## Adimula Sharon Ebere

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## 1. What are radioactive tracers

## Radioactive tracers are made up of carrier molecules that are bonded tightly to a radioactive atom. These carrier molecules vary greatly depending on the purpose of the scan. Some tracers employ molecules that interact with a specific protein or sugar in the body and can even employ the patient’s own cells, For most diagnostic studies in nuclear medicine, the radioactive tracer is administered to a patient by intravenous injection. However a radioactive tracer may also be administered by inhalation, by oral ingestion, or by direct injection into an organ. The mode of tracer administration will depend on the disease process that is to be studied.

## Radioactive tracers form the basis of some medical imaging systems, such as PET scans. Radio labeling is used in research to trace the path of elements in biochemical reactions and cells. Radioisotopes are also used to track the flow of fluids, particularly in the petroleum and natural gas industry.

2. **Discuss explicitly one application of tracer in medicine**

Radioactive tracers are used in positron Emission tomography (PET) scans is a type of nuclear medicine procedure that measures metabolic activity of the cells of body tissues. PET is actually a combination of nuclear medicine and biochemical analysis. Used mostly in patients with brain or heart conditions and cancer, PET helps to visualize the biochemical changes taking place in the body, such as the metabolism (the process by which cells change food into energy after food is digested and absorbed into the blood) of the heart muscle.

Since PET is a type of nuclear medicine procedure, this means that a tiny amount of a radioactive substance, called a radiopharmaceutical (radionuclide or radioactive tracer), is used during the procedure to assist in the examination of the tissue under study. Specifically, PET studies evaluate the metabolism of a particular organ or tissue, so that information about the physiology (functionality) and anatomy (structure) of the organ or tissue is evaluated, as well as its biochemical properties. Thus, PET may detect biochemical changes in an organ or tissue that can identify the onset of a disease process before anatomical changes related to the disease can be seen with other imaging processes such as computed tomography (CT) or magnetic resonance imaging (MRI).

PET works by using a scanning device (a machine with a large hole at its center) to detect photons (subatomic particles) emitted by a radionuclide in the organ or tissue being examined.

The radionuclides used in PET scans are made by attaching a radioactive atom to chemical substances that are used naturally by the particular organ or tissue during its metabolic process. For example, in PET scans of the brain, a radioactive atom is applied to glucose (blood sugar) to create a radionuclide called fluorodeoxyglucose (FDG), because the brain uses glucose for its metabolism. FDG is widely used in PET scanning.

Other substances may be used for PET scanning, depending on the purpose of the scan. If blood flow and perfusion of an organ or tissue is of interest, the radionuclide may be a type of radioactive oxygen, carbon, nitrogen, or gallium.

The radionuclide is administered into a vein through an intravenous (IV) line. Next, the PET scanner slowly moves over the part of the body being examined. Positrons are emitted by the breakdown of the radionuclide. Gamma rays are created during the emission of positrons, and the scanner then detects the gamma rays. A computer analyzes the gamma rays and uses the information to create an image map of the organ or tissue being studied. The amount of the radionuclide collected in the tissue affects how brightly the tissue appears on the image, and indicates the level of organ or tissue function.