Patient discharge, travel advice, precautions at home

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17th Panhellenic & 12th Balkan Congress of Nuclear Medicine

DISCLOSURES

I do not have any conflict of interest

DISCHARGE OF A RADIONUCLIDE THERAPY PATIENT

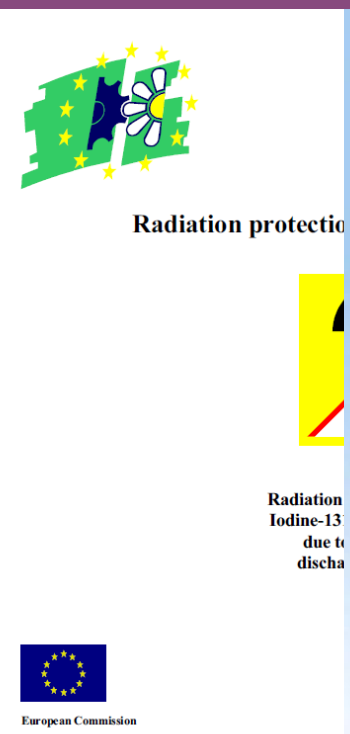
- Special precautions for the public are rarely required after diagnostic NM procedures and usually involve special groups (e.g. children, pregnant women).
- However, some therapeutic NM procedures may result in significant exposures to other people, especially those involved in the care and support of patients.
- Decision to hospitalize or release a patient should be taken on an individual basis (ICRP).

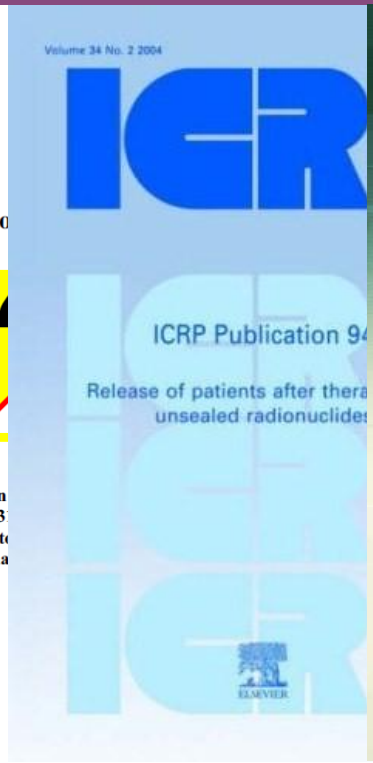
DISCHARGE OF A RADIONUCLIDE THERAPY PATIENT

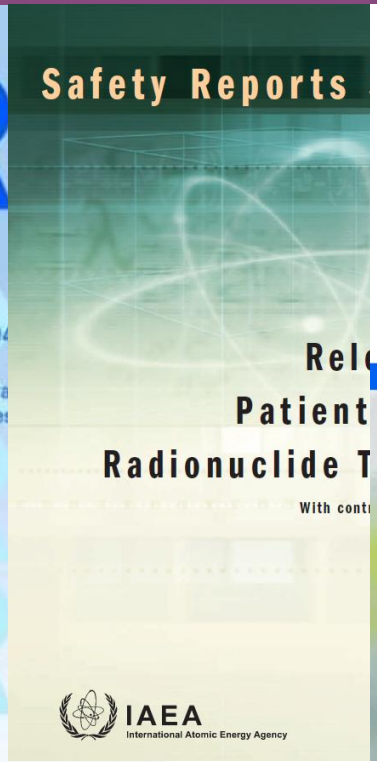
Decision to discharge is based upon:

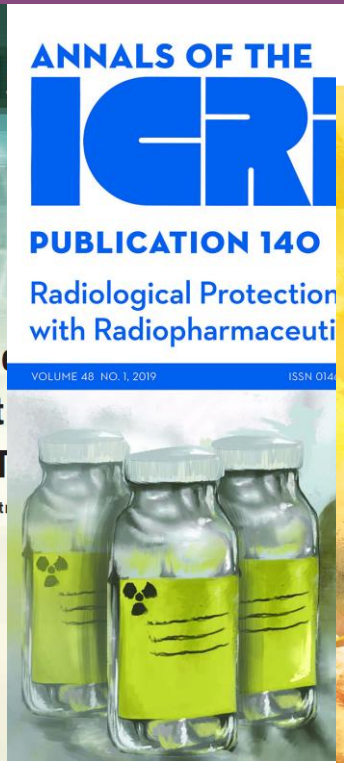
- Patient's medical needs
- Radiopharmaceutical administered (emitted radiations, physical and effective half-life)
- Residual radiopharmaceutical activity in patient
- Patient status (ability to isolate himself and self-care)
- Family members at home (especially children or pregnant women)
- Compliance with applicable Dose Limits and Dose Constraints
- Patient cooperation to follow radiation protection instructions

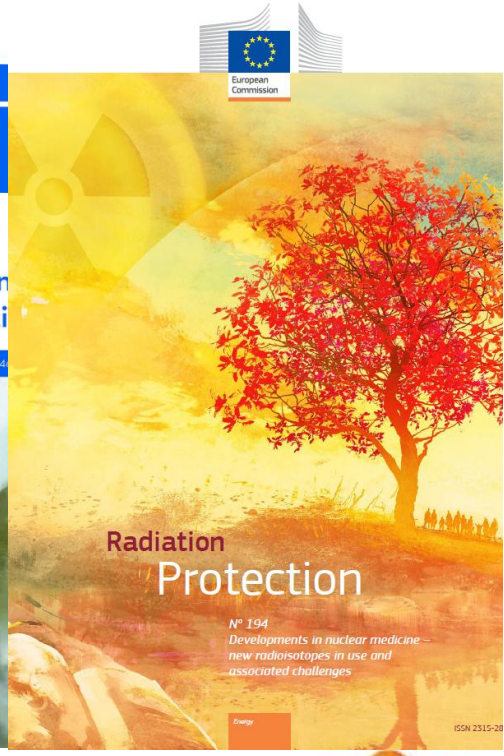
DISCHARGE OF A RADIONUCLIDE THERAPY PATIENT











17th Panhellenic & 12th Balkan Congress of Nuclear Medicine

DISCHARGE OF A RADIONUCLIDE THERAPY PATIENT

ANNALS OF THE ICRP

PUBLICATION 140

Radiological Protection in Therapy with Radiopharmaceuticals

2019

- The decision to hospitalise or release a patient after therapy should be made based on existing guidance and regulations, as well as on the individual patient's situation, considering factors such as the residual activity in the patient, the patient's wishes, and family considerations (particularly the presence of children or pregnant family members). Information to guide radiological protection at home should be provided to patients and carers.

EXPOSED GROUPS AFTER PATIENT RELEASE

- Family members, willingly and voluntarily providing support to the patient (carers/comforters)
- Other family members, including children
- Neighbors, visitors to the household
- Co-workers
- Co-travelers using public transport
- People encountered at public events, such as entertainments
- General public

INTERNAL EXPOSURE DUE TO CONTAMINATION

- For pure beta emitting radionuclides (Y-90, Sr-89) radioactive contamination from patient's excreta is practically the single pathway of possible exposure to other people.

- External exposure due to bremsstrahlung radiation usually poses no significant risk to other people, provided that simple precautions are followed.

INTERNAL EXPOSURE DUE TO CONTAMINATION

Written instructions for the patient:

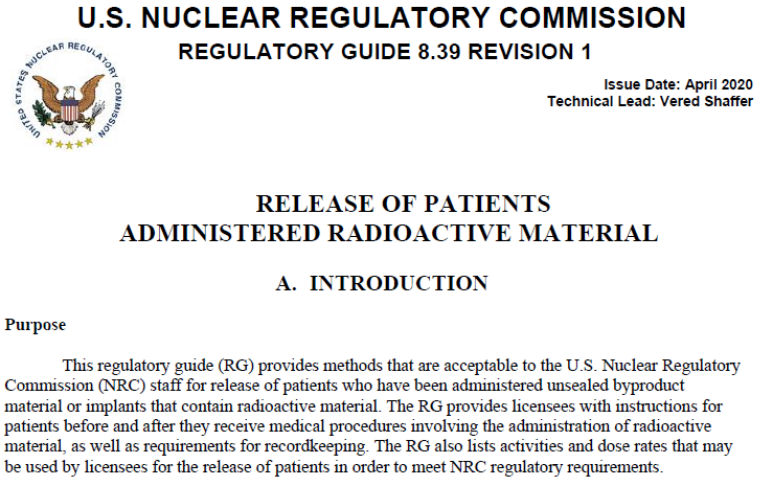
- Urinate in a seated position (men also). Flush toilet paper down the toilet and flush toilet twice. Wash hands thoroughly.
- Take a shower and wash your hair every day.
- Do not share cutlery during meals.

Written instructions for family, carers/comforters:

- Use gloves when handling items contaminated with patient's excreta.
- Wash patient's underwear, pajamas, sheets separately.

EXTERNAL EXPOSURE

- For radionuclides with significant photon emissions



U.S. NUCLEAR REGULATORY COMMISSION

REGULATORY GUIDE 8.39 REVISION 1

Issue Date: April 2020
Technical Lead: Vered Shaffer

RELEASE OF PATIENTS
ADMINISTERED RADIOACTIVE MATERIAL

A. INTRODUCTION

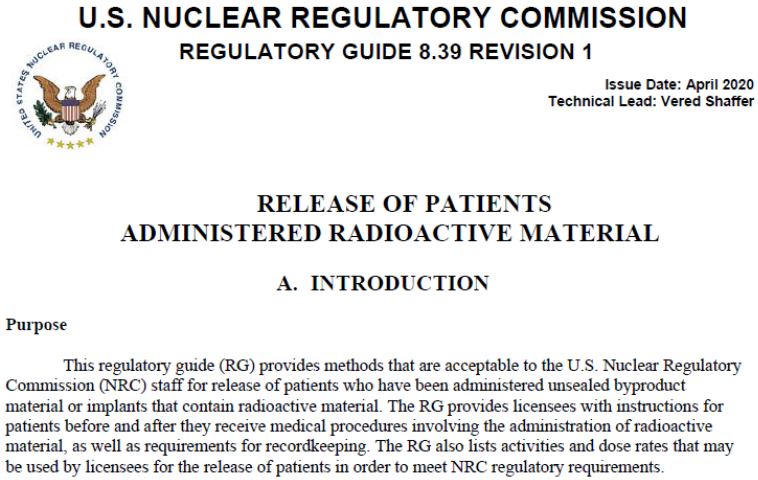
Purpose

This regulatory guide (RG) provides methods that are acceptable to the U.S. Nuclear Regulatory Commission (NRC) staff for release of patients who have been administered unsealed byproduct material or implants that contain radioactive material. The RG provides licensees with instructions for patients before and after they receive medical procedures involving the administration of radioactive material, as well as requirements for recordkeeping. The RG also lists activities and dose rates that may be used by licensees for the release of patients in order to meet NRC regulatory requirements.

$$D(\mathrm{t}) = \frac{1.44\Gamma Q_0 T_p \left(1 - e^{\frac{-(ln2)t}{T_p}}\right)}{r^2}$$

- Γ the radionuclide dose rate constant (μSv.m^2/MBq.h)
- Q_0 the administered activity (MBq)
- T_p the radionuclide physical half-life (h)
- r is the person's distance from the patient (m)
- t is the time the person spends at distance r from the patient (h)

EXTERNAL EXPOSURE



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If t is taken until total decay:

$$D(\infty) = \frac{1.44 \Gamma Q_0 T_p E}{r^2}$$

- Γ the radionuclide dose rate constant (μSv.m^2/MBq.h)
- Q_0 the administered activity (MBq)
- T_p the radionuclide physical half-life (h)
- r is the person's distance from the patient (m)
- E is an occupancy factor (fraction of time the person remains at distance r)

ASSUMPTIONS USED IN THE ESTIMATION

$$D(\mathrm{t}) = \frac{1.44\Gamma Q_0 T_p \left(1 - e^{\frac{-(ln2)t}{T_p}}\right)}{r^2} \qquad D(\infty) = \frac{1.44\Gamma Q_0 T_p E}{r^2}$$

- Activity in patient behaves as an unattenuated point source
- Inverse square law with distance is used
- Activity at the time of release equal to administered activity
- No biological elimination of radiopharmaceutical
- Conservative assumptions on the occupancy factor

ESTIMATE DOSE FROM EXTERNAL EXPOSURE

$$D(\mathrm{t}) = \frac{1.44\Gamma Q_0 T_p \left(1 - e^{\frac{-(ln2)t}{T_p}}\right)}{r^2} \qquad D(\infty) = \frac{1.44\Gamma Q_0 T_p E}{r^2}$$

Modifications, in order to avoid overestimations:

- Use the remaining activity in patient (Q_{rem}) instead of Q_0
- Use the measured dose rate at 1 m from the patient ($\dot{D}$) instead of ΓQ_0
- Use the effective half-life (T_{eff}) instead of T_p
- Use a personalized occupancy factor, E, adjusted to each patient's status

PROPOSED DOSE CONSTRAINTS

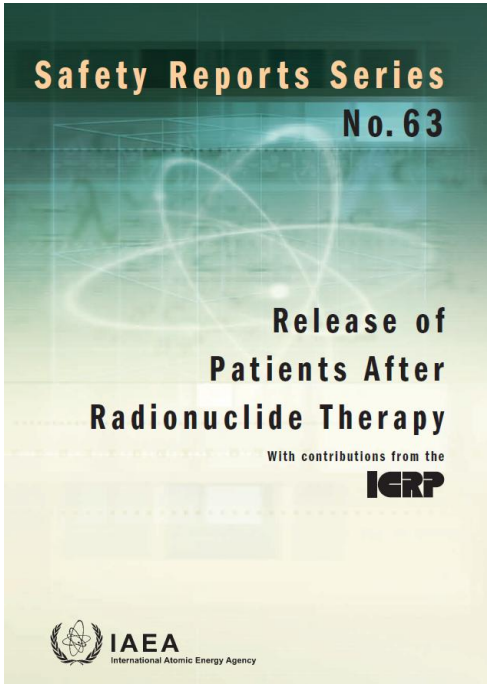


TABLE 5. DOSE CONSTRAINTS PER EPISODE FOR DIFFERENT CATEGORIES
(adapted from ICRP 94 [2] and based on a rationale developed in the EU [10])

Type of person/caregiver	Reason for dose constraint (e.g. risks or habits)	Dose constraint (mSv)
Third person (not carer)	A fraction of the dose limit for the public	0.3/episode
Family and close friends:		
Pregnant women	Protection of the unborn child	1/a
Children up to two years old	Close physical contact with parents	1/a
Children between three and ten years old	Same risk as that for unborn child	1/episode
Children older than ten and adults up to 60 years old (average population)	Two to three times lower risk than that for younger children. Certain recommendations for partners not to be applied when comforting very ill hospitalized patients	3/episode
Adults older than 60 years	Three to ten times lower risk than that for the average population	15/episode

DISCHARGE OF A RADIONUCLIDE THERAPY PATIENT

There is a lack of harmonization among European countries about:

- Dose Constraints for public and medical exposure
- Patient discharge criteria
- Instructions and precautions (and their duration) after patient discharge

https://op.europa.eu/en/publication-detail/-/publication/f351ae09-1a69-11f0-b1a3-01aa75ed71a1

DOSE CONSTRAINTS IN EUROPEAN COUNTRIES

Table I.1: Examples of the use of dose constraints in some European countries

Country	General Public	Comforters/Carers
Germany	No specific constraint	No specific constraint
Norway [I.3]	0.25 mSv per treatment cycle	Children <18 y: 1 mSv per treatment cycle Adults >18 y and <60 y: 3 mSv per treatment cycle Adults >60 y: 15 mSv per treatment cycle
Spain [I.4]	0.3 mSv/y	Pregnant women: 1 mSv/y Children <2 y: 1 mSv/y Children between 3 and 10 y: 1 mSv per treatment cycle Children >10 y and adults: 3 mSv per treatment cycle Adults >60 y: 15 mSv per treatment cycle
UK [I.5]	0.3 mSv per procedure	5 mSv per procedure
Italy (Lombardy)	0.3 mSv per treatment cycle	<60y: 3 mSv per treatment cycle >60y: 15 mSv per treatment cycle
Belgium [I.6]	No specific constraint	No specific constraints
Netherlands	1 mSv/y [I.7]	Children <10 y: 1 mSv per treatment cycle Children >10 y and adults: 3 mSv per treatment cycle Adults >60 y: 15 mSv per treatment cycle [I.8]
Sweden	0.1 mSv per treatment cycle	Children <18 y: 1 mSv per treatment cycle Adults >18 y and <70 y: 3 mSv per treatment cycle Adults >70 y: 15 mSv per treatment cycle

https://op.europa.eu/en/publication-detail/-/publication/f351ae09-1a69-11f0-b1a3-01aa75ed71a1

RELEASE CRITERIA IN EUROPEAN COUNTRIES

Table I.2: Examples of release criteria in some European countries

Country	Benign ^{131}I Therapy 500 Mbq	^{177}Lu-DOTATATE	^{177}Lu-PSMA	^{223}Ra
Germany [I.9]	48 h and (<3.5 μSv/h @ 2 m or A <250 MBq)	48h	48h	None
Norway	<20 μSv/h @1 m	None	None	None
Spain	A<800 MBq	<20 μSv/h @ 1 m	<20 μSv/h @ 1 m	None
UK	None	24 h	<25 uSv/h @ 1 m	None
Italy (Lombardy)	<30 μSv/h @1 m	<30 μSv/h @1 m	<30 μSv/h @ 1 m	None
Belgium	<20 μSv/h @1 m [I.10]	24 h and <20 μSv/h @1 m [1.11]	24 h and <20 μSv/h @1 m	None
Netherlands [I.12]	<20 μSv/h @1 m	<20 μSv/h @1 m	6 h	None

https://op.europa.eu/en/publication-detail/-/publication/f351ae09-1a69-11f0-b1a3-01aa75ed71a1

GUIDELINES FOR I-131 THERAPY PATIENTS

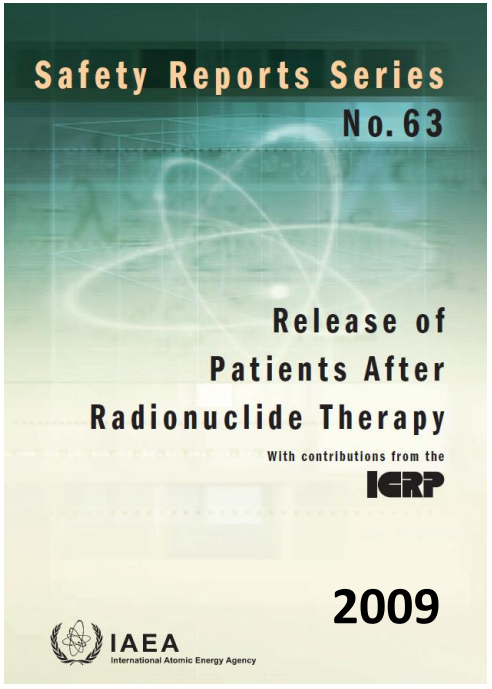


TABLE 6. SUGGESTED GUIDELINES FOR RADIOIODINE PATIENTS TO RESTRICT DOSE TO 1 mSv IN CO-WORKERS AND FAMILY
(adapted from ICRP 1994 [2], O'Doherty et al. [30] and Barrington et al. [32, 33])

Activity (MBq)	Patient type	Time off work (d)	Time to sleep apart and restrict contact with partner (d)[a]	Time to restrict contact with child <2 years of age (d)	Time to restrict contact with child 2–5 years of age (d)	Time to restrict contact with child 5–11 years of age (d)
200	Hyperthyroid	0	15	15	11	5
400	Hyperthyroid	3	20	21	16	11
600	Hyperthyroid	6	24	24	20	14
800	Hyperthyroid	8	26	27	22	16
1850	Cancer	1, 3[b]	3, 16[b]	4, 16[b]	3, 13[b]	2, 10[b]
3700	Cancer	2, 7	4, 20	4, 20	4, 17	3, 13
5550	Cancer	2, 10	4, 22	5, 22	4, 19	3, 16
7400	Cancer	2, 12	5, 23	5, 24	4, 21	4, 17

[a] Assumes sleeping 1.0 m apart for eight hours.
[b] The first value is for cancer follow-up patients; the second is for ablation patients.

Lu-177-DOTATATE

Levart *et al. EJNMMI Physics* (2019) 6:7
https://doi.org/10.1186/s40658-019-0243-1

ORIGINAL RESEARCH Open Access

Radiation precautions for inpatient and outpatient ^{177}Lu-DOTATATE peptide receptor radionuclide therapy of neuroendocrine tumours

D. Levart*, E. Kalogianni, B. Corcoran, N. Mulholland and G. Vivian

Table 1 Mean (SD) [range] administered activity, length of stay in hospital, percentage ^{177}Lu and activity retention at discharge for outpatient and inpatient administrations

	Number of administrations	Number of patients	Administered activity (MBq)	Time T_0–T_D (h)	^{177}Lu retention (%)	Retained activity (MBq)
Inpatients ^{177}Lu-DOTATATE Mallinckrodt	32	16	7079 (419) [5925–7890]	18.1 (1.5) [16.2–21.2]	36 (15) [15–62]	2537 (1079) [1087–4482]
Inpatients Lutathera® AAA	24	18	7545 (204) [7076–7913]	18.2 (1.1) [16.7–21.0]	24 (7) [13–37]	1806 (494) [984–2740]
Outpatients Lutathera® AAA	20	15	7608 (242) [7259–8038]	5.2 (0.7) [3.6–6.3]	38 (8) [28–58]	2897 (663) [2103–4670]

- Patient discharge: 5-6 h p.a.
- Mean retained activity: 3 GBq
- 5-25 μSv/h (mean 15 μSv/h) @ 1m

Lu-177-DOTATATE

Levart *et al. EJNMMI Physics* (2019) 6:7
https://doi.org/10.1186/s40658-019-0243-1

ORIGINAL RESEARCH Open A

Radiation precautions for inpatient and outpatient ^{177}Lu-DOTATATE peptide receptor radionuclide therapy of neuroendocrine tumours

D. Levart*, E. Kalogianni, B. Corcoran, N. Mulholland and G. Vivian

Table 5 Mean (upper 95th percentile) [range] restriction durations for inpatient and outpatient ^{177}Lu-DOTATATE administrations to limit dose for close relatives to 1 mSv per cycle and 0.3 mSv per year for members of the public

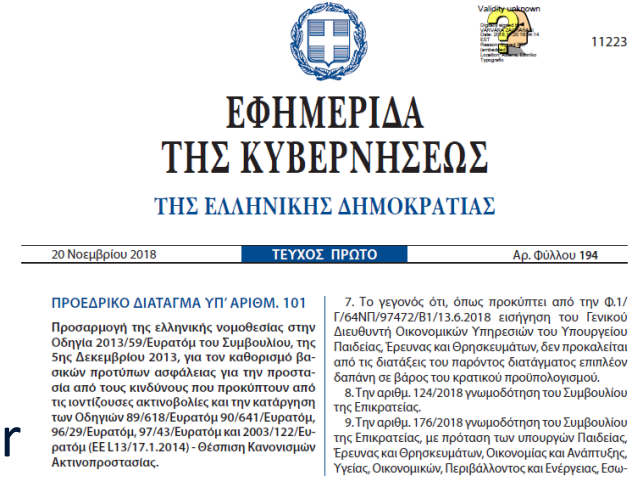
Restriction	Inpatient therapy period (days)	Outpatient therapy period (days)
Restrict day contact < 1 m and sleep apart from partner	8 (15) [3–15]	9 (16) [4–16]
Restrict contact < 1 m with < 2 year old child	9 (16) [4–16]	9 (17) [5–17]
Restrict contact < 1 m with child aged 2–5 years	5 (13) [1–13]	6 (13) [1–13]
Restrict contact < 1 m with child aged 5–11 years	3 (9) [0–9]	3 (10) [1–10]
Remain off work	1 (5) [0–5]	1 (6) [0–6]

Table 6 Mean (lower 5% percentile) [range] number of hours (rounded to the nearest hour) travel allowed on public transport at 0–9 days post-therapy to limit dose for members of the public to 0.3 mSv per year

No. of days post-therapy	0	1	2	3	4	5	6	7	8	9
Inpatients	–	3 (1) [1–6]	4 (1) [1–8]	5 (1) [1–11]	6 (1) [1–13]	8 (1) [1–16]	10 (2) [2–21]	13 (2) [2–28]	16 (2) [2–39]	21 (3) [3–55]
Outpatients	2 (1) [1–5]	3 (1) [1–7]	4 (1) [1–9]	5 (1) [1–11]	6 (1) [1–14]	8 (1) [1–17]	11 (2) [2–23]	14 (2) [2–31]	18 (3) [3–43]	24 (3) [3–63]

DOSE CONSTRAINTS USED IN GREECE

- Members of the public: 0.3 mSv per year
- Persons voluntarily taking care of patient (carers/comforters):
  - ✓ 5 mSv per patient
- Family members, close relatives, friends:
  - ✓ Adults < 60 years old: 3 mSv
  - ✓ Adults > 60 years old: 15 mSv
  - ✓ Children: 1 mSv per year
  - ✓ Pregnant women (embryo): 1 mSv per year



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ΕΦΗΜΕΡΙΔΑ
ΤΗΣ ΚΥΒΕΡΝΗΣΕΩΣ
ΤΗΣ ΕΛΛΗΝΙΚΗΣ ΔΗΜΟΚΡΑΤΙΑΣ

20 Νοεμβρίου 2018 | ΤΕΥΧΟΣ ΠΡΩΤΟ | Αρ. Φύλλου 194

ΠΡΟΕΔΡΙΚΟ ΔΙΑΤΑΓΜΑ ΥΠ' ΑΡΙΘΜ. 101

Προσαρμογή της ελληνικής νομοθεσίας στην Οδηγία 2013/59/Ευρατόμ του Συμβουλίου, της 5ης Δεκεμβρίου 2013, για τον καθορισμό βασικών προτύπων ασφάλειας για την προστασία από τους κινδύνους που προκύπτουν από τις ιοντίζουσες ακτινοβολίες και την κατάργηση των Οδηγιών 89/618/Ευρατόμ 90/641/Ευρατόμ, 96/29/Ευρατόμ, 97/43/Ευρατόμ και 2003/122/Ευρατόμ (ΕΕ L13/17.1.2014) - Θέσπιση Κανονισμών Ακτινοπροστασίας.

7. Το γεγονός ότι, όπως προκύπτει από την Φ.1/Γ/64ΝΠ/97472/Β1/13.6.2018 εισήγηση του Γενικού Διευθυντή Οικονομικών Υπηρεσιών του Υπουργείου Παιδείας, Έρευνας και Θρησκευμάτων, δεν προκαλείται από τις διατάξεις του παρόντος διατάγματος επιπλέον δαπάνη σε βάρος του κρατικού προϋπολογισμού.

8. Την αριθμ. 124/2018 γνωμοδότηση του Συμβουλίου της Επικρατείας.

9. Την αριθμ. 176/2018 γνωμοδότηση του Συμβουλίου της Επικρατείας, με πρόταση των υπουργών Παιδείας, Έρευνας και Θρησκευμάτων, Οικονομίας και Ανάπτυξης, Υγείας, Οικονομικών, Περιβάλλοντος και Ενέργειας, Εσω-

I-131 THERAPY FOR HYPERTHYROIDISM

- $\Gamma = 5.7 \times 10^{-2}\ \mu Sv \cdot m^2/MBq \cdot h$
- $Q_0 = 740\ MBq$
- $T_p = 192\ h$
- $r = 1\ m$
- $E = 0.25$

$$D(\infty) = \frac{1.44 \Gamma Q_0 T_p E}{r^2} = 2.9\ mSv$$

$D(\infty)$ < 3 mSv (DC for adult family/friends)

$D(\infty)$ > 1 mSv (DC for children family members)

Instructions to avoid prolonged close contact, to sleep in a separate bed, to avoid any contact with children for a number of days

I-131 THERAPY FOR HYPERTHYROIDISM

How many days before close contact with children ($D(\infty) \leq 1\ mSv$)?

- $\Gamma = 5.7 \times 10^{-2}\ \mu Sv \cdot m^2/MBq \cdot h$
- $D(\infty) = 1000\ \mu Sv$
- $T_p = 192\ h$
- $r = 1\ m$
- $E = 0.25$

$$Q_{rem} = \frac{D(\infty) r^2}{1.44 \Gamma T_p E} = 253\ \text{MBq}$$

Considering only the physical half-life, it takes 12 days for the administered activity of 740 MBq to decay to 253 MBq.

I-131 THERAPY FOR HYPERTHYROIDISM

How many days before close contact with children ($D(\infty) \leq 1\ mSv$)?

- $\Gamma = 5.7 \times 10^{-2}\ \mu Sv \cdot m^2/MBq \cdot h$
- $D(\infty) = 1000\ \mu Sv$
- $T_{eff} = 144\ h$
- $r = 1\ m$
- $E = 0.25$

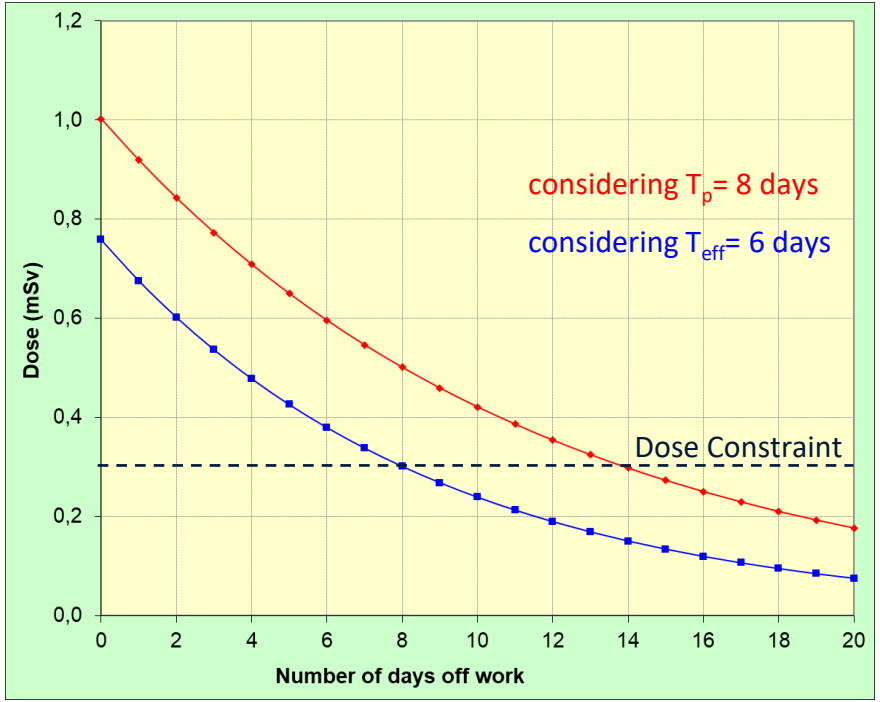
$$Q_{rem} = \frac{D(\infty)r^2}{1.44\Gamma T_{eff} E} = 338\ \text{MBq}$$

Considering the effective half-life, it takes only 7 days for the administered activity of 740 MBq to decay to 338 MBq.

I-131 THERAPY FOR HYPERTHYROIDISM

Patient administered with 740 MBq of I-131 for hyperthyroidism treatment. Cumulative dose to adult co-workers, after patient staying off work for a number of days.

After that period: r=2m, E=0.33



PATIENT DISCHARGE CRITERIA: MAX DOSE RATE

Max dose rate @ 1 m from patient, for $D(\infty)$ < 3 mSv (adult family)
Assume r=1 m, E=0.25, decay through physical half life only

	I-131 HYPERTHYR	I-131 DTC	Lu-177 DOTATATE	Lu-177 PSMA
T_p (h)	192	192	159.5	159.5
$\dot{D}_{out}$ (μSv/h)	(43.4) 40	43.4	(52.3) 50	(52.3) 50

Instructions to avoid prolonged close contact and to sleep alone.

Instructions to avoid any contact with children or pregnant women.

PATIENT DISCHARGE CRITERIA: MAX DOSE RATE

Max dose rate @ 1 m from patient, for $D(\infty) < 3$ mSv per year
Assume r=1 m, E=0.25, decay through effective half life

	I-131 HYPERTHYR	I-131 DTC	Lu-177 DOTATATE*	Lu-177 PSMA**
T_{eff} (h)	144	30	120	90
$\dot{D}_{out}$ (μSv/h)	(43.4) 40	60	17.4	15.4

* *4 treatment cycles*
** *6 treatment cycles*

CONTACT WITH CHILDREN/PREGNANT WOMEN

Duration of no contact with children/pregnant women (< 1 mSv/year)

	I-131 HYPERTHYR	I-131 DTC	Lu-177 DOTATATE	Lu-177 PSMA
T_{eff} (h)	144	30	120	90
$\dot{D_{out}}$ (μSv/h)	(43.4) 40	60	17.4	15.4
Days with no contact	6	0	8	6

After that, assume r=1 m, E=0.25, decay through effective half life

DAYS OFF-WORK

Number of days off-work (< 0.3 mSv/year). After that, assume for co-workers r=2 m, E=0.33, decay through effective half life

	I-131 HYPERTHYR	I-131 DTC	Lu-177 DOTATATE*	Lu-177 PSMA**
T_{eff} (h)	144	30	120	90
$\dot{D_{out}}$ (μSv/h)	(43.4) 40	60	17.4	15.4
Days off work	7	0	9	7

* *4 treatment cycles*

** *6 treatment cycles*

MAX DURATION OF TRAVEL

Max duration of travel ($D(t) < 0.3$ mSv). Assume r=0.3 m (bus, train)

	I-131 HYPERTHYR	I-131 DTC	Lu-177 DOTATATE	Lu-177 PSMA
T_{eff} (h)	144	30	120	90
$\dot{D}_{out}$ (μSv/h)	(43.4) 40	60	17.4	15.4
Duration of travel	40 min	27 min	90 min	105 min

Lu-177-DOTATATE, sample instructions

What to consider after every treatment with Lutathera®

Daytime

- **For the first 7 days**, keep at least 1 metre away from other people, limiting any close contact with children and pregnant women to a maximum of 15 minutes per day.[1]

Night-time

- **For the first 7 days**, sleep in a separate bedroom from your partner.[1]
- **For the first 15 days**, sleep in a separate bedroom from children and pregnant partners.[1]

Drinking

- Remain hydrated and urinate frequently before, on the day of and the day after administration of Lutathera® (e.g. drink one glass of water every hour).[1] The more you urinate, the faster the radiation leaves your body.

Using the toilet

- **For the first 7 days:**
  - Try to pass a stool every day. Use laxatives if you need to.[1]
  - Men should always use the toilet in a seated position and use toilet paper, even if only urinating.
  - Flush all toilet paper down the toilet, and flush twice each time.
  - Wash your hands carefully after every toilet visit.

Waste

- **For the first 7 days**, flush down the toilet any tissues containing bodily fluids (e.g. blood, urine or faeces).[1]
- If you expect to have non-flushable waste items (e.g. sanitary towels), please discuss this with your NM team.

Showering or bathing

- **For at least the first 7 days**, shower or bathe every day.

Laundry

- Wash your underwear, pyjamas, sheets and any clothes that contain sweat, blood or urine separately from the laundry of other members of your household, using a standard washing cycle. You do not need to use bleach and do not need extra rinses.

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Lu-177-DOTATATE, sample instructions

Public contact

- **For at least the first 7 days**, avoid situations that would place you close to the same members of the public for prolonged periods (e.g. going to the cinema or church).

Public transport

- **For at least the first 7 days**, avoid public transport if possible. If you must use public transport, single journeys should last no longer than 1 hour. For single journeys over an hour, discuss these with your NM team.
- **From day 8 until day 14**, single public transport journeys should last no longer than 3 hours.
- After this time, you can use public transport as usual.

Car travel

- **For at least the first 7** days, sit in the rear passenger seat diagonally opposite the driver if travelling by car, ensuring no other passengers are in the vehicle.

Air travel

- **For the first 7 days**, air travel journeys should ideally last no longer than 1 hour. Please discuss with your NM team if you may need to take longer air travel journeys.
- After each treatment, you may set off airport radiation detectors. Please discuss any planned air travel with your NM team.

Work

- **For at least the first 7 days**, do not go to work.
- After this time, discuss with your NM team when you are able to return to work.

Pregnancy and fatherhood

- **During Lutathera® treatment and for 7 months after completing treatment**, female patients should use effective birth control.
- **During Lutathera® treatment and for 4 months after completing treatment**, male patients should use effective birth control.
- If you become pregnant or think you are pregnant after starting treatment with Lutathera®, tell your doctor and/or nuclear medicine doctor right away.

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Lu-177-DOTATATE

Monserrat Fuertes *et al. EJNMMI Physics* (2023) 10:50
https://doi.org/10.1186/s40658-023-00570-7

ORIGINAL RESEARCH Open Access

Individualisation of radiation protection recommendations for patients treated with [^{177}Lu]Lu-DOTA-TATE

Teresa Monserrat Fuertes[1,2], Borja Santos Zorrozua[3], Emilia Rodeño Ortiz de Zarate[4], Miguel Ángel Peinado Montes[1], Carmen Vigil Díaz[5] and Pablo Mínguez Gabiña[6,7*]

- Patient discharge: 24 h p.a.
- 2.4-19.5 µSv/h (mean 5.4) @ 1m
- T_{eff}: 58 h (mean), 119 h (max)

Table 1 Effective dose limits and constraints considered for each population group

Group of population	Limit/ constraint (mSv/cycle)
Children; pregnant women; people away from home	0.25
Adults < 60 years old at home	0.75
Adults > 60 years old at home	3.75
Public transport users	1

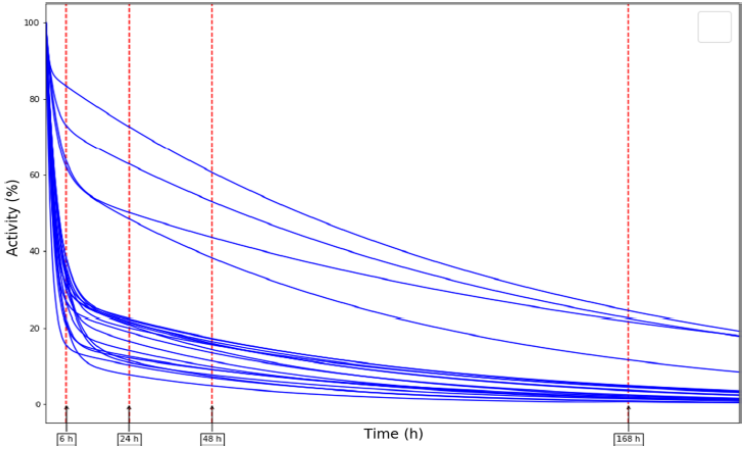

Fig. 2 Percentage of the remaining whole-body activity A_{wb}(%) as a function of time for the 20 patients included in the study

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INPUT DATA (to be completed by hospital staff)

Discharge day:	12/01/2023
$\dot{D}_{1m}$ (μSv/h) =	5.1
$T_{eff}^{6,24}$ (h) =	23
$T_{eff,mod}^{6,24}$ (h) =	69
AT HOME	
Infants < 2y	NO
Children between 2y - 5y	NO
Children between 5y - 14y	NO
Adults < 60y	YES
Adults > 60y	NO
Partner < 60y	YES
Partner > 60y	NO
Pregnant partner	NO
AT WORK	
Work with children	NO

INSTRUCTIONS CARD FOR THE PATIENT

PLEASE FOLLOW THE INSTRUCTIONS BELOW:

- Avoid spending periods > 3h at < 1m and sleep away from partner until: 18/01/2023
- Avoid spending periods > 3h at < 1m with other persons away from home until: 16/01/2023
- You may return to work on: 12/01/2023
- Recommended maximum times in public transport in following days after discharge:

Day	Maximum hours of travel
12/01/2023	14
13/01/2023	18
14/01/2023	NO RESTRICTIONS

(a) at home:

- patients will spend 6 h at 1 m and 3 h at 0.5 m from any adult and another 8 h at 0.1 m with partner when sleeping together.
- patients will spend 15 periods of 35 min per day at 0.1 m from infants of less than 2 years.
- patients will spend 8 h at 1 m and 4 h at 0.1 m from children between 2 and 5 years.
- patients will spend 4 h at 1 m and 2 h at 0.1 m from children between 5 and 14 years.

(b) away from home:

- patients will spend 3 h at 1 m, 2 h at 0.5 m and 1 h at 0.1 m from any person, adult or child.

(c) at work:

- patients will spend 8 h at 1 m from adult co-workers.
- patients will spend 4 h at 1 m, 2 h at 0.5 m and 2 h at 0.1 m from children (if working with them).

(d) on public transport (this assumption applies after patient is discharged):

- patients will travel at a distance of 0.1 m from other passengers.

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CONCLUSIONS

- Discharge policies and duration of restrictions vary widely.
- Harmonization of Dose constraints is required.
- Patient discharge, travel advice, instructions at home and their duration should be decided on an individual basis.
- Restrictions and instructions are not arbitrary, they arise from calculations, given certain (realistic/conservative) assumptions.
- Personal experience indicates that, most often, patients and relatives are already stressed because of radiation and tend to exaggerate on restrictions. We need not enhance this stress.


THANK
YOU!
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