

RADIO PHARMACEUTICALS

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Radiopharmaceuticals: These are the pharmaceutical formulations consisting of radioactive substances (radioisotopes and molecules labeled with radioisotopes), which are intended for use either in diagnosis or therapy or diagnosis.

- About forty radioactive elements are known which are arranged in to families such as uranium, thorium and actinium series.
- The elements are termed as radioactive elements because they are unstable and undergo spontaneous decomposition accompanied by emission of radiations or rays.
- The emission of radiations by radioactive substances is not influenced by temperature, pressure, concentration or a catalyst.

Radioactivity: The phenomenon of a spontaneous emission of certain kind of invisible radiations by certain substances is called radioactivity.

Units of Radioactivity:

1. In the International System (SI), the unit of radioactivity is one nuclear transmutation per second and is expressed in **Becquerel (Bq)**, named after the scientist Henri Becquerel.

The Becquerel (Bq) is the SI derived unit of radioactivity. One becquerel is defined as the activity of a quantity of radioactive material in which one nucleus decays per second. The activity of a source is measured in becquerel.

This is a very small unit, and multiples are often used:

- **1 MBq = 1 mega Becquerel = 1,000,000 Bq**
- **1 GBq = 1 giga Becquerel = 1,000,000,000 Bq**
- **1 TBq = 1 tera Becquerel = 1,000,000,000,000 Bq**

2. The **Sievert (Sv)** is a measure of the health effects of low levels of ionizing radiation on the human body. At equal doses, the effects of radioactivity on living tissue depends on the type of radiation (alpha, beta, gamma, etc.), on the organ concerned and also on the length of exposure.

Contrary to the Becquerel, the sievert is a very large unit, and we often use sub-multiples:

- **1 mSv = 1 millisievert = 0.001 Sv**
- **1 μSv = 1 microsievert = 0.000001 Sv**

3. **Curie (Ci):** named after the scientists *Madame Marie Curie* and *Pierre Curie*, the pioneers who studied the phenomenon of radioactivity.

It may be defined as the quantity of any radioactive substance which undergoes the same number of disintegrations in unit time as **1gm of radium is equal to 3.7×10^{10} disintegrations per second (dps)**

The sub-units have been termed as:

- **1 millicurie (mc) = 1×10^{-3} of curie = 3.7×10^7 dps**
- **1 microcurie (μ) = 1×10^{-6} of curie = 3.7×10^4 dps**

After Curie, it was replaced with Rutherford.

4. **Rutherford (Rd):** It is defined as an amount of a radioactive substance which undergoes 10^6 dps
 5. **Roentgen (R):** It is the unit of exposure
 - **1 R = 2.58×10^{-4} C Kg⁻¹** (C = a Coulomb)
 6. **RAD:** It is the unit of absorbed dose
 - **1 rad = 10^{-2} J kg⁻¹**

The energy absorption equivalent of one roentgen in air has been 0.87 RAD and for water it is 0.97 RAD.
 7. **REM:** It refers to the unit of dose equivalent. The dose in REM has been equal to the dose in RADs multiplied by quality factor and the distribution factor.
 8. **Exposure rate constant:** It refers to the dose rate in roentgens per hour at 1m distance from 1 curie. It is about one-tenth of the dose at a distance of 1 foot from curie.
 9. **Relative Biological Effectiveness (RBE):** The effect of given radiation on biological system depends upon the type of radiation a unit known as RBE. This expresses the relative effects of radiations α , β and γ on the biological systems.
- ❖ **Pharmaceutical dosage forms may be described in terms of RAD units.**