



# RADIATION POISONING

# INTRODUCTION



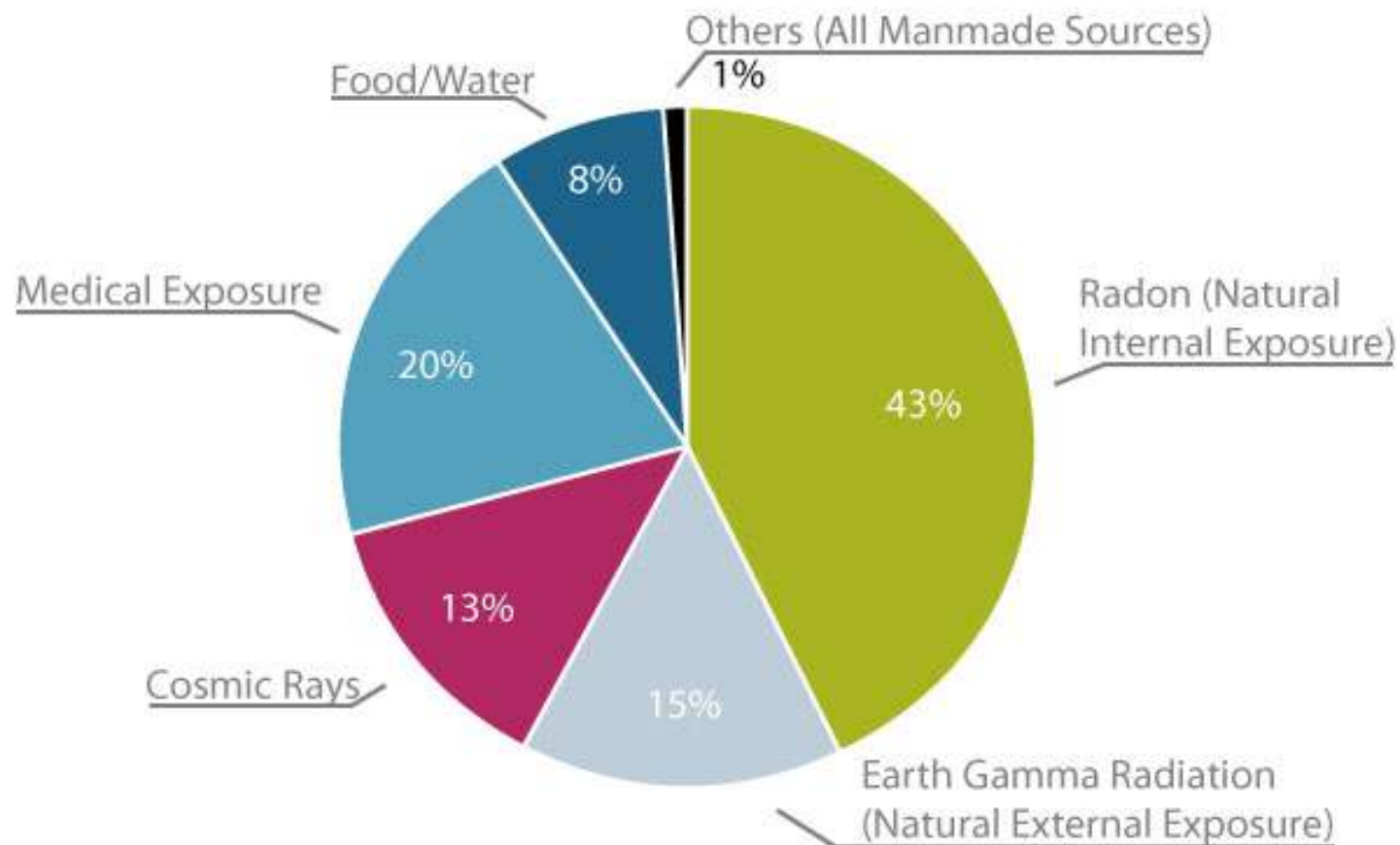
- Radiation is a form of energy whose sources are ***synthetic and naturally*** occurring.
- Small quantity of radioactive materials is available in the environment and are referred to as internal exposure.
- External exposure result from *sunlight radiation* and from synthetic and naturally occurring radioactive material.
- Radiation poisoning is also known as ***Radiation sickness***
- Radiation is often categorized as either ***ionized or non ionized*** depending on the energy of radiated particles

# TYPES OF RADIATION



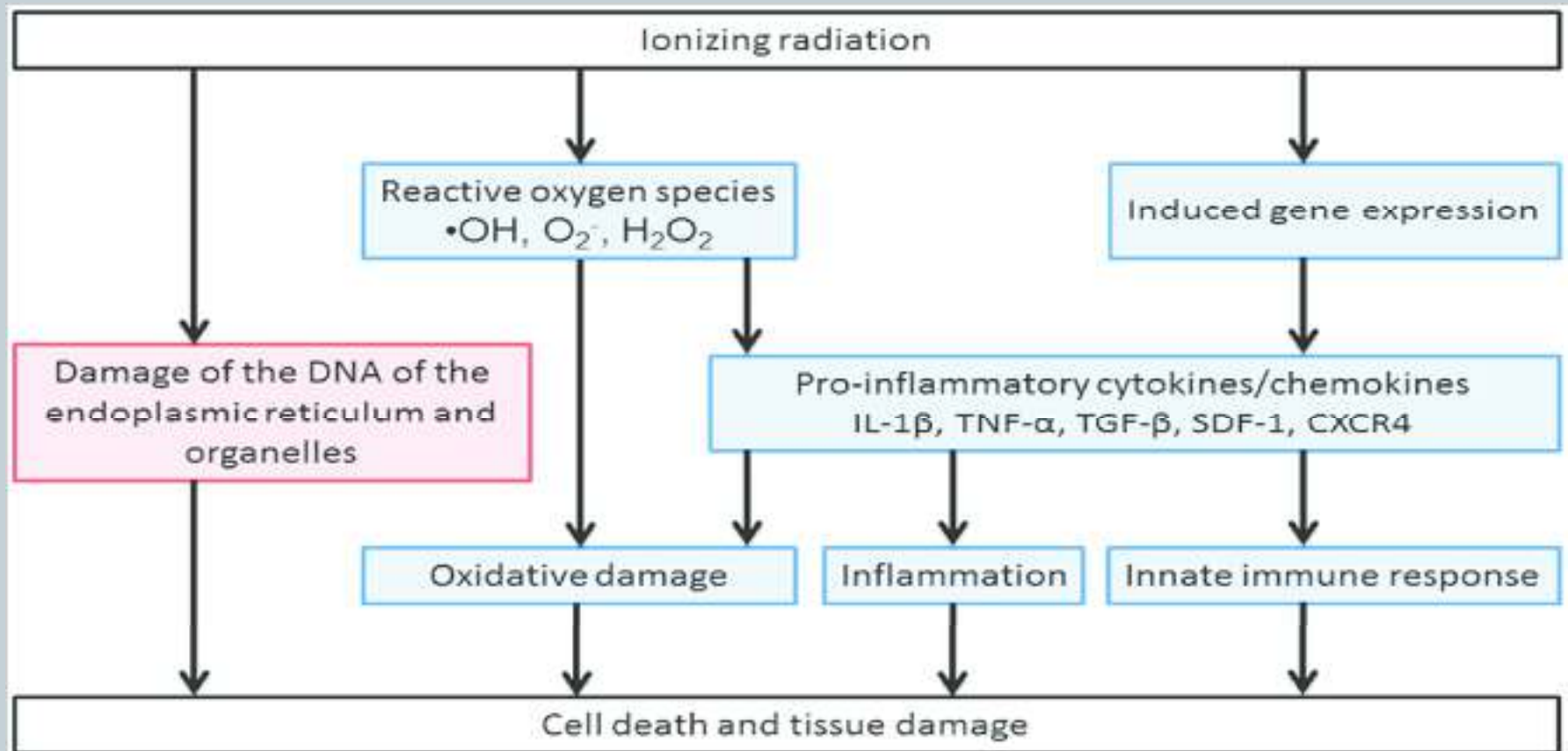
- **IONISING RADIATION-E.g. ultraviolet (UV), x-ray, and gamma frequencies.**
- **NON IONISING RADIATION-E.g. Radiofrequency (Rf), Microwave, Infrared (IR), Visible, and lower-energy Ultraviolet (UV) frequencies.**

# SOURCES OF RADIATION



# MECHANISM OF RADIATION EXPOSURE

- IONISING RADIATION:



□ Direct mechanisms

□ Indirect mechanisms



- **NON IONISING RADIATION:**

**Cause biologic damage - *the production of heat.***

**Unless exposure to non-ionizing radiation produces so much heat that it overwhelms the body's capacity to dissipate it, there will be no damage.**

**When more heat is produced than can be dissipated, heat builds up, and burns occur**

# SAFE DOSE EXPOSURE



- **Exposure to the general population (a maximum of 0.5 rem (radiation equivalent, man) per person per year**
- **Occupational exposure to x-rays (5 rem/year to the total body)**
- **Radiation during pregnancy (50 mrem per month)**

# LETHAL DOSE



- **In man, the median lethal dose of radiation (LD<sub>50/60</sub>) is estimated to be 3.5 Gy.**



# CLINICAL PRESENTATION



## OCULAR EFFECTS :

**Eye irritation, Corneal burns, Cataracts, Photoreinitis, Keratoconjunctivitis.**

## HEMATOLOGICAL :

**Increased total WBCs, lymphocytopenia, monocytosis.**

## GASTROINTESTINAL:

**Peptic ulcer, chronic gastritis, Unspecified liver disorders, Nausea, Dizziness**



## DERMATOLOGIC

**Photosensitivity, Erythema(Skin ("sun") burn), Skin cancer, Thermal burn, Hyperesthesia.**

## REPRODUCTIVE

**Abortion, Fertility decreased in female,  
Congenital anomaly**

## CARCINOGENECITY

**Skin cancer, brain carcinoma, Leukemia,  
Lymphomas**



## **ACUTE RADIATION SYNDROME**

**Acute Radiation Syndrome (ARS) is an acute illness caused by irradiation of the entire body (or most of the body) by a high dose of penetrating radiation in a very short period of time.**

**Acute radiation syndrome has four clinical phases:**

- **prodrome,**
- **latent,**
- **manifest illness,**
- **recovery.**

Syndrome	Prodromal Stage	Latent Stage	Manifest Illness Stage	Recovery
Hematopoietic (Bone Marrow)	<p>Symptoms are anorexia, nausea and vomiting.</p> <ul style="list-style-type: none"> <li>• Onset occurs 1 hour to 2 days after exposure.</li> <li>• Stage lasts for minutes to days.</li> </ul>	<p>Stem cells in bone marrow are dying, although patient may appear and feel well.</p> <ul style="list-style-type: none"> <li>• Stage lasts 1 to 6 weeks.</li> </ul>	<p>Symptoms are anorexia, fever, and malaise.</p> <ul style="list-style-type: none"> <li>• Drop in all blood cell counts occurs for several weeks.</li> <li>• Primary cause of death is infection and hemorrhage.</li> <li>• Survival decreases with increasing dose.</li> </ul>	<p>in most cases, bone marrow cells will begin to repopulate the marrow.</p> <ul style="list-style-type: none"> <li>• There should be full recovery for a large percentage of individuals from a few weeks up to two years after exposure.</li> </ul>

Syndrome	Prodromal Stage	Latent Stage	Manifest Illness Stage	Recovery
Gastrointestinal (GI)	<ul style="list-style-type: none"> <li>• Symptoms are anorexia, severe nausea, vomiting, cramps, and diarrhea.</li> <li>• Onset occurs within a few hours after exposure.</li> <li>• Stage lasts about 2 days.</li> </ul>	<ul style="list-style-type: none"> <li>• Stem cells in bone marrow and cells lining GI tract are dying, although patient may appear and feel well.</li> <li>• Stage lasts less than 1 week.</li> </ul>	<ul style="list-style-type: none"> <li>• Symptoms are malaise, anorexia, severe diarrhea, fever, dehydration, and electrolyte imbalance.</li> <li>• Death is due to infection, dehydration, and electrolyte imbalance.</li> <li>• Death occurs within 2 weeks of exposure.</li> </ul>	<ul style="list-style-type: none"> <li>• the LD100<sup>±</sup> is about 10 Gy (1000 rads)</li> </ul>

Syndrome	Prodromal Stage	Latent Stage	Manifest Illness Stage	Recovery
Cardiovascular (CV)/ Central Nervous System (CNS)	<ul style="list-style-type: none"> <li>• Symptoms are extreme nervousness and confusion; severe nausea, vomiting, and watery diarrhea; loss of consciousness; and burning sensations of the skin.</li> <li>• Onset occurs within minutes of exposure.</li> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Patient may return to partial functionality.</li> <li>• Stage may last for hours but often is less.</li> </ul>	<ul style="list-style-type: none"> <li>• Symptoms are return of watery diarrhea, convulsions, and coma.</li> <li>• Onset occurs 5 to 6 hours after exposure.</li> <li>• Death occurs within 3 days of exposure.</li> </ul>	<ul style="list-style-type: none"> <li>• No recovery is expected.</li> </ul>



**Brain:** May cause seizures

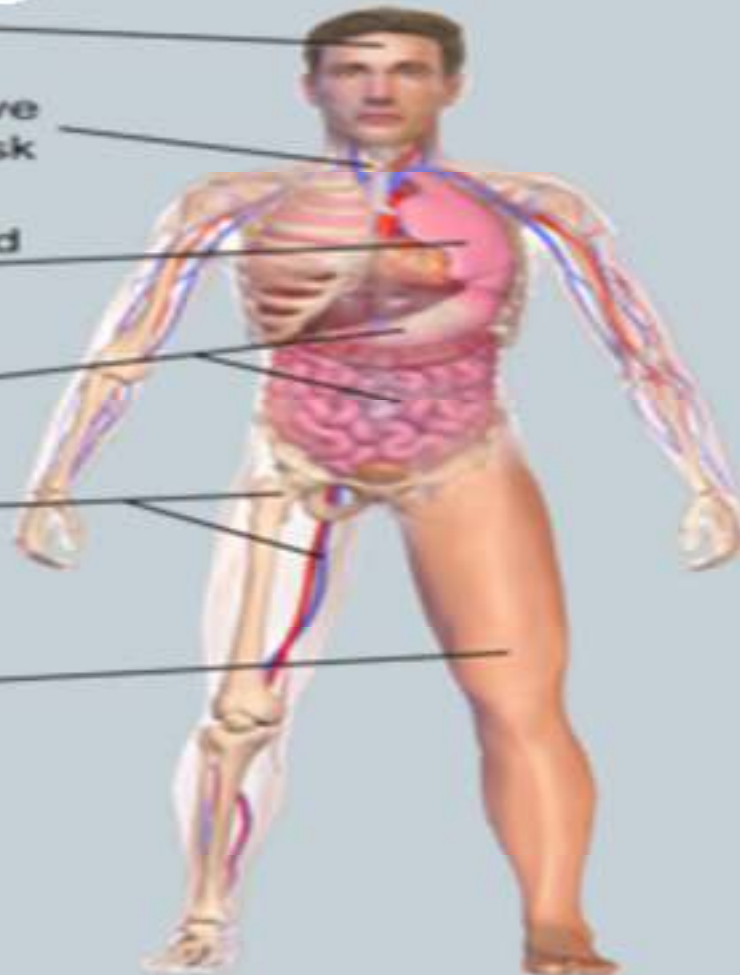
**Thyroid gland:** Absorbs radioactive iodine increasing thyroid cancer risk

**Lungs:** Inflammation, scarring, and possible cancer risk

**GI Tract:** Internal bleeding

**Bone marrow and blood vessels:** Loss of white blood cells increasing risk of infection

**Skin:** Burns from acute exposure



## **Selected Risks from Radiation Sickness**

# DIAGNOSIS



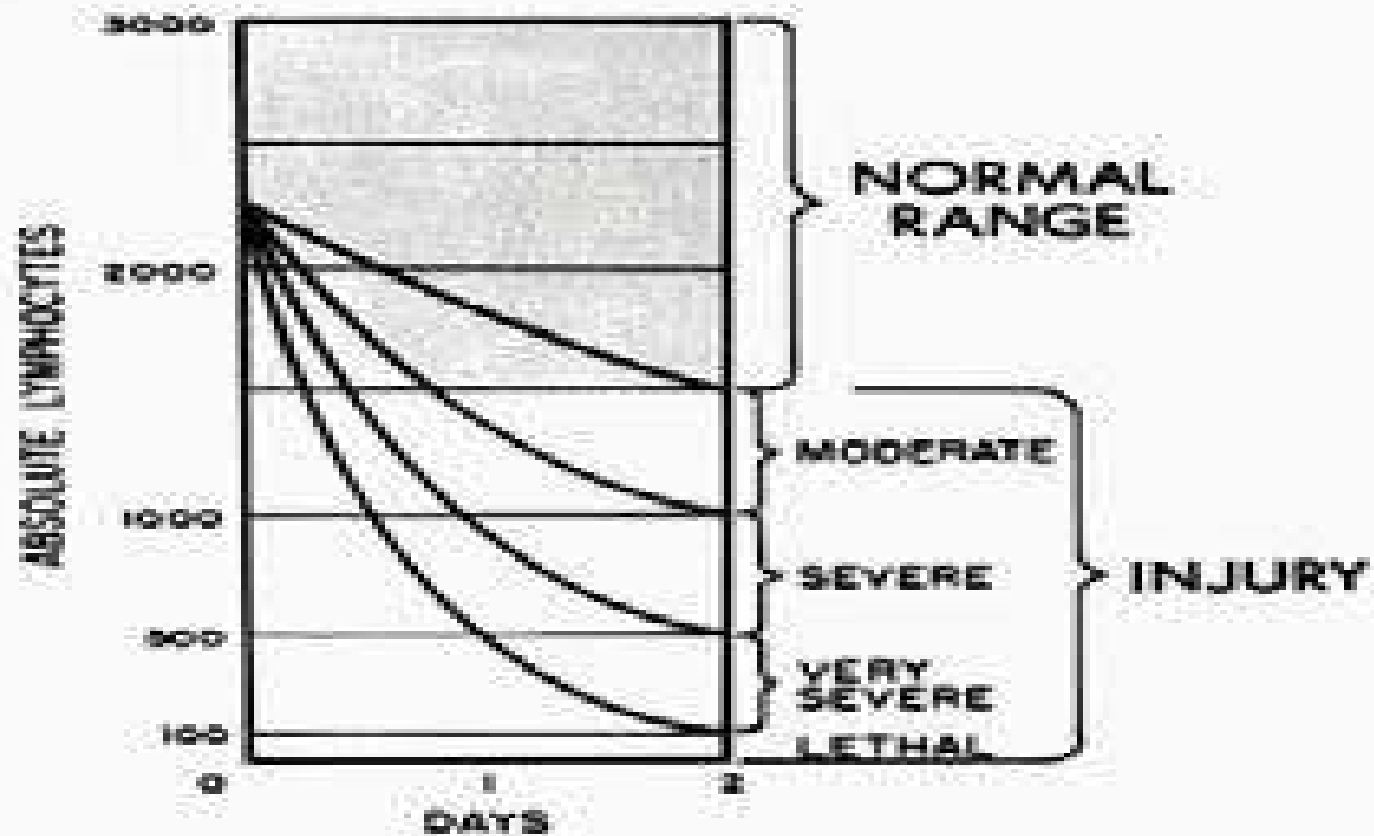
**KNOWN EXPOSURE: Details about distance from the source of radiation and duration of exposure can help provide a rough estimate of the severity of radiation sickness.**

**Baseline laboratory studies should include a CBC with differential count(lymphocyte count), platelet count, and electrolyte panel,**

**These studies should be repeated frequently in the first 48 hours postexposure.**



## ANDREWS LYMPHOCYTE NOMOGRAM





**SLIT LAMP EXAMINATION:--is useful for surveillance of individuals occupationally exposed to *RADIOFREQUENCIES* known to cause lens or retinal damage .**

**DOSIMETER:-**

**A device called a dosimeter can measure the *absorbed dose of radiation* but only if it was exposed to the same radiation event as the affected person.**

# TREATMENT



- If radiation exposure is suspected:
- **Secure ABCs (airway, breathing, circulation) and physiologic monitoring (blood pressure, blood gases, electrolyte and urine output) as appropriate.**

## DERMAL EXPOSURE

- **Decontamination involves removing external radioactive particles.**
- **Removing clothing and shoes eliminates about 90 percent of external contamination.**
- **Gently washing with water and soap removes additional radiation particles from the skin.**
- **It also lowers the risk of internal contamination from inhalation, ingestion or open wounds.**



## BURN

### DEBRIDEMENT

**After initial flushing with large volumes of water to remove any residual chemical material, clean wounds with a mild disinfectant soap and water.**

### TOPICAL ANTIBIOTIC

**Prophylactic topical antibiotic therapy with silver sulfadiazine is recommended for all burns.**

**SYSTEMIC ANTIBIOTIC- not indicated unless infection is present.**



## **DRESSING**

**Depending on the site and area, the burn may be treated open (face, ears, ) or covered with sterile nonstick porous gauze. The gauze dressing should be fluffy and thick enough to absorb all drainage.**

**Alternatively, a petrolatum fine-mesh gauze dressing may be used alone on partial-thickness burns.**

**Daily dressing changes are indicated if a burn cream is used; changes every 3 to 4 days are adequate with a dry dressing.**

**Analgesics such as acetaminophen with codeine may be used for pain relief if needed.**



## BONE MARROW SUPPRESSION

- A protein called **granulocyte colony-stimulating factor**, which promotes the growth of white blood cells, may counter the effect of radiation sickness on bone marrow.
- Treatment with this protein-based medication, which includes *filgrastim* (Neupogen), *sargramostim* (Leukine) and *pegfilgrastim* (Neulasta), may increase white blood cell production and help prevent subsequent infections.
- If you have severe damage to bone marrow, you may also receive transfusions of red blood cells or blood platelets.
- *Filgrastin-10 mcg/kg via short IV infusion (over 15 to 30 minutes) OR continuous IV infusion.*
- *Pegfilgrastin- 6 mg subcutaneously once a week*  
*Duration of treatment: 2 weeks*



## INTERNAL CONTAMINATION

- **During a radiological or nuclear emergency, radioactive materials may be released into the air and then breathed into the lungs, or may get into the body through open wounds.**
- **Radioactive materials can also contaminate the local food supply and get into the body through eating or drinking. This is called internal contamination.**
- **The sooner internal contamination is removed from the body, the fewer and less severe the health effects will be.**
- **Small amounts of internal contamination may not need treatment.**
- **Some medical treatments are available for limiting or removing internal contamination depending on the type of radioactive material involved.**
- [Potassium Iodide \(KI\)](#)
- [Prussian Blue](#)
- [DTPA \(Diethylenetriamine pentaacetate\)](#)



- **POTASSIUM IODIDE**

- If you're exposed to significant radiation, your thyroid will absorb radioactive iodine (radioiodine) just as it would other forms of iodine. The radioiodine is eventually cleared from the body in urine.
- If you take potassium iodide, it may fill "vacancies" in the thyroid and prevent the absorption of radioiodine. Potassium iodide isn't a cure-all and is most effective if taken within a day of exposure.
- Infants have the highest risk of getting thyroid cancer after being exposed to radioactive iodine.

**Table 1. FDA-Recommended  
Potassium Iodide Dosing**

<b>Age</b>	<b>Dosage</b>
18 y and older	130 mg/24 h
3 to 18 y	65 mg (1/2 tablet)
1 mo to 3 y	32 mg (1/4 tablet)
Younger than 1 mo	16 mg (1/8 tablet)

*Source: Reference 2.*





## PRUSSIAN BLUE

- **This type of dye binds to particles of radioactive elements known as cesium and thallium.**
- **The radioactive particles are then excreted in feces.**
- **This treatment speeds up the elimination of the radioactive particles and reduces the amount of radiation cells may absorb.**
- **Prussian blue is given in 500mg capsules that can be swallowed whole**

# HOW PRUSSIAN BLUE WORKS

Prussian blue is a pill that may be used in a radiation emergency to help remove radioactive cesium (Cs) and thallium (Tl) from inside a person's body.



Prussian blue traps radioactive cesium and thallium in the intestines and keeps them from being reabsorbed by the body.



The radioactive materials then move through the intestines and are passed (excreted) in bowel movements.

Because Prussian blue reduces the time that radioactive cesium and thallium stay in the body, it helps limit the amount of time the body is exposed to radiation.

Prussian blue is available only by prescription. Public health and medical professionals will determine if Prussian blue is needed.

People **SHOULD NOT** take Prussian blue artist's dye in an attempt to treat themselves. This type of Prussian blue is not designed to treat radioactive contamination and can be harmful.



U.S. Department of  
Health and Human Services  
Centers for Disease  
Control and Prevention

<http://emergency.cdc.gov/radiation>



- **DTPA**
- **This substance binds to metals. DTPA binds to particles of the radioactive elements plutonium, americium and curium.**
- **The radioactive particles pass out of the body in urine, thereby reducing the amount of radiation absorbed.**
- **DTPA can be injected directly into a vein in the arm or dripped into a vein from a bag (intravenously [IV]).**

# CASE PRESENTATION



- Patient :Thirty-one-year-old male.
- Chief complaint: Anorexia, general weakness, vomiting, and mild dizziness for several days.
- Past medical history and family disease: No specific findings.
- Social history: Current smoker (15 pack-years) and social drinker. The patient had worked for **5 years as a non-destructive testing worker**. The patient visited the hospital via the emergency room, and underwent a complete blood count test and bone marrow biopsy. It was revealed that the patient performed **non-destructive tests without radiation shielding when working in high places of the large pipe surface**.



## PHYSICAL EXAMINATION

- Patient was conscious ,anemic.
- BP-140/80mmHg
- Temp-98.4 C
- PR-104 beats/min
- RR-20 /min
- The venous injection areas had bruises and bleeding tendency. There were no abnormal findings in the cornea and lens of the eye.



- LABORATORY FINDINGS
- ON THE DAY OF ADMISSION
- The patient showed the symptoms of severe *pancytopenia*.

VARIABLES	NORMAL RANGES	OBSERVED VALUES
Hemoglobin (Hb)	12-18gm/dl	9.4 gm/dl
WBC	4000-10,800 cells/mm <sup>3</sup>	1360 cells/mm <sup>3</sup>
platelets (Pt)	130–450 × 10 <sup>3</sup> /mm <sup>3</sup>	14 × 10 <sup>3</sup> /mm <sup>3</sup>



- **DAY 2-The Hb, WBC and Platelet count decreased further. As the condition started deteriorating, transfusion of packed RBC and platelets were started.**
- **The laboratory results showed a slight recovery after 26 days from the date of prohibition of work:** *white blood cell count: 2200 cells/mm<sup>3</sup>, absolute neutrophil count: 760 cells/mm<sup>3</sup>, absolute lymphocyte count: 1080 cells/mm<sup>3</sup>.*
- **After a 13-month follow-up on the blood test, pancytopenia improved over time.**

# MULTIPLE CHOICE QUESTION



1. The ability of photon energy to displace electrons off their atomic nuclei
  - a) Non ionizing radiation
  - b) ionizing radiation
  - b) Vibrational radiation
  - d) rotational radiation
2. A gamma particle is a high energy
  - a) electron
  - b) neutron
  - c) molecule
  - d) photon
3. Exposure to more than -----radiation absorbed dose causes nausea and vomiting.
  - a) 73
  - b) 63
  - b) 75
  - d) 65





4. Exposure to more than 400 rad is potentially lethal
  - a) with medical intervention
  - b) without medical intervention
  - c) improper intervention
  - d) both A and B
5. Nausea, vomiting, abdominal cramp and diarrhea is including in
  - a) prodromal stage
  - b) latent stage
  - c) manifest illness stage
  - d) recovery stage
6. Prussian blue is used in treating the poisoning of
  - a) iodine
  - b) cesium
  - c) strontium
  - d) plutonium
7. Potassium iodide, FDA –recommended dosing for 3 to 18 years old is
  - a) 16mg
  - b) 32mg
  - c) 130mg
  - d) 65mg
8. Recommended exposure dose during pregnancy is
  - a) 50 mrem per month
  - b) 60 mrem per month
  - c) 53 mrem per month
  - d) 65 mrem per month
9. Treatment with protein based medication may
  - a) decrease WBC production
  - b) decrease RBC production
  - c) increase WBC production
  - d) increase RBC production
10. Most women consequences of exposure to direct low energy rays are
  - a) burns and thermal injury
  - b) epithelial injury
  - c) skin injury
  - d) discolouration of skin