# SNS COLLEGE OF ALLIED HEALTH SCIENCES- COIMBATORE 35

DEPARTMENT : RADIOGRAPHY AND IMAGNG TECHNOLOGY

SUBJECT : GENERAL PHYSICS, RADIATION PHYSICS AND PHYSICS OF DIAGNOSTIC RADIOLOGY

PAPER : PAPER II ( UNIT 3 – RADIOACTIVITY )

TOPIC : 1. SOURCES OF RADIATION
2. NATURAL RADIATION SOURCES
3. ARTIFICIAL RADIATION SOURCES

# SOURCES OF RADIATION

- The sources of radiation are classified into
- ( i) Natural radiation sources,
- ( ii ) Enhanced natural sources,
- ( iii) Artificial radiation sources ( man made ) and
- ( iv ) occupational exposures
- About 82 % of the exposure ( 3 mSv ) arise from naturally occurring sources, 18% arise from technologic enhancements of naturally occurring sources ,18% (0.6mSv) arise from technology enhancements of naturally occurring source and artificial radiation sources ( diagnostic X-ray is a major contributor ).

# SOURCES OF RADIATION

## NATURAL RADIATION SOURCES

- Natural radiation sources includes cosmic rays, terrestrial radionuclides and internal radio isotopes.

## COSMIC RAYS

- Cosmic rays are extra terrestrial radiation that strike the earth atmospheres that includes primary and secondary.
- Primary cosmic rays in which protons accounts for 80% .the primary cosmic rays collide with atmosphere, producing showers of secondary particles ( electrons and muons ) And electromagnetic radiations the average per capita equivalent dose is 270μSv per year, which makes 8% of natural background.
- A part of secondary cosmic rays particles collide with stable atmospheric nuclei and produce cosmogenic radionuclides. Examle $7N^{14}$ ( n,p ) , $6C^{14}$ but the contribution to the natural background is very little.

# SOURCES OF RADIATION

## TERRESTRIAL RADIONUCLIDES

- terrestrial radionuclides that have been present on earth since its formation are called primordial radionuclides. Their physical half lives are comparable to the age of the earth ( 4.5 billion years ). Their decay products are the major contributors of the terrestrial radiations. They mainly contribute in the form of external exposure, inhalation and ingestion

## EXTERNAL EXPOSURE

- K-40, U-238 and Th-232 are mainly responsible for external exposure and they account an equivalent dose of 280μSv per year. This may vary depending upon the local concentration of terrestrial radionuclides.

# SOURCES OF RADIATION

**INHALATION:**

- Rn-222 (u-238) is a noble gas, decays to polonium-218 by alpha emission with the half life of 3.8 days. Its decay product are the most significant source of inhalation exposure. It is deposited in the tracheobronchial region of the lung
- Radon inhalation accounts an equivalent dose of 2mSv/year to the bronchial epithelium. It accounts for about 55% of the natural background, which can be easily measured and reduced

**INGESTION**

- ingestion of food and water is the second largest sources of natural background in which K-40 is the most significant. It is a naturally occurring isotopes of potassium having concentration at the skeletal muscle it account an average equivalent dose rate of 400 μSv/year .

# SOURCES OF RADIATION

## INTERNAL RADIONUCLIDES

- Internal radionuclides includes K-40 and C-14, which are present in the human body. The main contributor is K-40, which emits β and γ rays and decays with the half life of $1.3 \times 10^9$ years.

## ENHANCED NATURAL SOURCES

- Enhanced natural sources mainly consists of consumer products. The largest contributor is tobacco products.
- Building material consists of uranium, thorium and potassium and these are present in brick, concrete, granite which may contribute an annual effective dose of 30μSv / year.
- Mining and agricultural activity contribute to a lesser level by fertilizers (uranium, thorium decay products K-40 )

# SOURCES OF RADIATION

## ARTIFICIAL SOURCES

- The artificial sources of radiation includes medical exposure, radioactive fallout, nuclear power and occupational exposure.

## MEDICAL EXPOSURE

- Majority of the exposure is the from medical X-rays ( fluoroscopy and CT ) which contribute to 58% of the artificial radiation exposure. Next contributor is the nuclear medicine which is 21%. Both produces an annual average dose equivalent of 540μSv per year.it accounts for about 69% of artificial radiation.

# SOURCES OF RADIATION

## CONSUMER PRODUCTS

- It accounts to 16% of the artificial radiation exposure. Substances in consumer products such as tobacco, the domestic water supply, building materials, and to a lesser extent, smoke detectors, televisions, and computer screens, accounts for the above exposure.

## RADIOACTIVE FALLOUT

- It arises from atmospheric testing of nuclear weapons and consists of Carbon-14 ( 70% ) And other radionuclides including H-3, Mn-54, Cs-136,137, Ba- 140, Ce-144, plutonium and transplutonium elements. It results in an annual effective dose equivalent of < 10μSv. It contributes 2% of the manmade radiation exposures.

## NUCLEAR FUEL CYCLE

- The contribution from nuclear power production is very minimal, which is about 1% of artificial radiation.it involve all phases of fuel cycle; mining, manufacturing, reactor operations, and waste disposal.

# SOURCES OF RADIATION

## OCCUPATIONAL EXPOSURE

- The occupational exposures associates with the uranium mining ( 12mSV / year), nuclear power operations, medical diagnosis and therapy, aviation and research, non uranium mining, and applications of phosphate fertilizers. It contributes about 2% of the artificial radiation exposure.
- Radiologists, X-ray technologist receive an average annual effective dose of 1μSv. however special procedures involving fluoroscopy and cini-radiology ( eg: cardiac catheterization )may exceed 15mSv. These are only partial body exposures, if lead apron is used during this procedure.

# INTERROGATIONS

1. What is natural radiation sources
2. What is Manmade radioactive sources
3. Explain about enhanced radiation sources
4. Explain about occupational exposure

# REFERENCES


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# THANK YOU