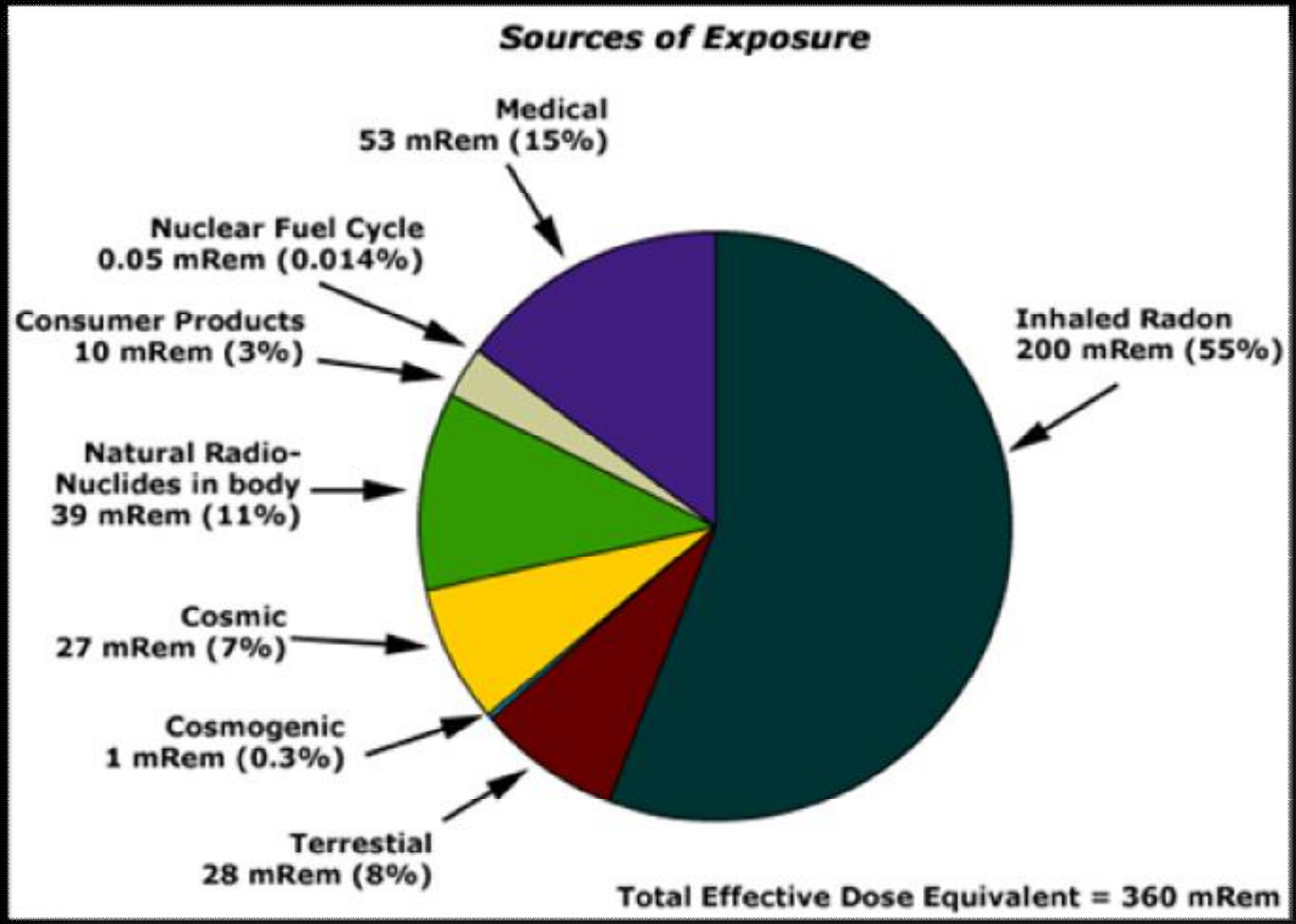
Radiation protection in Radionuclide therapy? How much is too much

Dr V Rangarajan
Professor &Head
Department of Nuclear Medicine & Molecular Imaging
Tata Memorial Centre Mumbai


Sources of Exposure
Medical
53 mRem (15%)
Nuclear Fuel Cycle
0.05 mRem (0.014%)
Consumer Products
10 mRem (3%)
Natural Radio-
Nuclides in body
39 mRem (11%)
Cosmic
27 mRem (7%)
Cosmogenic
1 mRem (0.3%)
Terrestial
28 mRem (8%)
Inhaled Radon
200 mRem (55%)
Total Effective Dose Equivalent = 360 mRem


ATOMKRAFT
NEIN DANKE


Jeder Tag ATOMKRAFT ist einer zu viel!
Jeder Tag ATOMKRAFT ist einer zu viel!
Germany says NO to nuclear power!
GREENPEACE

Translation Nuclear Medicine- to the bedside

JAPAN

- Long process
- Difficult process
- Severe restrictions in transport of isotope/RP
- Many cyclotrons/short lived Rps

KOREA

- Shorter process
- More supportive legislation and executive for molecular medicine/imaging

A L A R A

The objectives of radiation protection can be achieved by reducing all exposure to as low as reasonably achievable (ALARA) and by applying dose limits for controlling occupational and general public exposures.

For radiation protection purposes, it is assumed that *the risk of stochastic effects is strictly proportional to dose without threshold throughout the range of dose and dose rates of importance in radiation protection.*

Time

Minimize the amount off time during the exposure..

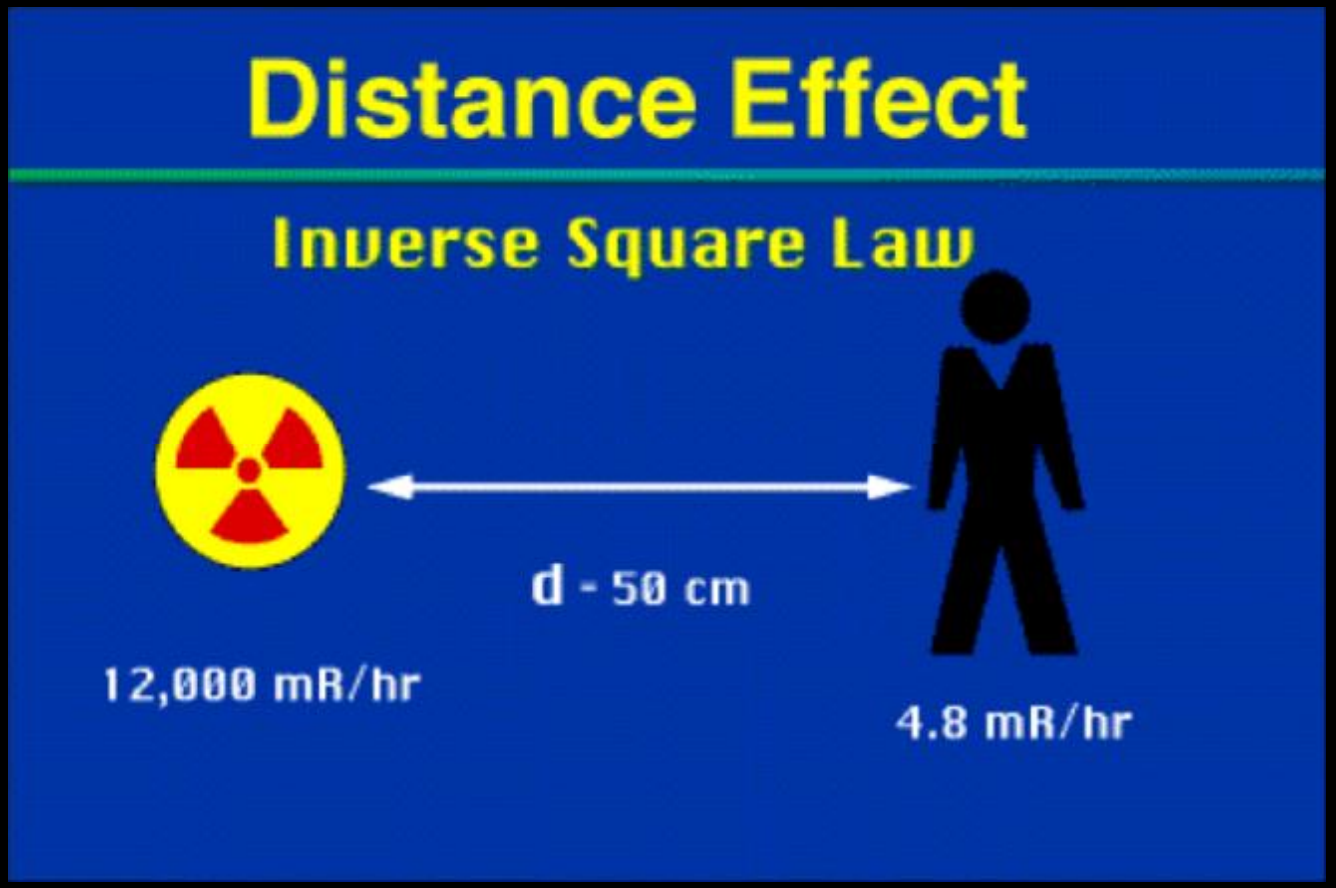
Distance

Maximize the distance from the radiation source..

Inverse-Square Law states that as you DOUBLE the distance from a radiation source,, you reduce the exposure levels by ONE-FOURTH (1/4)..

Shielding

Utilize shielding to avoid direct exposure to the radiation source..


Distance Effect
Inverse Square Law
d - 50 cm
12,000 mR/hr
4.8 mR/hr


02- 000
DECON KIT
CAUTION
RADIATION AREA
CAUTION
CAUTION

CONTROLLED AREA

"I.23. Registrants and licensees shall:

(a) delineate controlled areas by physical means or, where this is not reasonably practicable, by some other suitable means;

(c) display a warning symbol

(d) establish occupational protection and safety measures, including local rules and procedures that are appropriate for controlled areas;

(e) restrict access to controlled areas

CONTROLLED AREA

(f) provide, as appropriate, at entrances to controlled areas:

(i) protective clothing and equipment;

(ii) monitoring equipment; and

(iii) suitable storage for personal clothing;

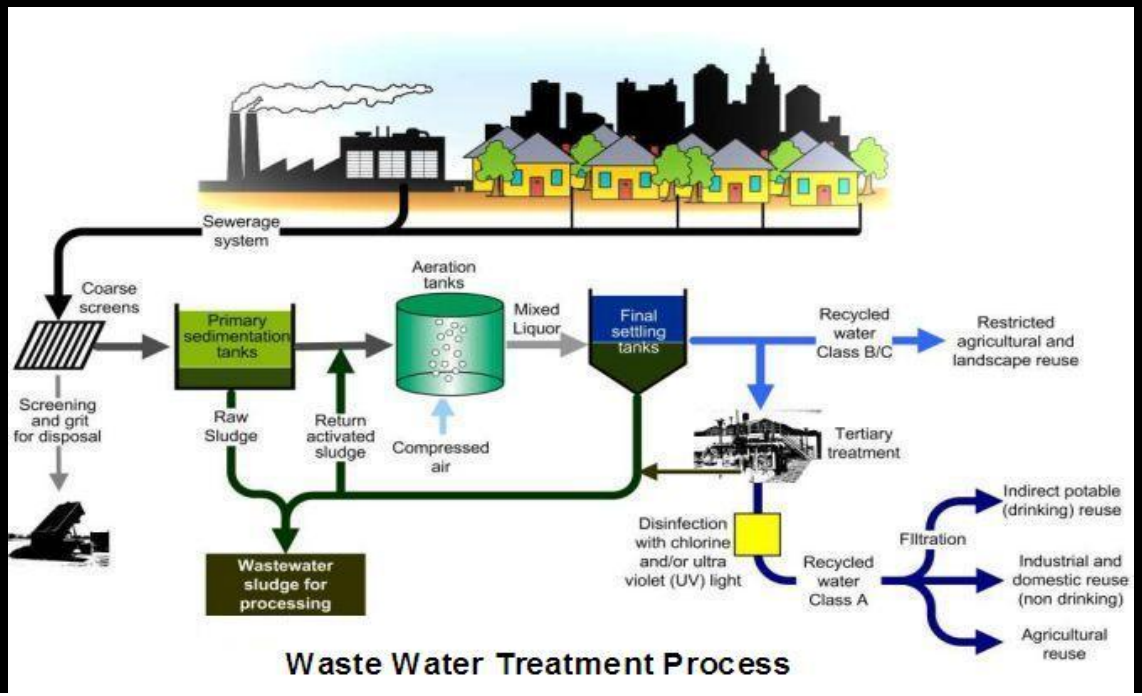
(i) equipment for monitoring for contamination of skin and clothing;

(ii) equipment for monitoring for contamination of any object or substance

(iii) washing or showering facilities

(iv) suitable storage

Waste Discharge



Waste Water Treatment Process


©vishnu kumar sharma


40

I-131 Therapy Discharge

It implies that in Germany, unlike US and other countries of EU, patient is reqd

to have less than 75MBq at discharge

Radionuclide	Retained activity (MBq)					
	USA	Germany [64]	Sweden [65]	Finland [71]	Japan [67]	Australia [45]
	NRC [47], NUREG-1556 [68]					
Phosphorus-32	[a]		1200			1200
Strontium-89	[a]				200	300
Yttrium-90	[a]		1200		1200	4000
Iodine-131	1200[b]	75	600	800	500	600
Samarium-153	26 000					4000

Country or organization	Release limit for I-131 (MBq)
BSS*	1100 (guidance level)
European Thyroid Association	800
Japan	500 or <30 μSv/h at 1 m
Germany	250 (based on 3.5 μSv/h at 1 m)
Other EU Member States	95–800, mostly 400–600

For patient with I-31 therapy and radioactive dosage above 30mci I-131, they should hospitalize in special rooms, and be controlled and follow up for their requirement and when their radiation decay at 1m distance of patients skin strike a balance, they could be discharge.

Segregation/Waste Containers

Containers to allow segregation of different types of radioactive waste should be available in areas where the waste is generated. The containers must be suitable for purpose (volume, shielding, leak proof, etc.)

- Glassware with radionuclides (short half-life)
- Syringes and needles
- Gloves and paper
- Glassware with radionuclides (medium half-life)

Storage of Radioactive Waste

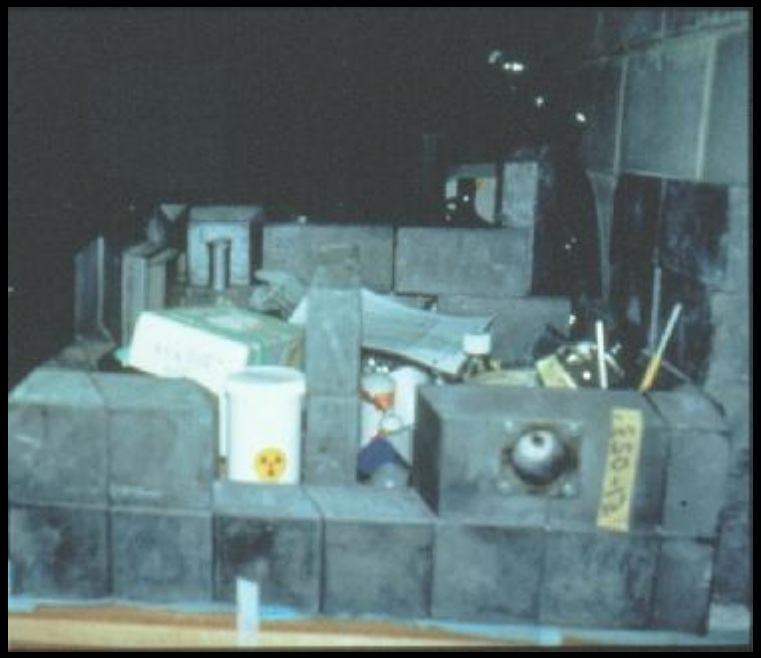
A room for interim storage of radioactive waste should be available. The room should be locked, properly marked and ventilated

Each type ners properly l radionucl oods should be

Records should be kept where the origin of the waste can identified.

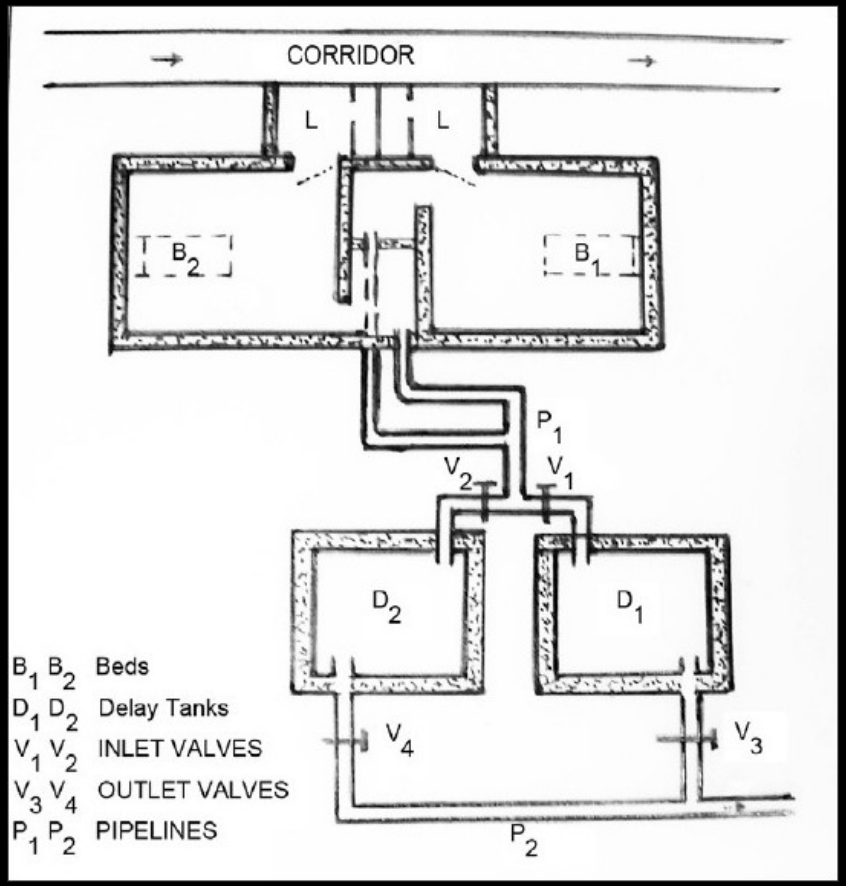
Storage of Radioactive Waste

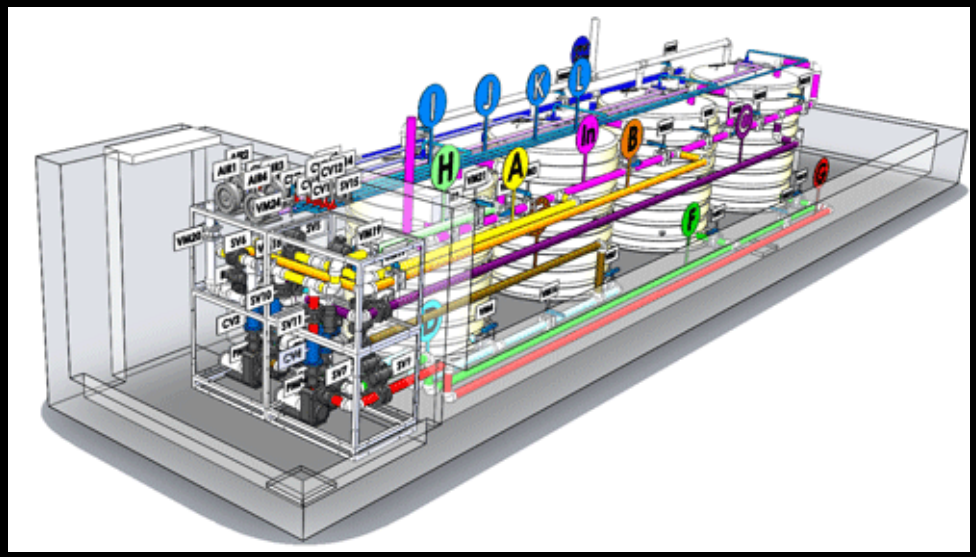
- Storage of Radioactive Waste



DELAY TANK


منطقة محظورة
Radiation Area


CORRIDOR
L
L
B2
B1
P1
V2
V1
D2
D1
V4
V3
P2
B1 B2 Beds
D1 D2 Delay Tanks
V1 V2 INLET VALVES
V3 V4 OUTLET VALVES
P1 P2 PIPELINES



EnviroRAD Retention Tank, Radioactive Decay Tanks

IAEA

Atoms for Peace

الوكالة الدولية للطاقة الذرية
国际原子能机构
International Atomic Energy Agency
Agence Internationale de l'énergie atomique
Международное агентство по атомной энергии
Organismo Internacional de Energía Atómica

Vienna International Centre, PO Box 100, 1400 Vienna, Austria
Phone: (+43 1) 2600 • Fax: (+43 1) 26007
Email: M.Rehani@iaea.org • Internet: http://www.iaea.org

2010-02-23

To
National Liaison Officers of IAEA Member States

In reply please refer to: K9010241
Dial directly to extension: (+431) 2600-21416

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

Ann Nucl Med (2014) 28:531–539
DOI 10.1007/s12149-014-0843-8

ORIGINAL ARTICLE

Radiation safety of outpatient ^{177}Lu-octreotate radiopeptide therapy of neuroendocrine tumors

Phillipe J. Calais · J. Harvey Turner

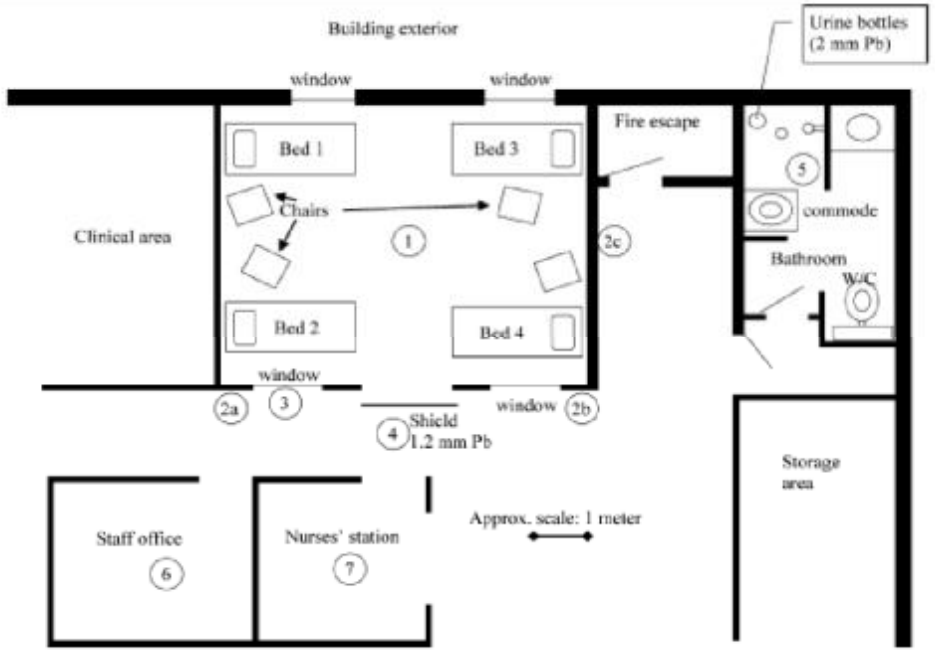
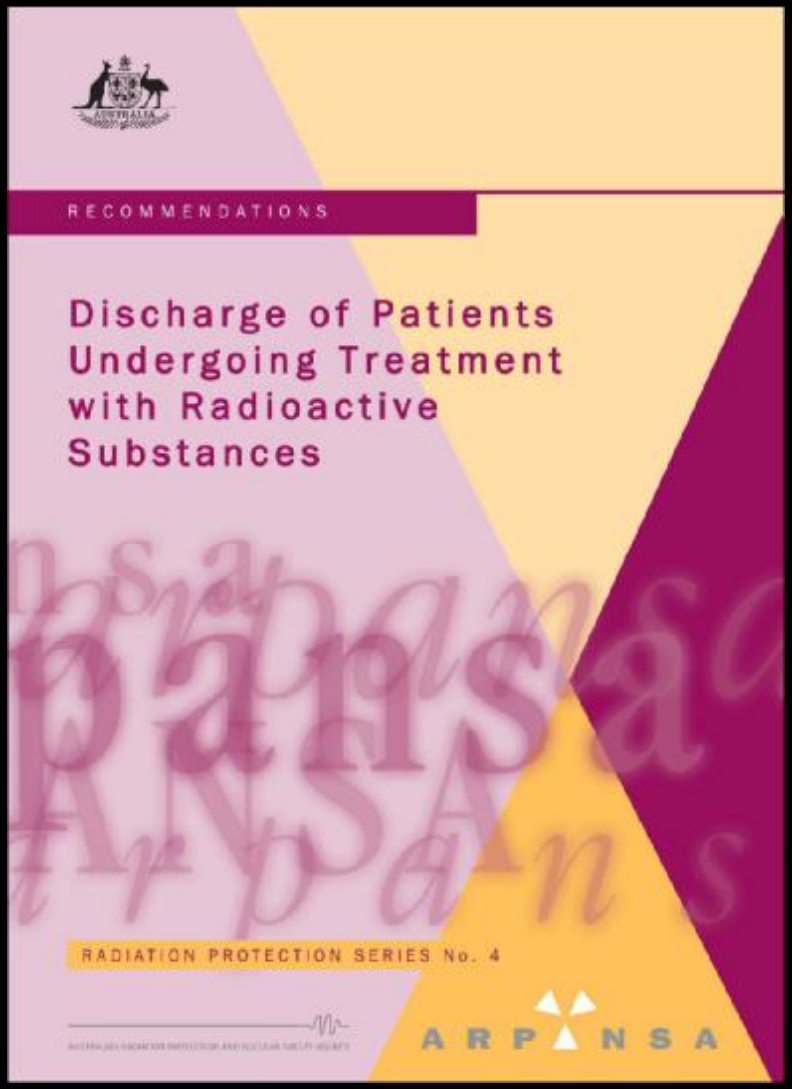
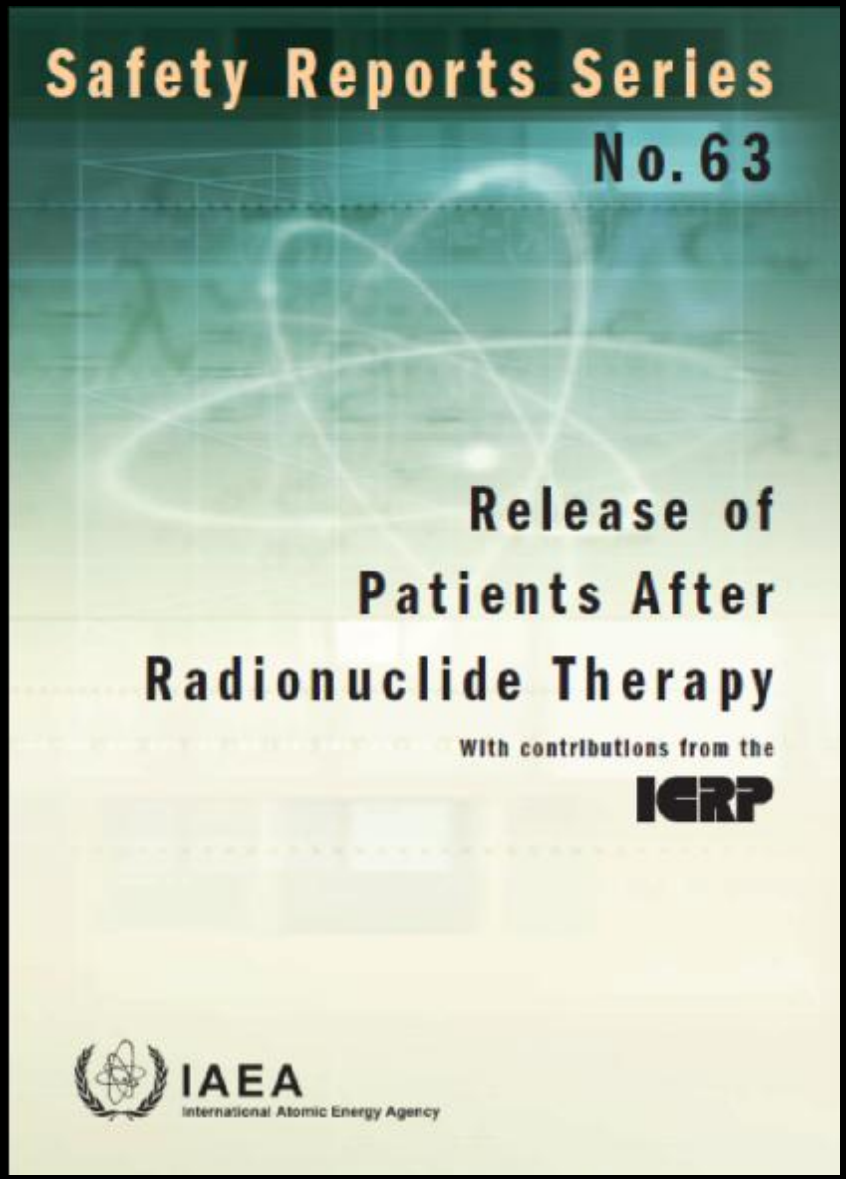


Fig. 1 The layout of the therapy rooms and immediate vicinity, with exposure rate measurement points indicated by *numbers 1–7*

Conclusion

Efficacious ^{177}Lu-peptide therapy of neuroendocrine tumors may be performed safely on an outpatient basis with quality-of-life, cost and logistic advantages. It offers affordable, practical and readily available radiopeptide therapy for potential adoption into mainstream clinical oncology practice throughout the world. The advent of multi-modality therapy of NETs with radiopeptide therapy, chemotherapy and biological therapy has the potential to improve patient outcomes by circumventing problematic radiation isolation ward bed availability by provision of outpatient therapy.


RECOMMENDATIONS
Discharge of Patients Undergoing Treatment with Radioactive Substances
RADIATION PROTECTION SERIES No. 4
ARPANSA


Safety Reports Series
No. 63
Release of Patients After Radionuclide Therapy
With contributions from the
ICRP
IAEA
International Atomic Energy Agency

Memorial Sloan Kettering Cancer Center

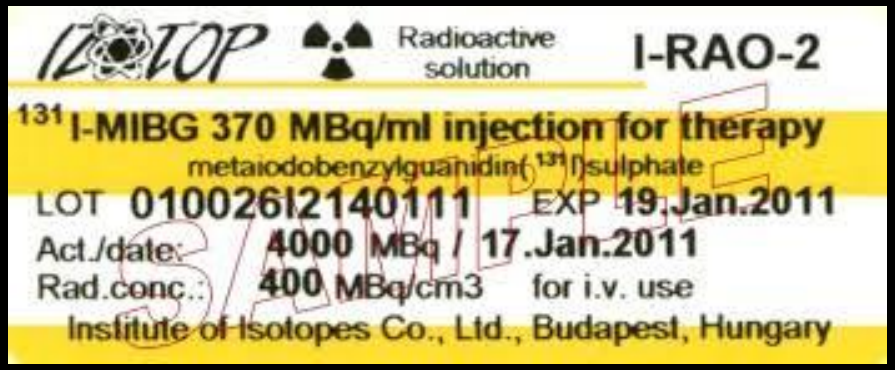
Radioactive Iodine Therapy for Thyroid Cancer: Outpatient Treatment

This information explains radioactive iodine therapy to treat thyroid cancer in the outpatient setting.

Arrange your transportation

Radioactive iodine gives off radiation. After your treatment, you cannot go home using public transportation such as buses, the subway, trains, or plane. You can drive yourself home, have someone pick you up and take you home, or take a taxi or private car home. Please make your arrangements before you come for your treatment.

Case study- 131I MIBG therapy


IZOTOP
Radioactive solution
I-RAO-2
131 I-MIBG 370 MBq/ml injection for therapy
metaiodobenzylguanidin(131I)sulphate
LOT 010026I2140111
EXP 19.Jan.2011
Act./date: 4000 MBq / 17.Jan.2011
Rad.conc.: 400 MBq/cm3 for i.v. use
Institute of Isotopes Co., Ltd., Budapest, Hungary
SAMPLE


08/08/2008 16:42:11


200
A
ALARIS


INSTRUCTIONS TO STAFF
RADIATION
AREA

Health consequences of Chernobyl accident

- 1800 children diagnosed with thyroid cancer (1998)

12 major pollutants carcinogenic

Radioactivity is the only one readily detectable

Are we over regulated?

- How do we perceive radiation?
- What is the overall quality of environment?
- ALARA implementation must be REALISTIC!
- Is Delay decay better than dilute and disperse?
- Is the RSO really empowered?
- Does not the patient, also be made responsible for his action?
- Is Nuclear medicine a soft target?

Are we over regulated?

- Largely we are rightly regulated.
- In some places/countries definitely we are overregulated
- In many places we are under regulated.