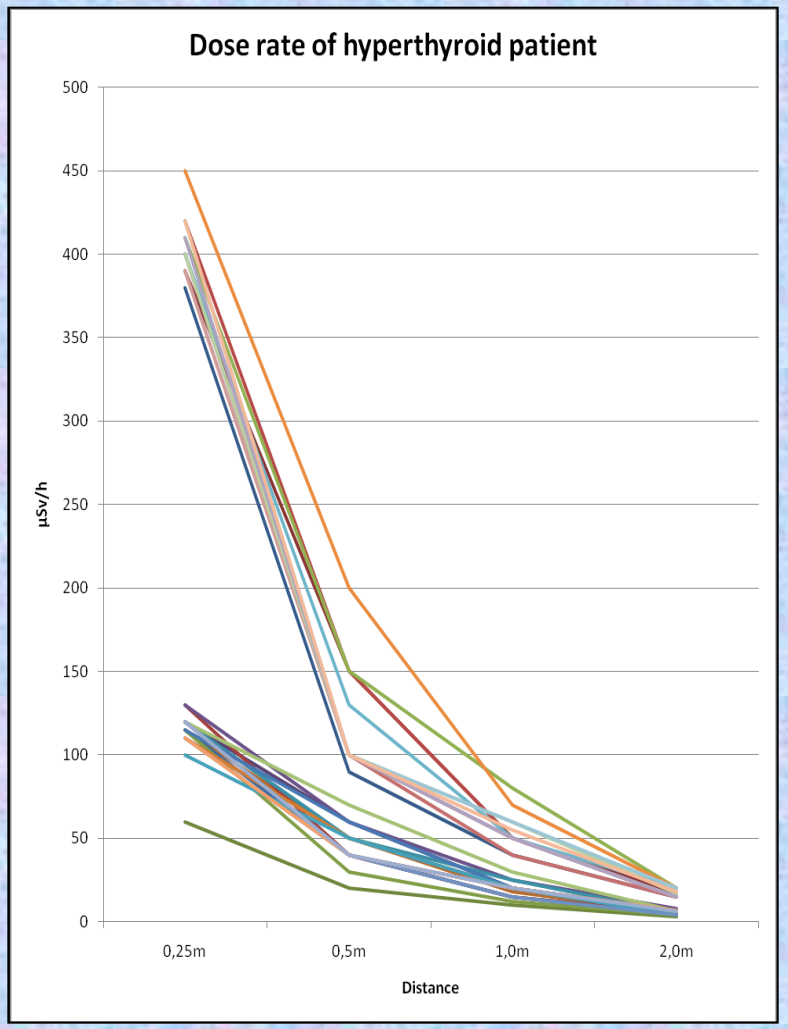
The dose rate measurements were performed with Survey meter “mini-rad” Series 1000 Morgan

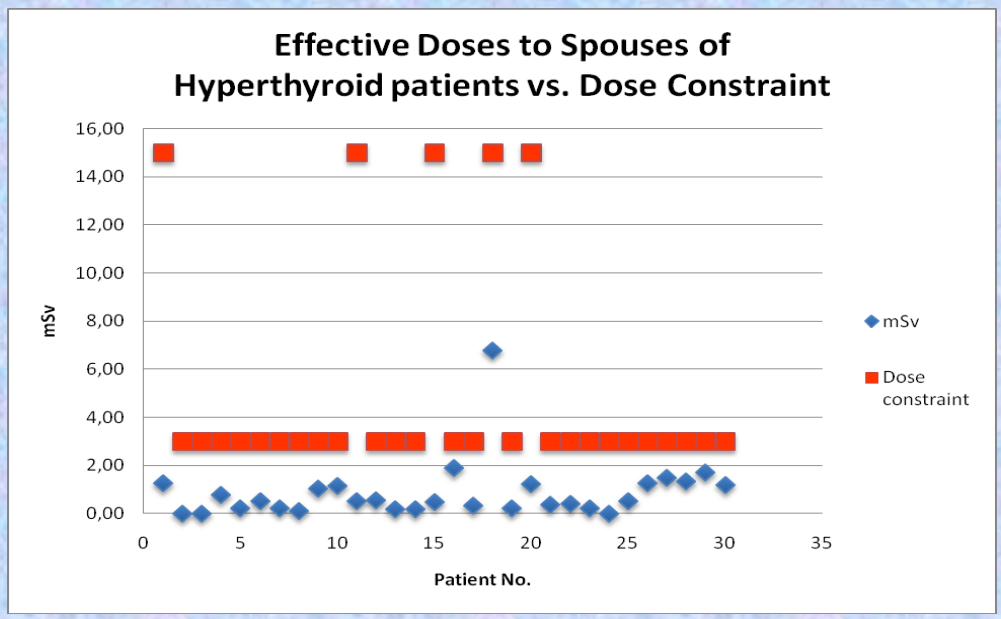
The effective dose measurements were carried out with TLD 100.
The detection threshold of the dosimetry system is 0,0054 mSv and combined standard uncertainty is less than 15 %.
Background readings were subtracted from the dose readings of the relatives.



RESULTS

The range varied (0,12 mSv to 6,79 mSv) the mean value was 0,87 mSv.





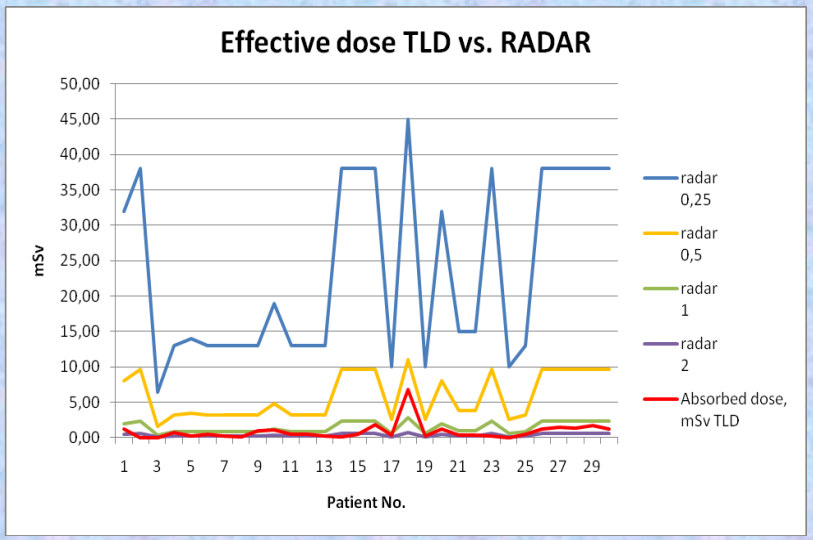
11 family members received dose greater than 1 mSv.

RADAR CALCULATED DOSES TO HYPERTHYROID PATIENTS

No	MBq	0.25 m		0.5 m		1.0 m		2.0 m	
		mSv	days	mSv	days	mSv	days	mSv	days
1	925	32	3885	8.0	971	2.0	243	0.50	61
2	1110	38	4613	9.60	1165	2.4	291	0.60	73
3	185	6.4	777	1.60	194	0.40	49	0.10	12
4	370	13.0	1578	3.20	388	0.80	97	0.20	24
5	407	14.0	1700	3.50	427	0.88	107	0.22	27
6	555	19.0	2307	4.80	582	1.20	146	0.30	36
7	296	10.0	1214	2.60	311	0.64	78	0.16	19
8	1295	45.0	5463	11.0	1334	2.80	340	0.70	85
9	444	15.0	1821	3.80	466	0.96	116	0.24	29
10	683	23,51	2855	5,9/716		1,48/179		0,37/45	

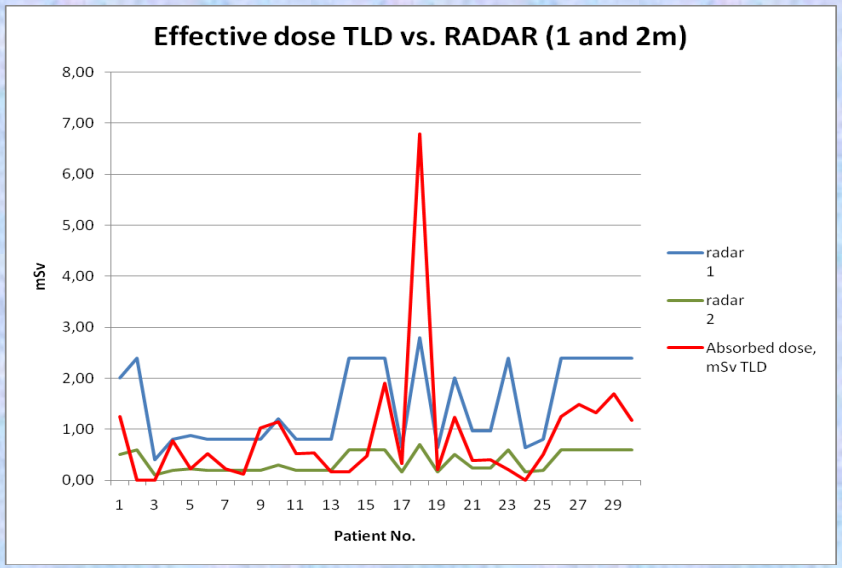
The table demonstrates the estimated total amount of radiation received to an individual at distances 0.25 m; 0.5 m; 1.0 m; and 2.0 m from the patient with given activity and number of days for the same amount of radiation should one received from natural background radiation according RADAR calculator.

COMPARISON BETWEEN RADAR and TLD



This chart demonstrates effective dose measured with TLD's compared with estimated doses with RADAR calculator. The calculated RADAR doses of family members overestimated the results several times in comparison with the TLD measured doses.

The TLD measured doses were close or similar with calculated RADAR doses for 1.0 m and 2.0 m



CONCLUSION

The effective doses of eleven family members of Hyperthyroid patients were higher than 1 mSv. One person received 6,79 mSv.

Hyperthyroid patients receiving radioactive iodine for therapy should continue to be treated on out-patient basis. After release they should get written information on their further behavior for next seven days. They should follow the advices with aim to reduce the doses to their close family members. The distance of two meters from the patients is safe in order proposed dose limits not to be reached.

RADAR is very useful software which can be easily implemented in daily routine practice in the field of radiation therapy. Even though the calculated doses were overestimated we found it as appropriate tool for fast estimation of dose to person who might come in close contact with hyperthyroid patients.

This study provided useful information on radiation protection and exposure to family members of hyperthyroid patients treated with radioiodine 131.

Thank you for the attention!

mzk2003@hotmail.com