Nuclear Medicine Safety

Nuclear Medicine procedures are not difficult and are very safe. These procedures use small amounts of radioactive materials to image different parts of the body.

Many Canadians benefit each year from nuclear medicine procedures used to diagnose and treat a wide variety of diseases and conditions.

What is Nuclear Medicine?
Nuclear medicine uses very small amounts of radioactive materials, called radiopharmaceuticals or radiotracers, to diagnose and treat disease.
The radiation risk involved in these procedures is very low compared with the potential benefits. There are no known long-term adverse side effects from nuclear medicine procedures, which have been performed for more than 50 years. Rarely, allergic reactions may occur but are extremely rare and usually mild.

How are radiopharmaceuticals used?
Nuclear medicine procedures require that a radiotracer be injected, swallowed or inhaled. Each radiotracer is attracted to specific organs, bones, or tissues. A special camera (PET, SPECT or gamma camera) takes pictures of the distribution of the radiotracer in the body.

The use of radiation in these procedures offers a safe means to provide doctors with diagnostic information that would otherwise require exploratory surgery or more expensive or difficult procedures to obtain the same information.

Radiopharmaceuticals are also used for therapy, to treat overactive thyroids and certain types of cancer.

Radiopharmaceuticals are approved by Health Canada and are tested carefully prior to general use and prepared with great care.

How much radiation exposure is involved in nuclear medicine procedures?
Because the amount of radiotracer used is nuclear medicine tests are extremely small, the patient’s radiation exposure is minimal.

Nuclear medicine specialists and technologists use the ALARA principle (As Low As Reasonably Achievable) to carefully select the amount of radiopharmaceutical that will provide an accurate test with the least amount of radiation exposure to the patient. The actual dosage is determined by the reason for the study and the body part being imaged.

The amount of radiation in most nuclear medicine tests is comparable to and often less than that of a diagnostic x-ray. Most nuclear medicine procedures expose patients to about the same amount of radiation as they receive in a few months of normal living.

What Is Radiation?
Radiation is simply a type of energy. The most familiar form of radiation is visible light, like that produced from the sun or a light bulb. Other forms of radiation, such as X-rays and gamma rays, are employed in a number of beneficial applications, including medicine.

Everyday Activities	**Radiation Exposure**
Watching television	.01 mSv/yr
Air travel (roundtrip across Canada)	0.05 mSv
Average annual exposure living in Ontario	2.7 mSv/yr
Average annual exposure from breathing radon gas	2 mSv
Smoking 20 cigarettes a day	53 mSv/yr

Medical Imaging	**Radiation Exposure**
Chest x-ray (1 image)	0.1 mSv
Nuclear medicine thyroid scan	0.14 mSv
Full set of dental X-rays	0.4 mSv/yr
Mammogram (four views)	0.7 mSv
Nuclear medicine lung scan	2 mSv
Nuclear medicine bone scan	4.2 mSv
Nuclear cardiac perfusion scan (Tc-99m)	10 mSv
Abdominal CT scan1	10 mSv
Various PET studies (18F FDG)	14 mSv
Cancer treatment (tumor receives)	50,000 mSv

Natural radiation exposure comes from the earth in rocks and soil and from outer space in the form of cosmic rays. A small amount of radioactive material even exists naturally in our bodies.

Every year, each person is exposed to this natural radiation and radiation from a variety of other sources, including household smoke detectors and color television sets. Air travel increases exposure to cosmic radiation due to the higher altitudes and less atmospheric shielding.

Naturally occurring background radiation and modern activities such as watching TV and flying in an airplane all contribute to a lifetime exposure that is only slightly increased by medical imaging.

How do nuclear medicine procedures compare with X-rays and CT scans?
Nuclear medicine tests and other imaging technologies differ in the way they use radiation to obtain pictures of the body.

Nuclear medicine scans detect the radiation coming from a radioactive material inside a patient's body. In contrast, other imaging procedures (for example, X-ray and computed tomography or CT scan) obtain images by using machines that send radiation through the body. Nuclear medicine is also different from other imaging procedures in that it determines the presence of disease based on biological changes in tissue rather than changes in anatomy.

Many commonly used nuclear medicine exams are often performed in along with computed tomography (CT). The combination of these images provides physicians with both functional and anatomical information on the body.

The following website provides more information on radiation exposure in CT exams:

http://www.radiologyinfo.org/en/safety/index.cfm?pg=sfty_xray.

How should I prepare for a nuclear medicine procedure?
The clerk who schedules your procedure will provide you with information on how to prepare for your specific nuclear medicine procedure. Patient information sheets provide additional information on individual procedures and are available on this web-site.

Radiotracers have very short physical half-lives, which means they decay quickly into non-radioactive forms. However, radiation detection devices used at airports and federal buildings may be sensitive to the radiation levels present in patients who have recently had nuclear medicine procedures.

Please inform your technologist if you are planning any trips where you will encounter airport or border security within two weeks of completing your procedure. Our clerks will provide you with documentation, indicating that you have received radioactive products for medical imaging or treatment.

The following guidelines indicate how long patients may emit detectable radiation following treatment.

Diagnostic Tests:
The majority of Nuclear Medicine procedures are performed using a very safe radioactive product called Technetium-99m. This product has a very short life within your body and cannot be detected by even very sensitive equipment within 3-4 days following your procedure.

If you are having a PET scan, the most common product used for this procedure is another very safe radioactive product called F-18 FDG. This product should be completely undetectable within 1 day of your procedure.

Gallium-67 is a safe radioactive product used for a small number of Nuclear medicine procedures and will be detectable as long as 30 days following your procedure.

Treatment or Therapy:
Radioactive Iodine-131 used to treat hyperthyroidism and thyroid cancer, may remain detectable for as long as three months after treatment.
More information on I-131 treatment is available from our clerks.

Are nuclear medicine studies safe for children?
Nuclear medicine studies have been performed on babies and children of all ages for more than 40 years without any known adverse effects. The functional nature of these exams and the low doses of radiation used make it a safe and effective diagnostic tool in children.

Nuclear medicine procedures expose children to a very small amount of radiation that is within the lower range of what is received from routine diagnostic imaging procedures using X-rays. The specific amount of radiation exposure varies depending on the type of study.

Are nuclear medicine procedures safe for pregnant women?
Women who are or might be pregnant and who are breastfeeding a child should tell their physician or technologist prior to having a nuclear medicine procedure so that medical care can be planned for both the mother and her baby.

Some of the pharmaceuticals used in nuclear medicine procedures may pass into a breast-feeding mother's milk and subsequently to the child. To avoid this possibility, it is important that a nursing mother inform her physician and the nuclear medicine technologist before the examination begins.

Related Resources:
1. Health Physics Society: Radiation Exposure From Medical Diagnostic Imaging Procedures (fact sheet)
http://hps.org/documents/meddiagimaging.pdf

2. American Nuclear Society: Radiation Dose Chart
http://www.ans.org/pi/resources/dosechart/

3. Nuclear Regulatory Commission: Biological Effects of Radiation (fact sheet)

https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/bio-effects-radiation.html

4. U.S. Department of Energy, Office of Biological and Environmental Research, Office of Science, Ionizing Radiation Dose Ranges

https://science.energy.gov/ber/research/bssd/low-dose-radiation/

5. SNM: About Nuclear Medicine
http://interactive.snm.org/docs/whatisnucmed.pdf

Additional Links:

U.S. Department of Health and Human Services: Understanding Radiation

http://www.remm.nlm.gov/remm_Rad-Physics.htm#understandingRelativeDoses

U.S. National Library of Medicine and National Institutes of Health: Nuclear Scans
http://www.nlm.nih.gov/medlineplus/nuclearscans.html