

What is radiation?

# What is nuclear medicine?

What kind of diseases can nuclear medicine diagnose?

Is the radioactivity harmful?

Do radiopharmaceuticals hurt when they are given?

How is nuclear medicine different from an x-ray, a CT scan, an ultrasound, or an MRI?

## What is nuclear medicine?



Nuclear medicine is a medical specialty that is used to diagnose and treat diseases in a safe and painless way. Nuclear medicine procedures permit the determination of medical information that may otherwise be unavailable, require surgery, or necessitate more expensive and invasive diagnostic tests. The procedures often identify abnormalities very early in the progression of a disease — long before some medical problems are apparent with other diagnostic tests. This early detection allows a disease to be treated sooner in its course when a more successful prognosis may be possible.

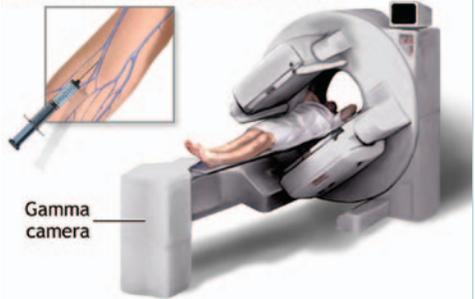
## Why is it called nuclear medicine?

Nuclear medicine refers to medicine (a pharmaceutical) that is attached to a small quantity of radioactive material (a radioisotope). This combination is called a radiopharmaceutical. There are many different radiopharmaceuticals available to study different parts of the body. Which radiopharmaceutical is used will depend upon the condition to be diagnosed or treated.

## How do radiopharmaceuticals work?

Radiopharmaceuticals are introduced into the patient's body by injection, swallowing, or inhalation. The amount given is very small. The pharmaceutical part of the radiopharmaceutical is designed to go to a specific place in the body where there could be disease or an abnormality. The radioactive part of the radiopharmaceutical that emits radiation, known as gamma rays (similar to x-rays), is then detected using a special camera called a gamma camera. This type of camera allows the nuclear medicine physician to see what is happening inside your body. During this imaging procedure, the patient is asked to lie down on a bed and then the gamma camera is placed a few inches over the patient's body. Pictures are taken over the next few minutes. These images allow expert nuclear medicine physicians to diagnose the patient's disease.

The radiotracer, injected into a vein, emits gamma radiation as it decays. A gamma camera scans the radiation area and creates an image.



## Do gamma cameras come in different shapes and sizes?

Yes. There are several types of gamma cameras, small and large. Depending upon the kind of pictures that need to be taken, these cameras will operate in a stationary mode, move across the body or rotate around the body. Gamma cameras do not hurt, nor do they make any noise that might frighten patients. Also, unlike other imaging devices, such as CT scanners, ultrasound and MRI, gamma cameras do not transmit any radiation to the patient.



## Are radiopharmaceuticals safe?

Absolutely. Like any medicine, they are prepared with great care. Before they are used, they are tested carefully and are approved for use by the U.S. Food and Drug Administration. The quantity of the pharmaceutical part of the radiopharmaceutical is very small, generally  $1/10^{\text{th}}$  of a millionth of an ounce. The risk of a reaction is 2-3 incidents per 100,000 injections, over 50% of which are rashes, as compared to 2000-3000 per 100,000 injections of x-ray contrast media.

## Do radiopharmaceuticals hurt when they are given?

Not at all. They are given in a very small dose, just a few drops.

## Is the radioactivity harmful?

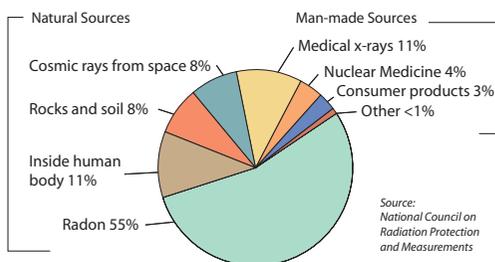
Although exposure to radioactivity in very large doses can be harmful, the radioactivity in radiopharmaceuticals is carefully selected by the nuclear medicine physician to be safe.

## Would I glow after receiving a radiopharmaceutical?

Not at all. The radioactivity given to a patient does not pose any demonstrable health hazard. The amount given is as small as it can be to achieve clear and accurate imaging results. The actual weight of the radioactivity is less than 1/10<sup>th</sup> of a billionth of an ounce.

As a result, radiation exposure is very low and poses little or no risk. The radiation dose received by a patient for a diagnostic procedure averages 300 mrem. This is equal to, or even less than the natural background radiation dose received on a yearly basis by almost every person living in the United States and in many other parts of the world during the course of our daily lives. This natural radiation exposure comes from space, rocks and soil. There is even a small amount of radioactivity that exists naturally in our bodies. We are also exposed to radiation from typical consumer products like household smoke detectors, color television sets, building materials, the domestic water supply, and luminous dial watches and clocks. Many exit signs may even contain radioactive material.

### Natural and Man-made Sources of Radiation

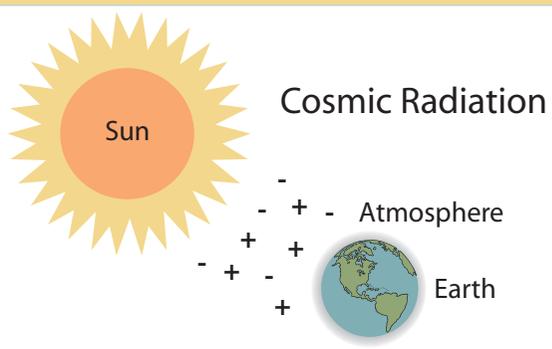


Everyone is also exposed to radiation during air travel. Radiation, known as cosmic radiation, is in the upper atmosphere due to solar and galactic emissions. A typical coast-to-coast flight in the U.S. is responsible for an exposure of approximately 5 mrem.

Chest x-rays, dental x-rays, CT scans, and many other medical procedures also expose patients to radiation.

## What is radiation?

Radiation is simply the release of energy. The most familiar form of radiation is visible light, like that produced by the sun or even a light bulb. Other forms of radiation include radiowaves, microwaves, ultraviolet light, and x-rays and gamma rays used in medical procedures.



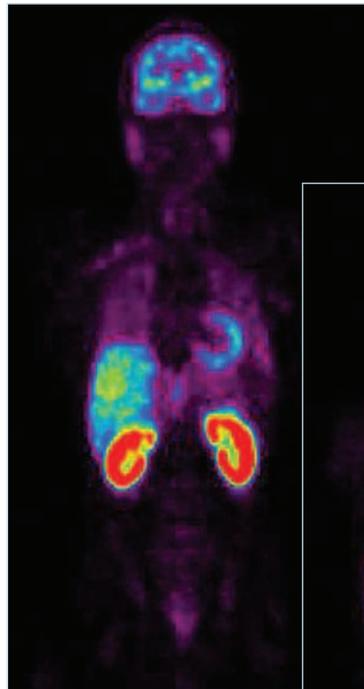
How many nuclear medicine procedures are performed in the U.S.? There are approximately 5,000 nuclear medicine centers in the U.S. Together, they perform nearly 18 million procedures every year. Nearly that many additional procedures are performed in the rest of the world and the number is increasing.

## What kind of diseases can nuclear medicine diagnose?

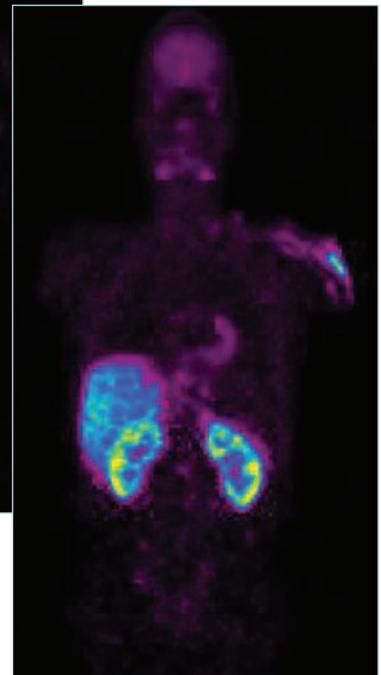
Nuclear Medicine can diagnose many different kinds of diseases. It can be used to identify abnormal lesions deep in the body without exploratory surgery. The procedures can also determine whether or not certain organs are functioning normally. For example, nuclear medicine can determine whether or not the heart can pump blood adequately, if the brain is receiving an adequate blood supply, and if the brain cells are functioning properly or not. Nuclear medicine can determine whether or not the kidneys are functioning normally, and whether the stomach is emptying properly. It can determine a patient's blood volume, lung function, vitamin absorption, and bone density. Nuclear medicine can locate the smallest bone fracture before it can be seen on an x-ray.

It can also identify sites of seizures (epilepsy), Parkinson's disease, and Alzheimer's disease. Nuclear medicine can find cancers, determine whether they are responding to treatment, and determine if infected bones will heal.

After a heart attack, nuclear medicine procedures can assess the damage to the heart. It can also tell physicians how well newly transplanted organs are functioning.



**Non-Smoker  
Normal Enzyme Level**



**Smoker  
Reduced Enzyme Level**

## Can nuclear medicine treat diseases?



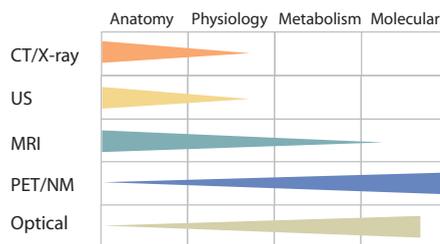
Yes. For instance, thousands of patients with hyperthyroidism are treated with nuclear medicine (using radioactive iodine) every year. It can be used to treat certain kinds of cancers (lymphomas) and it can treat bone pain that is a result of cancer.

Image Copyright © 2004 Nucleus Art, Inc. All rights reserved. [www.nucleusinc.com](http://www.nucleusinc.com)

## How is nuclear medicine different from an x-ray, a CT scan, an ultrasound, or an MRI?

Nuclear medicine can detect the radiation coming from inside a patient's body. All of these other procedures expose the patient to radiation from outside the body using machines that send radiation through the body. As a result, nuclear medicine determines the cause of a medical problem based on organ function in contrast to the other diagnostic tests, that determine the presence of disease based on anatomy or structural appearance. One nuclear medicine procedure, called a PET (positron emission tomography) scan, precisely localizes many types of diseases in the body just by determining how the disease uses sugar. No other imaging method has the ability to use our body's own functions to determine disease status.

### Medical Imaging Modalities and Their Range of Detection



Can I have nuclear medicine procedures performed more than once? Absolutely. Many patients have several performed a year as part of their medical evaluation. Your doctor will help you decide what is right for you.

## Do my doctors need special training to perform nuclear medicine procedures?

Yes. The physician who supervises the procedure and interprets the results is a specially trained and certified physician. The technologists who perform the scans are also specially trained and certified.

## Do I need to do anything special after I have a nuclear medicine procedure?

After most nuclear medicine procedures it is generally best to drink a lot of fluids and urinate as frequently as you can. This helps to flush the remaining radioactivity out of your body. The length of time you need to do this will depend on the kind of study you had and the type of radiopharmaceutical that was used. Again, it is best to ask your doctor.

## If I am a nursing mother, can I continue to nurse my baby after a nuclear medicine procedure?

It is best to stop breastfeeding your baby for anywhere from a few hours to a few days after your nuclear medicine study. For many therapy procedures, nursing may have to stop completely. This depends on what kind of study you are having and the radiopharmaceutical that will be used. Your doctor will give you the best advice.

## How long has nuclear medicine been a medical specialty?

Nuclear medicine is older than CT, MRI, and ultrasound. It was first used in patients over 60 years ago. Today it is an established medical specialty, practiced every day in all major countries in the world. In the United States alone more than 333 million procedures have been performed. That is more than every individual living in the United States.

The National Institutes of Health (NIH) promotes research in nuclear medicine and new advances are made every day. The constant refinement of nuclear medicine equipment and procedures and the development of new radiopharmaceuticals promise to serve patients for generations to come.

If you have any questions, please ask your physician or technologist.  
You can find more information about nuclear medicine at [www.snm.org](http://www.snm.org).

Nuclear medicine procedures are safe and helpful in the management of many diseases. This booklet was prepared to answer frequently asked questions for patients undergoing nuclear medicine procedures. The answers are concise and informative, allowing patients to read the booklet in the waiting room as well as share it with friends and family members. As part of the patient outreach initiative on the occasion of the 50<sup>th</sup> Anniversary of the Society of Nuclear Medicine, it is our hope that patients and their friends and families will share this information with others and continue to spread the word about the safety and efficacy of nuclear medicine for the diagnosis and treatment of disease.

For additional copies of this booklet contact the Society of Nuclear Medicine at 703.708.9000.

*Jeffry A. Siegel, PhD*  
*Mathew Thakur, PhD*  
*Chair, 50<sup>th</sup> Anniversary Task Force*

Created by the SNM 50th Anniversary Task Force.

Photo/Art credits:

Page 2 (top): Philips Medical Systems

Page 2 (bottom): ADAM

Page 3: Seimens Medical Solutions, USA, Inc.

Page 4: U.S. Nuclear Regulatory Commission

Page 5: Brookhaven National Laboratory



The Society of Nuclear Medicine would like to thank MDS Nordion for their support.



Society of Nuclear Medicine  
1850 Samuel Morse Drive • Reston, VA 20190-5316 • [www.snm.org](http://www.snm.org)