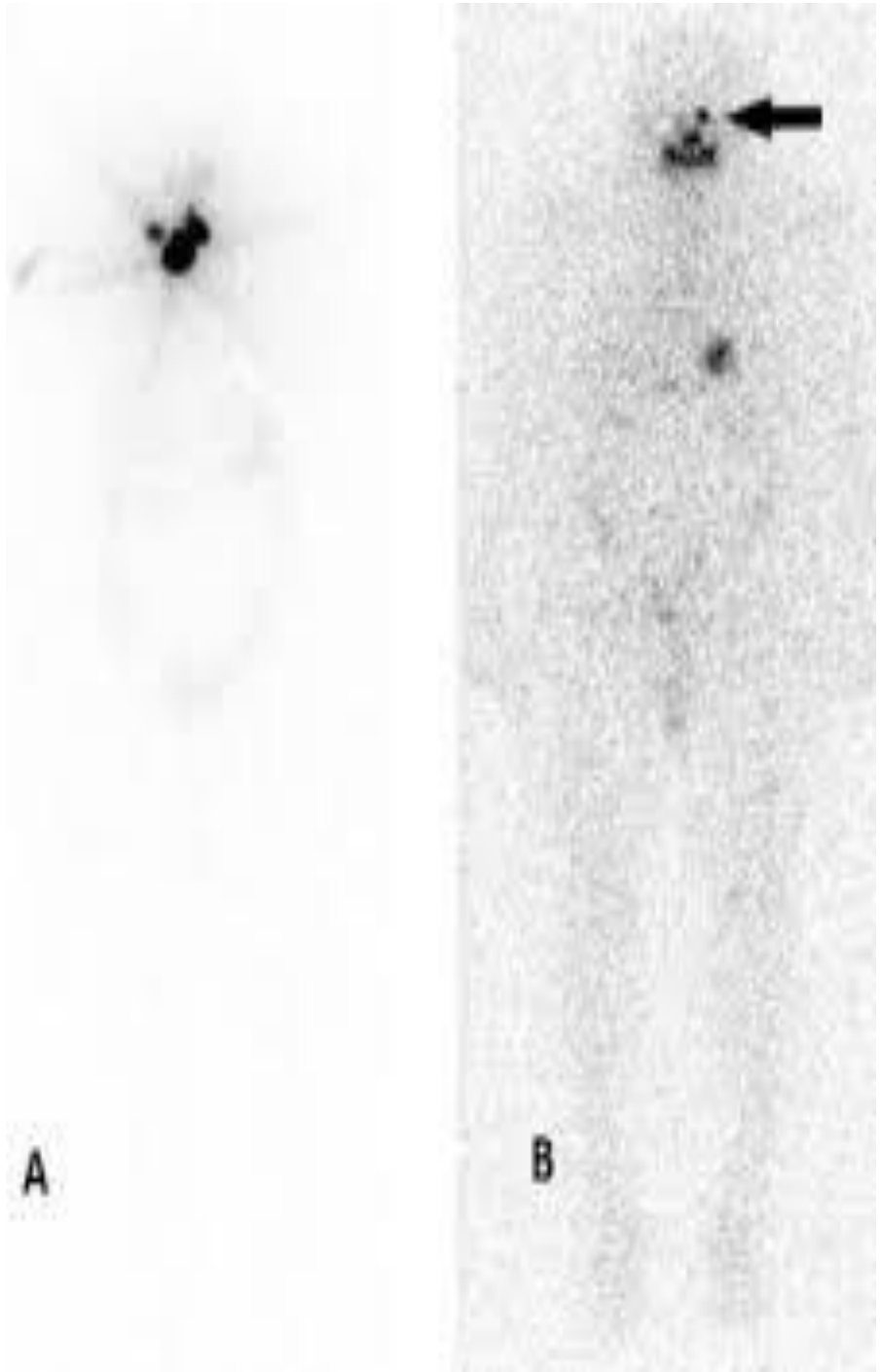
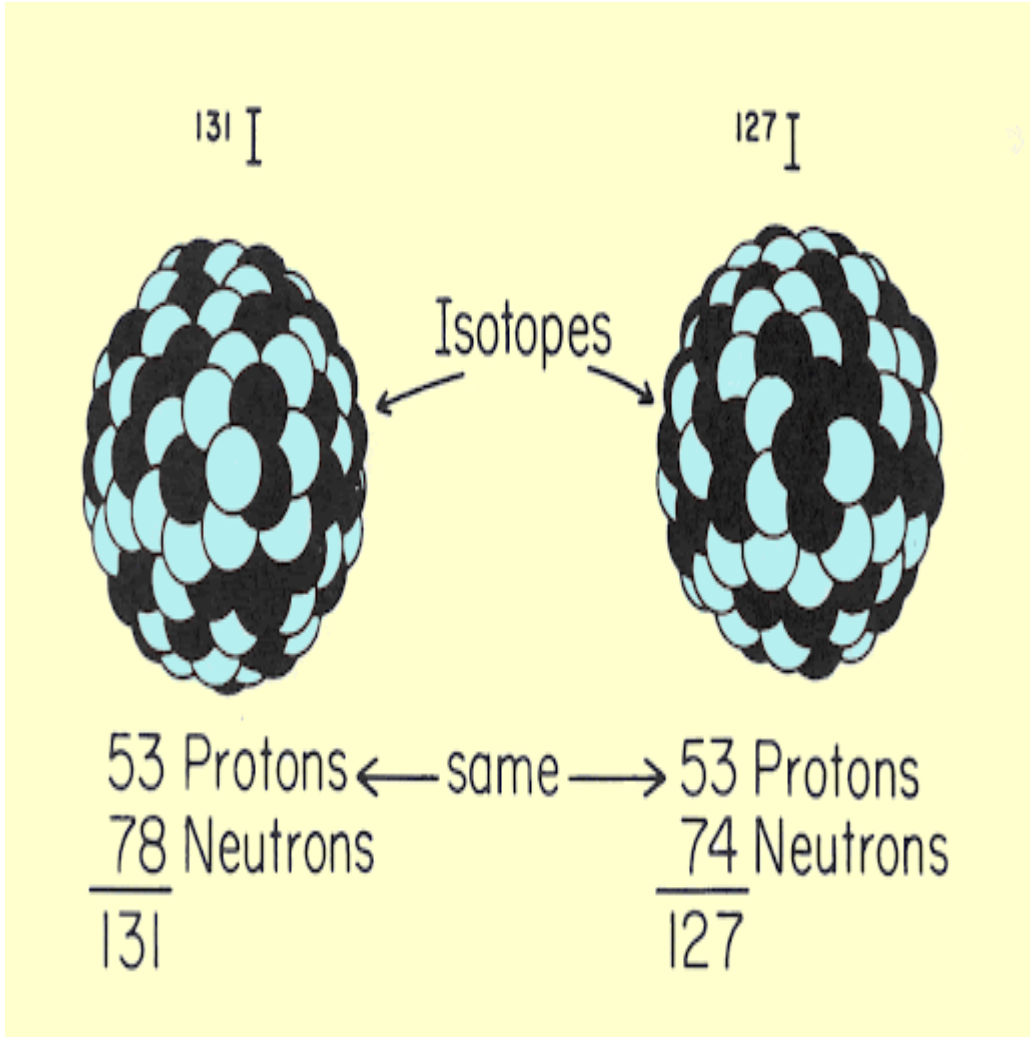
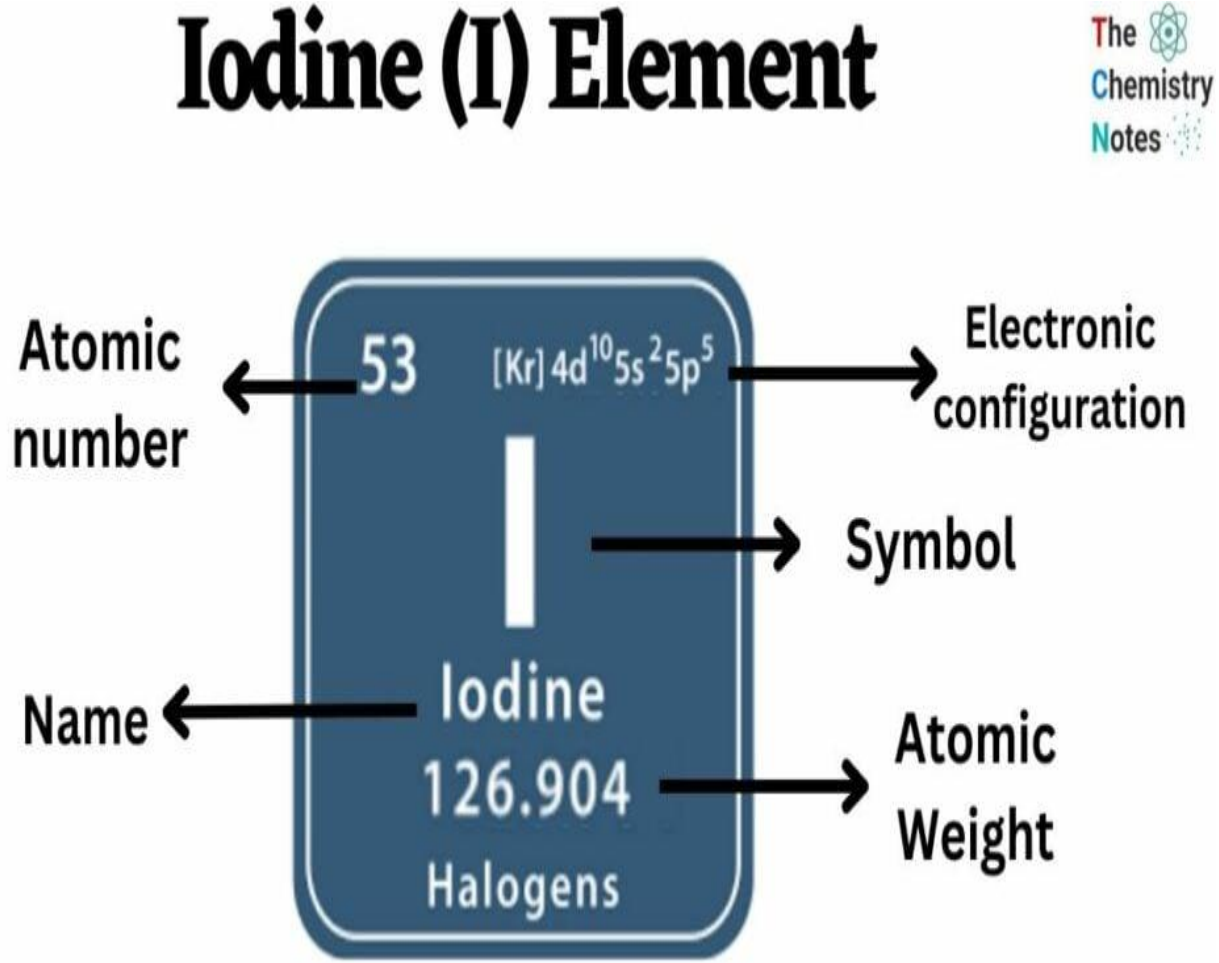


Dr. Mohseni

Nuclear medicine phisician

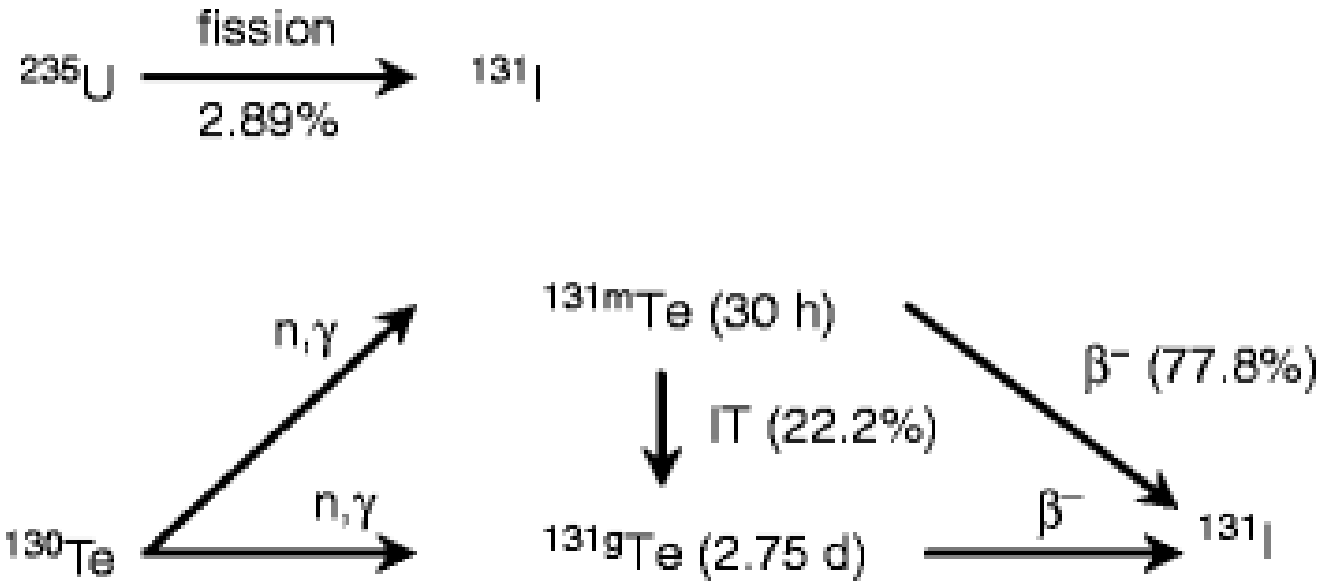

131 I
127 I
Isotopes
53 Protons
78 Neutrons
131
same
53 Protons
74 Neutrons
127


Iodine (I) Element
The Chemistry Notes
Atomic number
53
[Kr] 4d10 5s2 5p5
Electronic configuration
Symbol
Name
Iodine
126.904
Halogens
Atomic Weight

Mass # = p + n

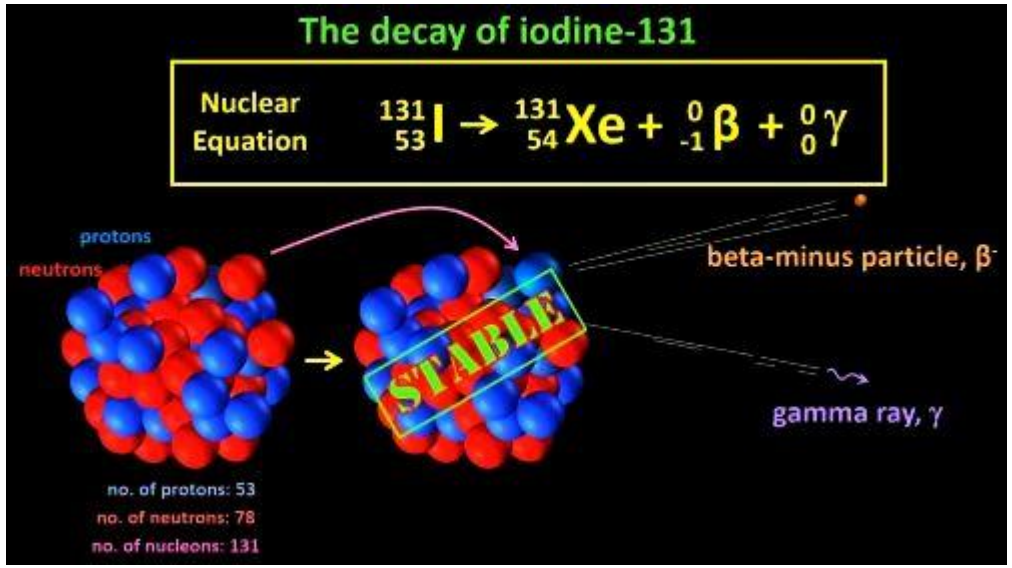
Atomic # = p

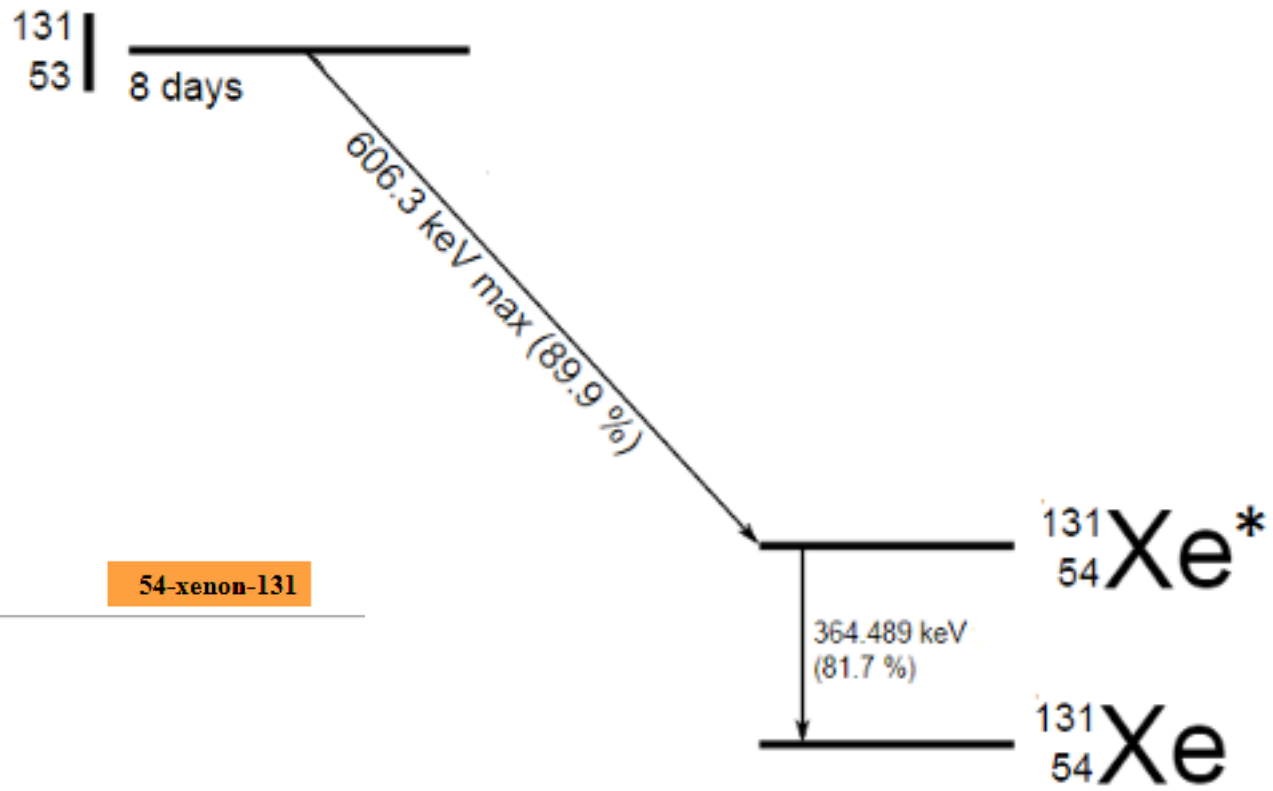
$^{131}_{53}I$



Iodine-131

- Due to its volatility, short half-life, and high abundance in fission products, ^{131}I (along with the short-lived iodine isotope ^{132}I, which is produced from the decay of ^{132}Te with a half-life of 3 days) is responsible for the largest part of radioactive contamination during the first week after accidental environmental contamination from the radioactive waste from a nuclear power plant. Thus highly dosed iodine supplements (usually potassium iodide) are given to the populace after nuclear accidents or explosions (and in some cases prior to any such incident as a civil defense mechanism) to reduce the uptake of radioactive iodine compounds by the thyroid before the highly radioactive isotopes have had time to decay.
- Relative ease of creating ^{131}I by neutron bombardment of natural tellurium(the heaviest naturally occurring tellurium nuclide, ^{130}Te (34% of natural tellurium) absorbs a neutron to become tellurium-131, which beta decays with a half-life of 25 minutes to ^{131}I.) in a nuclear reactor.
- ^{131}I is a fission product with a yield of 2.878% from uranium-235 and can be released in nuclear weapons tests and nuclear accidents. However, the short half-life means it is not present in significant quantities in cooled spent nuclear fuel, unlike iodine-129 whose half-life is nearly a billion times that of ^{131}I .





54-xenon-131

- Atomic Mass: 130.9050819 +- 0.0000010 amu
- Excess Mass: -88415.608 +- 0.972 keV
- Binding Energy: 1103511.812 +- 0.989 keV
- Beta Decay Energy: B- -352.395 +- 5.311 keV

"The 1995 update to the atomic mass evaluation" by G.Audi and A.H.Wapstra, Nuclear Physics A595 vol. 4 p.409-480, December 25, 1995.

- Atomic Percent Abundance: 21.2%
- Spin: 3/2+
- Stable Isotope

Meta state at 0.164 Mev

- Spin: 11/2-
- Half life: 11.934 d
- Mode of decay: IT
  - Decay energy: 0.164 MeV

- Possible parent nuclides:
  Beta from I-131
  Electron capture from Cs-131

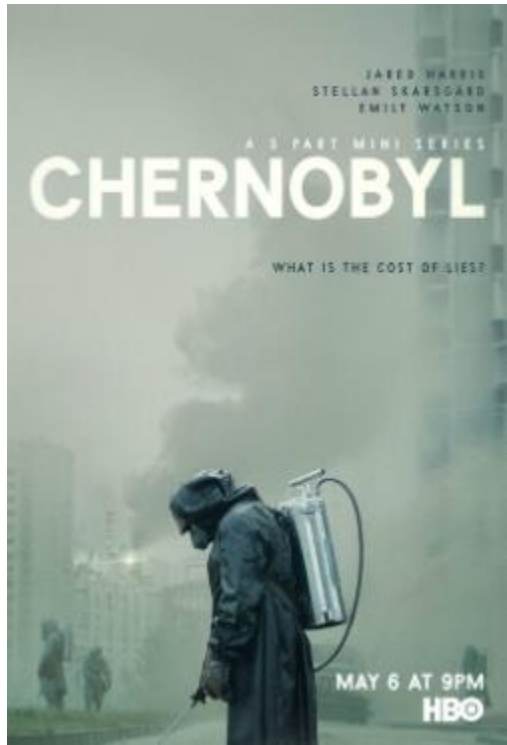
Iodine-131

- comparatively energetic (190 keV average and 606 keV maximum energy) beta radiation, which penetrates 0.6 to 2.0 mm from the site of uptake, destroys the associated thyroid tissue with little damage to surrounding tissues (more than 2.0 mm from the tissues absorbing the iodine).
- Due to similar destruction, ^{131}I is the iodine radioisotope used in other water-soluble iodine-labeled radiopharmaceuticals (such as MIBG).
- The high energy beta radiation (up to 606 keV) from ^{131}I causes it to be the most carcinogenic of the iodine isotopes. It is thought to cause the majority of excess thyroid cancers seen after nuclear fission contamination (such as bomb fallout or severe nuclear reactor accidents like the Chernobyl disaster). However, these epidemiological effects are seen primarily in children, and treatment of adults and children with therapeutic ^{131}I, and epidemiology of adults exposed to low-dose ^{131}I has not demonstrated carcinogenicity.

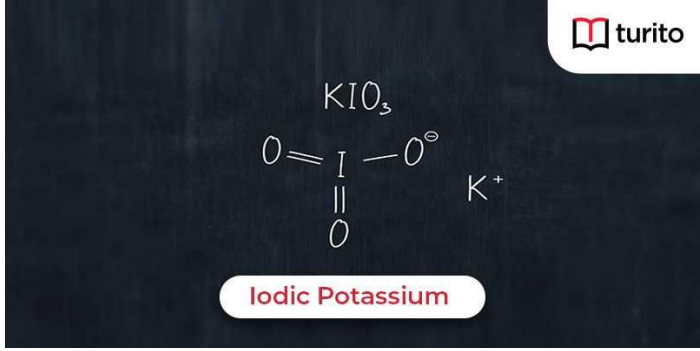
- Since ^{131}I has both a beta and gamma decay mode, it can be used for radiotherapy or for imaging. Due to its mode of beta decay, iodine-131 causes mutation and death in cells that it penetrates, and other cells up to several millimeters away. For this reason, high doses of the isotope are sometimes less dangerous than low doses, For example, children treated with moderate dose of ^{131}I for thyroid adenomas had a detectable increase in thyroid cancer, but children treated with a much higher dose did not.

Thyroid protection

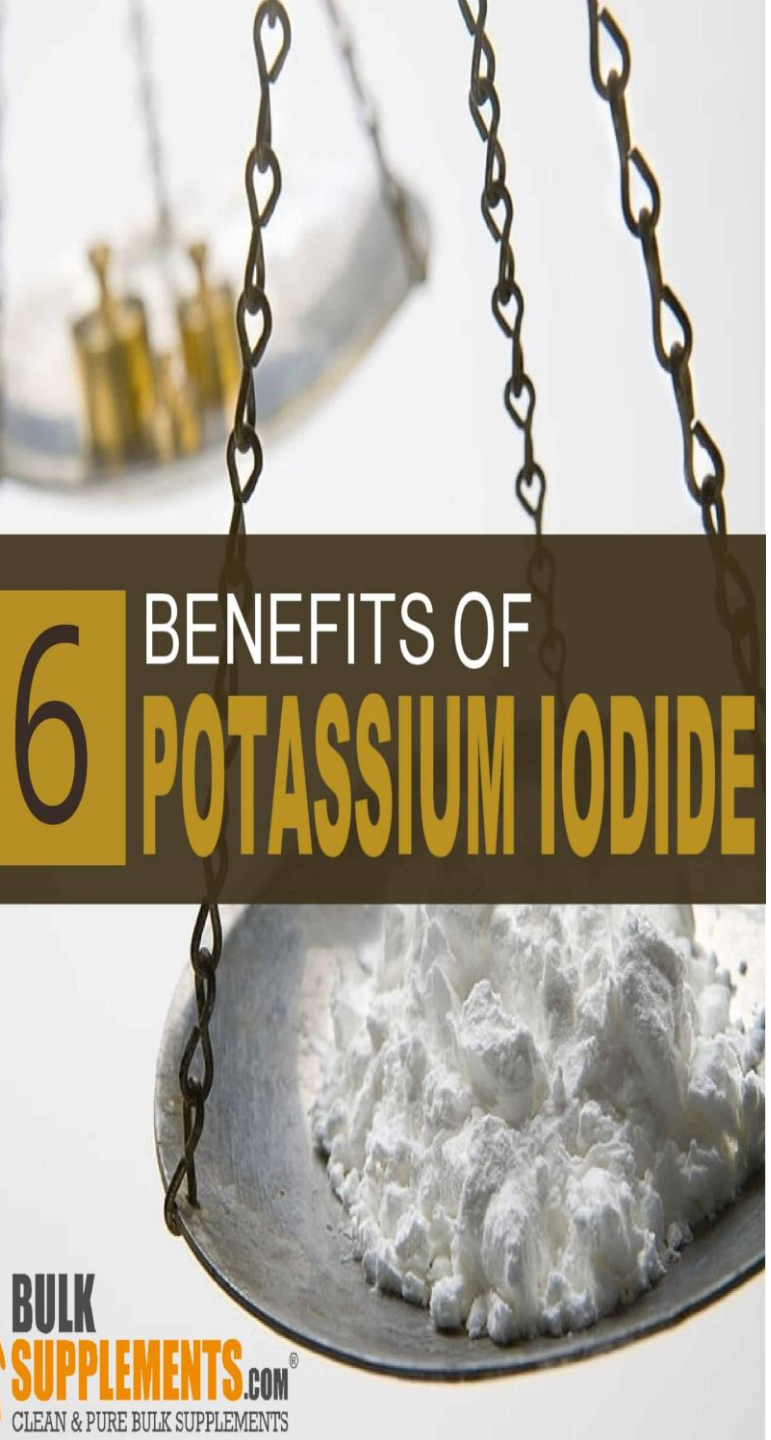
- Potassium iodide(KI) has been distributed to populations exposed to nuclear fission accidents such as the Chernobyl disaster. The iodide solution **SSKI**, a **s**aturated **s**olution of potassium (**K**) **i**odide in water, has been used to block absorption of the radioiodine (it has no effect on other radioisotopes from fission).
- In theory, many harmful late-cancer effects of nuclear fallout might be prevented in this way, since an excess of thyroid cancers, presumably due to radioiodine uptake, is the only proven radioisotope contamination effect after a fission accident, or from contamination by fallout from an atomic bomb (prompt radiation from the bomb also causes other cancers, such as leukemias, directly).
- Taking large amounts of iodide saturates thyroid receptors and prevents uptake of most radioactive iodine-131 that may be present from fission product exposure (although it does not protect from other radioisotopes, nor from any other form of direct radiation). The protective effect of KI lasts approximately 24 hours, so must be dosed daily until a risk of significant exposure to radioiodines from fission products no longer exists. Iodine-131 (the most common radioiodine contaminant in fallout) also decays relatively rapidly with a half-life of eight days, so that 99.95% of the original radioiodine has vanished after three months.



Potassium Iodide



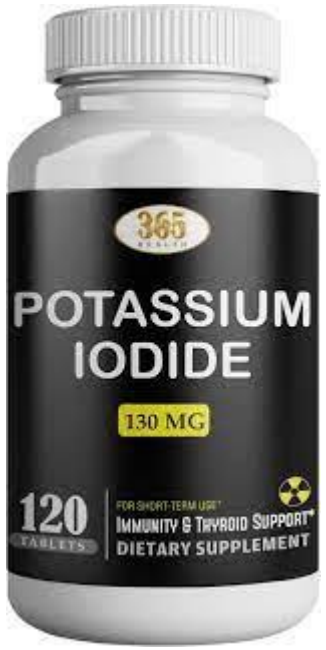
- KI is the stable (non-radioactive) form of iodine. They are both absorbed by the thyroid.
- The thyroid cannot distinguish between stable or radioactive iodine. To protect the thyroid from radioactive iodine, a person must take KI before or shortly after being exposed to radioactive iodine to saturate the thyroid and prevent the radioactive iodine from concentrating in the thyroid.
- KI is recommended only for people under 40 and women who are pregnant or breastfeeding. However, officials or healthcare providers may instruct adults over 40 to consume KI if the predicted exposure is high enough to cause hypothyroidism.
- KI protects only the thyroid. KI does not protect other parts of the body.



- KI must be taken within 24 hours before or 4 hours after exposure to be most effective.
- KI is not a treatment and cannot reverse damage already done to the thyroid.
- KI may not give a person 100% thyroid protection from radioactive iodine.
- **There are two U.S. FDA-approved forms of KI:**
- Tablets in two strengths, 130 milligram (mg) and 65 mg. The tablets may be cut into smaller pieces for lower doses.
- Oral liquid solution available in one concentration, each milliliter (mL) containing 65 mg of KI.

Potassium Iodine (KI): Recommended Single Dosage by Age

Age Group	Predicted Thyroid Exposure	KI dose (mg)	Number or fraction of 130 mg tablets	Number or fraction of 65 mg tablets	Milliliters (mL) of oral solution, 65 mg/mL
Infants birth through 1 month	≥ 5	16	Use KI oral solution**	1/4	0.25 mL
Children 1 month through 3 years	≥ 5	32	Use KI oral solution**	1/2	0.5 mL
Children over 3 years through 12 years	≥ 5	65	1/2	1	1 mL
Adolescents, 12 through 18 years (adolescents that weigh over 150 pounds should take adult dose)	≥ 5	65	1/2	1	1 mL
Adults over 18 through 40 years	≥ 10	130	1	2	2 mL
Pregnant or Lactating Women	≥ 5	130	1	2	2 mL
Adults over 40 years* **	≥ 500	130	1	2	2 mL



کد ملی اسکن های هسته ای مرتبط با تخصص غدد درون ریز

نوع اسکن	کد ملی خدمات درمانی	کد ملی تامین اجتماعی
اسکن تیروئید	۷۰۴۷۲۵	۰۳۹۷۵۷-۰۰۰
اسکن پاراتیروئید	۷۰۴۶۹۰	۰۳۹۷۴۲-۲۰۰
اسکن تمام بدن با ید	۷۰۴۶۱۰	۰۸۱۵۸۸-۶۰۰
ید ۳۰ میلی کوری	۷۰۴۶۳۵	۷۰۴۶۳۵-۰۰۰
ید۲۵ میلی کوری	۷۰۴۶۳۰	۷۰۴۶۳۰-۰۰۰
ید ۲۰ میلی کوری	۷۰۴۶۲۰	۷۰۴۶۲۵-۰۰۰
ید ۱۵ میلی کوری	۷۰۴۶۲۵	۷۰۴۶۲۰-۰۰۰
ید ۱۰ میلی کوری	۷۰۴۶۱۵	۷۰۴۶۱۵-۰۰۰
اسکن تمام بدن استخوان	**۷۰۴۸۵۵**	**۰۳۹۸۱۸-۰۰۰**
اسپکت سی تی	**۷۰۵۰۸۵**	**۷۰۵۰۸۵**
Octerotide	۷۰۵۰۱۵	۰۴۳۶۴۹-۳۰۰

اسپکت 705080 705080

استاد محترم با توجه به تفاوت تعرفه اسکن معمولی با اسپکت سی تی لطفاً جهت اسکن پاراتیروئید، کد ملی اسپکت سی تی نیز وارد گردد.

جمهوری اسلامی ایران
وزارت بهداشت، درمان و آموزش پزشکی

معاونت درمان

دبیرخانه شورای راهبردی تدوین راهنماهای سلامت

شناسنامه و استاندارد خدمت

اسکن تمام بدن با ید رادیواکتیو

فروردین ماه ۱۳۹۷

ی) اقدامات پاراکلینیکی، تصویربرداری ، دارویی و ... مورد نیاز قبل از ارائه خدمت:

موارد الزامی:

۱- اندازه گیری سطح سرمی TSHو تیروگلوبولین و آنتی تیروگلوبولین

۲- سونوگرافی بستر تیرویید در گردن و غده لنفاوی دو طرف گردن

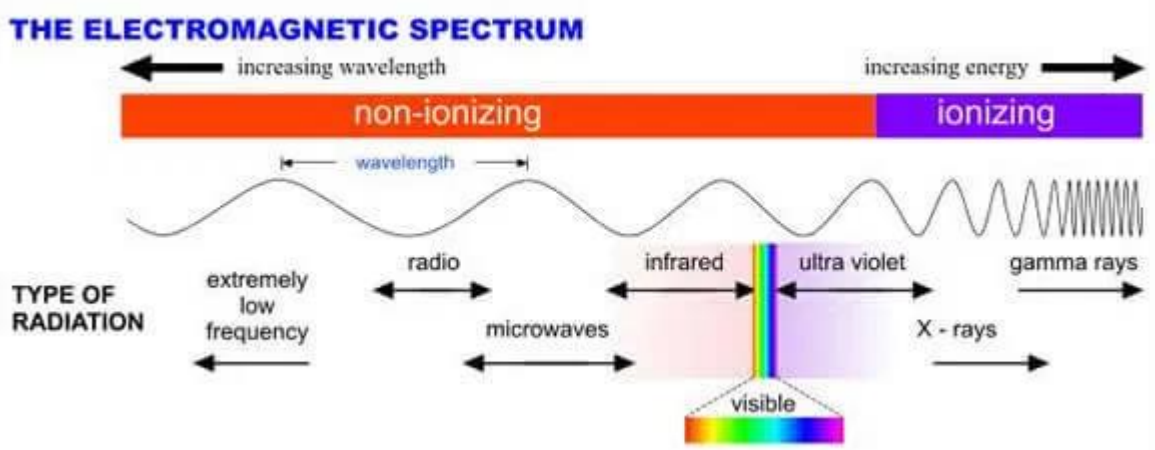
مواردیکه ممکن است بر حسب شرایط بیمار نیاز باشد:

۱- اندازه گیری Beta HCG سرم

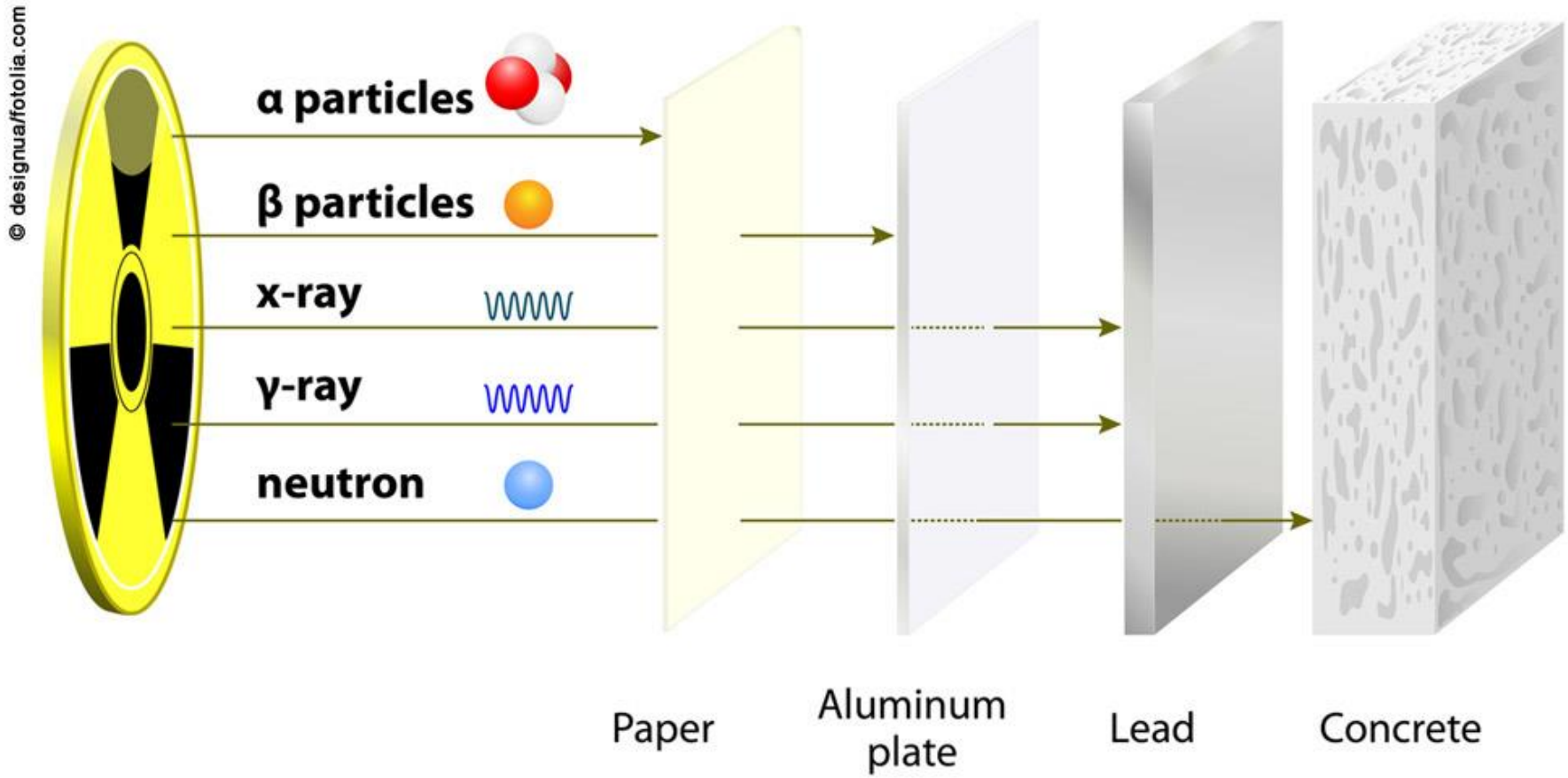
۲- اندازه گیری ید ادرار

RADIATION DOSIMETRY

Dosimetry is the scientific method and measurement of ionizing radiation. The purpose of dosimetry is to track the level of radiation exposure.



Types of Ionizing Radiation



Background radiation

- We are all exposed to radiation EVERY single day.
  - Ground contains radioactive isotopes like U-238.
  - Air contains Rn-222 and C-14.
  - Food contains K-40 and C-14.
  - Water contains Rn-222.
- People who fly frequently or who live at high altitu receive higher levels of cosmic rays.
- Fact: people living in Denver receive twice as much background radiation as we do.
- Fact: Cigarette smokers receive alpha radiation from Po-210 – which comes from phosphate fertilizers.

polonium

- FACT: CRT style TV's emit radiation.
- Exposure to x-rays (essentially a beta particle) may have a cumulative effect.
- The average person receives about 170mrem per year.

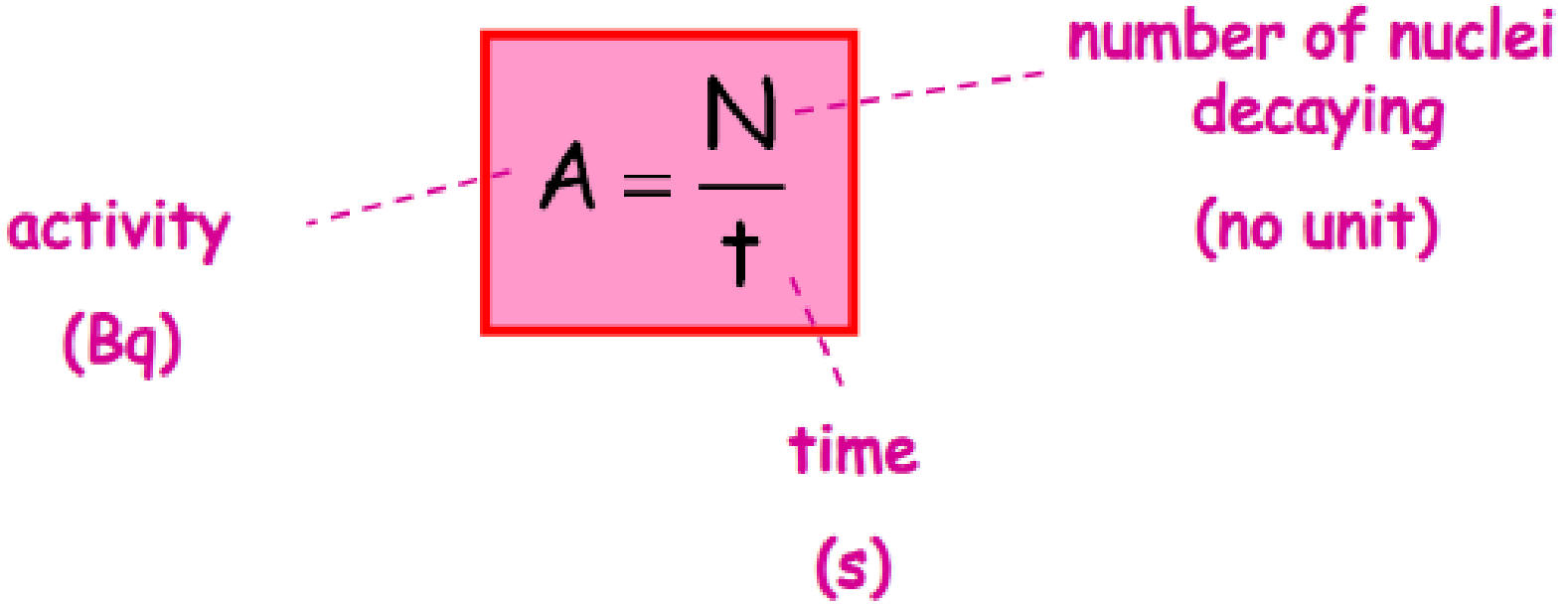
The average annual effective dose for people in the UK is 2 mSv.

Background Radiation	Effective Dose
Cosmic rays from space.	0.3 mSv
Radioactivity from rocks & soil	0.3 mSv
Radioactivity from human body	0.4 mSv

Estimated Exposures from Common Diagnostic Studies	
0.01 Sv (1 Rem)	CT Abdomen
0.003 Sv	Small Bowel Follow Through
0.00002 Sv	Chest radiograph
0.000009 Sv	Daily background (non-medical) sources

- **Banana equivalent dose** (**BED**) is an informal unit of measurement of ionizing radiation exposure, intended as a general educational example to compare a dose of radioactivity to the dose one is exposed to by eating one average-sized banana. Bananas contain naturally occurring radioactive isotopes, particularly potassium-40 (^{40}K),
- Its half-life is 1.25 billion years. It makes up about 0.012% (120 ppm) of natural potassium. One BED is often correlated to 10^{-7} sievert (0.1 µSv); however, in practice, this dose is not cumulative, as the potassium in foods is excreted in urine to maintain homeostasis.

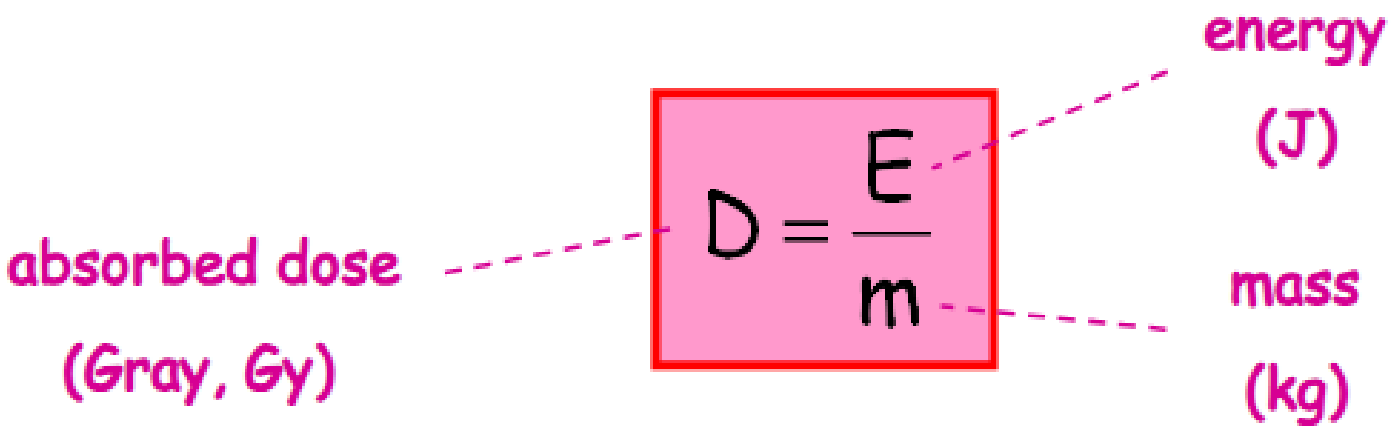
The activity of a radioactive source is the average number of nuclei decaying per unit time.



1 becquerel (Bq) = 1 decay per second

The old unit to measure exposure is **roentgen (R)**

When tissue is exposed to radiation, the **absorbed dose** is the **energy absorbed** per unit **mass** of tissue.

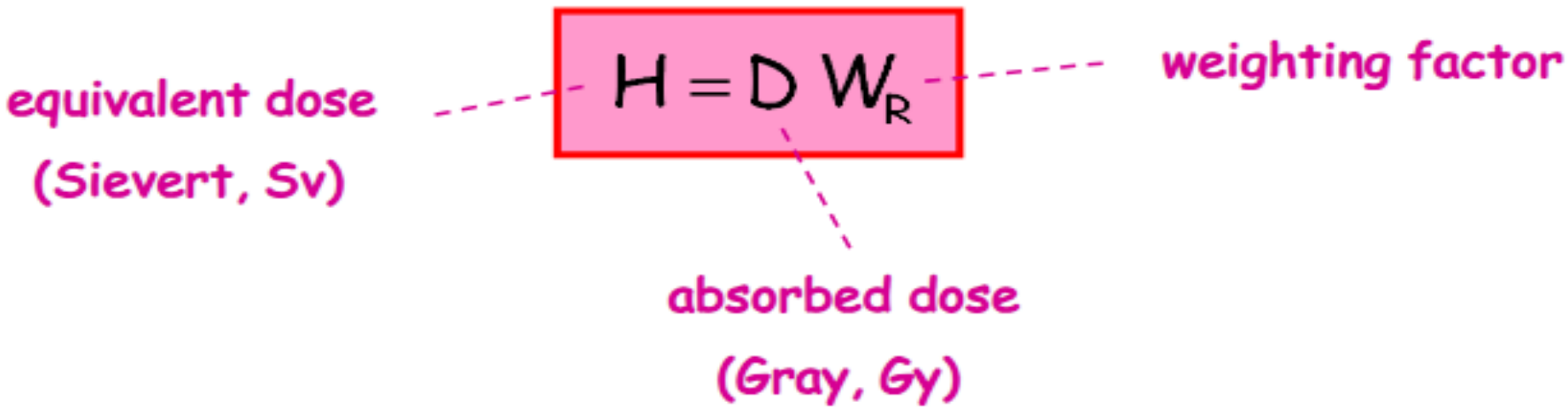


1 gray (Gy) = 1 joule per kilogram

- Traditional unit: *Radiation Absorbed Dose* (rad), 1 rad = 100 erg/g
- International unit: *Gray* (Gy), 1 Gray = 1000 joules/kg
- 1 Gray = 100 rads

The **equivalent dose** is a measure of the **biological damage** caused by radiation on living tissue.

Equivalent dose is the **product** of **absorbed dose** and radiation **weighting factor**.



System Internationale (SI) units

Absorbed dose	**Gray (Gy)**	= 1 J/kg = 100 rads
Equivalent dose	**Sievert (Sv)**	= Gy x Wr, where Wr is a weighting factor
Activity	**Becquerel (Bq)**	one nucleus decay per second

For x-rays, Sv and Gy are interchangeable, the Wr = 1.

Non-SI units

Absorbed dose	**Rad**	= 100 ergs/g = 1/100 Gy
Equivalent dose	**Rem** ("Roentgen equivalent man") = 1/100 Sv	
Activity	**Curie**	

Weighting Factor

The radiation weighting factor (W_R) is a measure of the biological effect of the radiation.

Radiation	Weighting Factor
α particle	20
fast neutrons	10
gamma rays	1

Ionizing radiation

Direct damage

Double strand break / Single strand break

Cell death

Indirect damage

Free radicals & Reactive oxygen species

$O_2^{\bullet -}$, $OH^{\bullet}$, H_2O_2 etc.

Double strand break / Single strand break

Cell death

سازمان انرژی اتمی ایران

مرکز نظام ایمنی هسته‌ای کشور

دفتر امور حفاظت در برابر اشعه کشور

دستورالعمل ترخیص بیماران تحت درمان با ید۱۳۱

شماره شناسه: **INRA-RP-WI-123-00/42-0-Sha.1389**

۶- معیارهای ترخیص بیماران بد درمانی

۶-۱ *ترخیص براساس مقدار پرتوزائی بد تجویز شده*

بیماران پس از کاهش پرتوزائی رادیوداروی تجویز شده به کمتر از ۳۰ میلی‌کوری، با رعایت دستورالعمل‌های ارائه شده در پیوست‌های ۱ و ۲ می‌توانند از بیمارستان یا مرکز درمانی ترخیص شوند.

۶-۲ *ترخیص بر اساس آهنگ دز در فاصله یک متری بیمار*

در صورتی که آهنگ دز در فاصله یک متری از سطح تیروئید بیمار کمتر از ۷۰ میکروسیورت در ساعت باشد می‌توان با ارائه دستورالعمل‌های حفاظتی مندرج در پیوست‌های ۱ و ۲ نسبت به ترخیص بیماران اقدام نمود.

۶-۳ *ترخیص براساس محاسبات دز همراه بیمار*

ترخیص بیمار براساس دز دریافتی همراه بیمار نیز یکی دیگر از معیارهای ترخیص می‌باشد. در این روش علیرغم پرتوزائی باقی‌مانده در بدن بیمار به مقدار بیش از ۳۰ میلی‌کوری، دز همراه بیمار محاسبه می‌شود. در صورتی‌که دز محاسبه شده برای همراه بیمار کمتر از ۵ میلی‌سیورت باشد، می‌توان بدون توجه به میزان پرتوزائی تجویز شده و با رعایت دستورالعمل مندرج در پیوست‌های ۱ و ۲ نسبت به ترخیص بیمار اقدام نمود.

Geiger muller Counter

- **در منزل**

از تماس طولانی‌مدت با اعضای خانواده و دیگران در امور روزمره خودداری کنید و در سه روز اول پس از ترخیص از بیمارستان موارد را زیر رعایت نمایید:

- در صورت لزوم حداقل فاصله ۲ متر را رعایت کنید و تا آنجا که ممکن است زمان ملاقات را به کمترین مقدار ممکن تقلیل دهید.
- محل خواب خود را از دیگران جدا کنید.
- تا آنجا که ممکن است آب و مایعات به میزان فراوان استفاده کنید.
- در سرو غذا از ظروف یک‌بار مصرف و یا از ظروف با قابلیت شستشوی آسان استفاده کنید و غذای مصرفی خود را با دیگران تقسیم نکنید.
- برای رعایت ایمنی بیشتر در ارتباط با اعضای خانواده، حداقل فاصله نیم متر را برای مدت ۲ ماه رعایت کنید.
- به‌طور روزانه استحمام نمایید و بعد از استحمام، حمام را با آب فراوان شستشو دهید. در صورت امکان به‌تنهایی استحمام کنید.
- لباس‌ها، ملحفه و پوشاک و لوازم شخصی را مجزا از سایر لباس‌ها بشویید.
- در هنگام دفع ادرار و مدفوع از پاشیدن آن به اطراف جلوگیری کرده و پس از آن ۲ بار فلاش تانک را تخلیه کنید.

درسفر و رفت و آمد

- پس از ترخیص از بیمارستان، از وسیله نقلیه اختصاصی جهت رفتن به منزل استفاده کنید و حتی‌الامکان از استفاده از وسایل حمل و نقل عمومی اجتناب کنید و درصورت ضرورت، زمان استفاده را به یک ساعت در روز برای مدت یک هفته محدود نمایید.
- از مسافرت‌های طولانی‌مدت همراه با دیگران خودداری کنید و در همه حال حداقل فاصله حدود ۱ متر را با دیگران حفظ نمایید.

فعالیت‌های اجتماعی

حتی‌الامکان تا یک هفته پس از ترخیص از فعالیت‌های اجتماعی مشروحه ذیل که مستلزم تماس طولانی‌مدت با دیگران است پرهیز کنید:

- رفتن به مکان‌های عمومی و پرجمعیت نظیر سینما، سالن‌های ورزشی؛
- رفتن به محل کار؛
- رفتن به مراکز خرید پرجمعیت؛
- شرکت در مهمانی‌ها؛
- رفتن به حمام‌های عمومی.

در صورتی‌که مسئولیت تهیه غذا و هرگونه مواد خوراکی دیگر و همچنین نگهداری از کودکان و زنان باردار را به‌عهده دارید، اکیدا توصیه می‌گردد تا ۳ هفته از فعالیت‌های فوق اجتناب کنید.

2A-1. Hyperthyroidism [Assumes 50% uptake by thyroid, with effective $T_{1/2}$ of about 5 days (12)]

	mCi (MBq) administered			
	10 (370)	*15 (555)*	*20 (740)*	*30 (1110)*
Nighttime restrictions	Days/24-h cycles			
Sleep in a separate (6-feet separation) bed from adults for days shown.	3	6	8	11
Sleep in a separate bed from pregnant partners, infant, or child for days shown.	15	18	20	23
Daytime restrictions				
You may return to work after days shown.	1	1	2	5
Maximize your distance (6 feet) from children and pregnant women for days shown.	1	1	2	5
Avoid extended time in public places for days shown.	1	1	1	3

2A-2. Thyroid carcinoma/remnant ablation [Assumes that disappearance of ^{131}I is biexponential with early effective $T_{1/2}$ of about 0.76 days, and 2% uptake in remnant with effective $T_{1/2}$ of about 7.3 days (7). Consider formal dosimetry (18) for larger administered doses given to patients with functioning carcinoma. ^{131}I kinetics in euthyroid patients stimulated by recombinant human thyrotropin may differ from those used here (11)]

	mCi (MBq) administered			
	50 (1850)	*100 (3700)*	*150 (5550)*	*200 (7400)*
Nighttime restrictions	Days/24-h cycles			
Sleep in a separate (6-feet separation) bed from adults for days shown.	1	1	2	4
Sleep in a separate bed from pregnant partners, infant, or child for days shown.	6	13	18	21
Daytime restrictions				
You may return to work after days shown.	1	1	1	1
Maximize your distance (6 feet) from children and pregnant women for days shown.	1	1	1	1
Avoid extended time in public places for days shown.	1	1	1	1

2A-1. Hyperthyroidism [Assumes 50% uptake by thyroid, with effective $T_{1/2}$ of about 5 days (12)]

	mCi (MBq) administered			
	10 (370)	*15 (555)*	*20 (740)*	*30 (1110)*
Nighttime restrictions	Days/24-h cycles			
Sleep in a separate (6-feet separation) bed from adults for days shown.	3	6	8	11
Sleep in a separate bed from pregnant partners, infant, or child for days shown.	15	18	20	23
Daytime restrictions				
You may return to work after days shown.	1	1	2	5
Maximize your distance (6 feet) from children and pregnant women for days shown.	1	1	2	5
Avoid extended time in public places for days shown.	1	1	1	3

2A-2. Thyroid carcinoma/remnant ablation [Assumes that disappearance of ^{131}I is biexponential with early effective $T_{1/2}$ of about 0.76 days, and 2% uptake in remnant with effective $T_{1/2}$ of about 7.3 days (7). Consider formal dosimetry (18) for larger administered doses given to patients with functioning carcinoma. ^{131}I kinetics in euthyroid patients stimulated by recombinant human thyrotropin may differ from those used here (11)]

	mCi (MBq) administered			
	50 (1850)	*100 (3700)*	*150 (5550)*	*200 (7400)*
Nighttime restrictions	Days/24-h cycles			
Sleep in a separate (6-feet separation) bed from adults for days shown.	1	1	2	4
Sleep in a separate bed from pregnant partners, infant, or child for days shown.	6	13	18	21
Daytime restrictions				
You may return to work after days shown.	1	1	1	1
Maximize your distance (6 feet) from children and pregnant women for days shown.	1	1	1	1
Avoid extended time in public places for days shown.	1	1	1	1

Radioactive Iodine Therapy

2B. Duration of Safe Travel by Public Transportation (Bus, Air, etc.) [Assumes 100 mrem limit and 0.3 m distance. Other assumptions are as in Table **2A-1** *and* **2A-2***]*

2B-1. Hyperthyroidism

	mCi (MBq) administered			
	10 (370)	*15 (555)*	*20 (740)*	*30 (1110)*
Travel time (hours) without exceeding regulatory dose limit				
Day (24-h cycles) 0 (beginning with treatment)	5.9	3.9	2.9	2.0
Day (24-h cycles) 1	9.2	6.1	4.6	3.1
Day (24-h cycles) 2	13.0	8.7	6.5	4.3
Day (24-h cycles) 3	–	10.6	8.0	5.3

2B-2. Thyroid carcinoma/remnant ablation

	mCi (MBq) administered			
	50 (1850)	*100 (3700)*	*150 (5550)*	*200 (7400)*
Travel time (hours) without exceeding regulatory dose limit				
Day (24-h cycles) 0 (beginning with treatment)	1.2	0.6	0.4	0.3
Day (24-h cycles) 1	3.0	1.5	1.0	0.8
Day (24-h cycles) 2	7.2	3.8	2.5	1.9
Day (24-h cycles) 3	15.0	7.5	5.0	3.8
Day (24-h cycles) 4	–	15.0	10.0	7.5

Examples should be modified to meet local and specific patient needs. These examples are based on dose rate of 0.17 mrem h^{-1} mCi^{-1} at 1 m (16,17), 500 mrem per year for family member and caregiver, 100 mrem for pregnant women, children, and the public, and Occupancy Factors for adults of 0.25 except for sleeping 0.33. Resumption of sleeping with a partner assumes a distance of 0.3 m (7).