

## How safe are Medical X-Rays?



Medical X-rays are safe when used appropriately and within guidelines set by The International Atomic Energy Agency (IAEA). In Singapore, all X-ray facilities are required to be licensed by National Environment Agency (NEA) under the regulations set by the Radiation Protection & Nuclear Science Department (RPNSD). Before an X-ray equipment can be put to clinical use, it is tested to ensure its safe use. The surrounding environment of the equipment will also be inspected to ensure it is safe for general public and staff.

## Medical Imaging Using X-rays

### General X-rays (General Radiography)

This includes chest X-rays, bone X-rays and abdomen X-rays. The X-ray equipment directs a beam of X-rays through the part of your body that is being examined and onto a special plate. The plate will be processed to generate a picture of the body part being imaged. Simple radiographs such as these involve extremely low amounts of radiation.



### Fluoroscopy

Fluoroscopy is used in barium studies and angiography where series of images will be acquired. An X-ray equipment is used such that, after passing through your body, the X-ray beam is viewed by a special camera which produces a moving picture on a TV screen. Snapshots of any important findings can be taken during the examination to give moving pictures of imaged structures.



Fluoroscopic examinations usually involve higher radiation doses than simple radiography.

### Computed Tomography (CT)

This is a more sophisticated way of using X-rays. A fan-shaped beam of X-rays passes through a slice of your body onto a row of detectors. The X-ray tube and the detectors will rotate inside the machine. Cross-sectional images or slices will then be generated by special computers. Depending on the number of slices, the radiation dose can be as high or higher than that for fluoroscopy.



### Nuclear Medicine, Positron Emission Tomography (PET) and Single-Photon Emission Computed Tomography (SPECT)

A nuclear medicine scan (including PET or SPECT) reveals how your tissues or organs are functioning. A small amount of radioactive material (also called a radiotracer) is injected into a vein (occasionally it is swallowed or inhaled). The radiotracer accumulates in areas of your body with higher levels of chemical activity, which often correspond to areas of disease. The radioactivity in your body falls to insignificant levels in a few days.



The total radiation dose you receive while the radiotracer is in your body will be similar to or less than that from fluoroscopy.

### Ultrasound and Magnetic Resonance Imaging (MRI)

These do not use X-rays or gamma rays. So far, no ill-effects have been reported from ultrasound or MRI examinations. So, why not use them for all imaging, then there will be no concern about possible radiation risks and this leaflet wouldn't be necessary? Although they can give detailed pictures of some parts of the body, they are unable to provide useful pictures to replace all types of X-ray examination. The different types of imaging tools (e.g., general X-rays, fluoroscopy, CT and MRI) generally complement each other so that your doctor is able to diagnose your condition accurately and give you the most appropriate treatment.

## Benefits of Medical X-rays

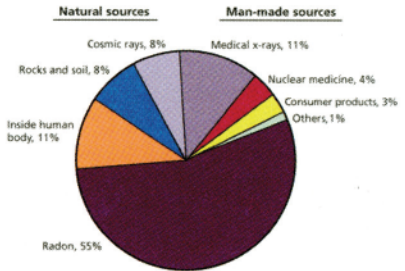
All methods of medical imaging can benefit patients. The overriding concern of your doctor and the radiology facility is to ensure that when radiation is used, the benefits from making the right diagnosis, and consequently giving you the right treatment, outweigh any small risk involved.

As fetus is more sensitive to radiation, you should inform the X-ray facility, if you are pregnant or suspect you are pregnant as you should not undergo any X-ray examination unless it is critical to your condition. You should discuss with your doctor on the benefit and risk of the X-ray examination.

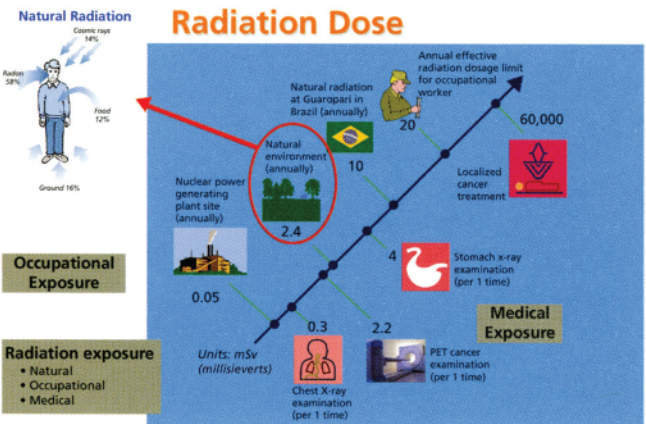
## Radiation doses of medical X-rays

We are all exposed to natural background radiation every day of our lives. This comes from the ground and building materials around us, the air we breathe, the food we eat and even from outer space (cosmic rays). Each medical X-ray or nuclear medicine examination gives us a small additional dose on top of this natural background radiation.

### Natural and Man-Made Sources of Radiation



The level of dose varies with the type of examination, ranging from the equivalent of a few days of natural background radiation to a few years. The most common X-ray examinations are those of the teeth, chest and limbs. These involve exceedingly small doses that are equivalent to only a few days of natural background radiation. Examinations involving many X-ray pictures and fluoroscopy (eg barium meals or barium enemas), CT scans or nuclear medicine will involve higher doses. Even these represent only a fraction of our lifetime dose from natural background radiation.



## Health effects of medical X-rays

The radiation doses from X-ray or nuclear medicine examinations are too low to produce immediate harmful effects such as skin burns or radiation sickness. The only possible effect on patient from these low doses is a very slight increase in the chance of cancer.

## Radiation risks

Everything we do in our daily lives carries some level of risks. Even activities that are classified as “safe” carries a risk albeit small, perhaps a 1 in 1,000,000 chance.

The radiation risks for simple X-ray examinations of the teeth, chest or limbs, fall in this negligible risk category (less than 1 in 1,000,000 risk). More complicated examinations carry a minimal to low risk.

Higher dose examinations such as barium enemas, CT scans or isotope bone scans fall in the low risk category (1 in 10,000 to 1 in 1,000 risk).

The benefits from any X-ray examination or isotope scan should outweigh these small radiation risks in order to justify the need for such examination. It should be remembered that higher dose examinations are normally used to diagnose more serious conditions when greater benefit to the patient is expected. The table above lists different types of medical imaging using X-ray and gamma rays. They are grouped from low to high radiation doses.

X-ray Examination (Nuclear medicine or isotope scan)	Equivalent period of natural background radiation	Lifetime additional risk of cancer per examination
Chest Teeth Arms and legs Hands and feet	A few days	NEGLECTIBLE RISK  Less than 1 in 1,000,000
Skull Head Neck	A few weeks	MINIMAL RISK  1 in 1,000,000 to 1 in 100,000
Breast [mammography] Hip Spine Abdomen Pelvis CT scan of head (Lung isotope scan) (Kidney isotope scan)	A few months to a year	VERY LOW RISK  1 in 100,000 to 1 in 10,000
Kidneys and bladder [IVU] Stomach – barium meal Colon – barium enema CT scan of chest CT scan of abdomen (Bone isotope scan)	A few years	LOW RISK  1 in 10,000 to 1 in 1,000

## Health effects of having many X-rays

Each X-ray examination or nuclear medicine scan carries the level of risk indicated in the table above. To estimate the effect of having many examinations, the risks for each one are simply added together (also known as cumulative effect). If you have already had a large number of X-rays and the total risk is causing you concern, the need for each new examination should still be judged on its own merits. Its benefit is to be weighed against its small risk.

## Radiation risks for older and younger patients

As you get older, you are more likely to need an X-ray examination. Fortunately, radiation risks for older people are lower than younger people. This is because there is less time for a radiation-induced cancer to develop, so the chances of it happening are greatly reduced. Children, however, with most of their life still ahead of them, may be at twice the risk of middle-aged people from the same X-ray examination. This is why particular attention is paid to ensuring that there is a clear medical benefit for every child who is X-rayed. The radiation dose is always also kept as low as possible.

A baby in the womb may also be more sensitive to radiation than an adult, so we are particularly careful about X-rays during pregnancy especially for body parts such as abdomen and pelvis. There is no problem with something like an X-ray of the hand or the chest because the radiation does not go anywhere near the baby. There will be occasions when diagnosing and treating your illness is essential for your health and your unborn child. When this health benefit clearly outweighs the small radiation risks, the X-ray or scan may go ahead after your doctor discusses all the options with you.



## Radiation risks for future generations

If the reproductive organs (ovaries or testes) are exposed to radiation, there is a small possibility that hereditary diseases or abnormalities may be passed on to future generations. Although the effect has never been observed in humans, lead protective shields can be placed over the ovaries or testes during some X-ray examinations, as a safety precaution. They are only necessary for examinations of the lower abdomen and thighs on children and patients who are young enough to have children. Even then, there are some examinations where it is not practicable to place these shields since they will obscure important diagnostic information.



**If you have further concerns or questions, please approach our staff:**

**Radiology Department, Gleneagles Hospital**

6A Napier Road Singapore 258500  
Tel: (65) 6388 4333 Fax: (65) 6470 5749

**Radiology Department, Mount Elizabeth Hospital**

3 Mount Elizabeth, Level 2 Singapore 228510  
Tel: (65) 6388 4333 Fax: (65) 6732 3368

**Department of Radiology & Nuclear Medicine, Mount Elizabeth Novena Hospital**

38 Irrawaddy Road, Level 2, Singapore 329563  
Tel: (65) 6388 4333 Fax: (65) 6933 0526

**Radiology Department, Parkway East Hospital**

321 Joo Chiat Place, Singapore 427990  
Tel: (65) 6388 4333 Fax: (65) 6340 8670

**Radiologic Clinic, Mount Elizabeth Medical Centre**

3 Mount Elizabeth, #01-01/02, Mount Elizabeth Medical Centre  
Singapore 228510  
Tel: (65) 6388 4333 Fax: (65) 6235 5279

**Radiologic Clinic, Gleneagles Branch**

6A Napier Road, #02 25/26, Gleneagles Hospital Singapore 258500  
Tel: (65) 6388 4333 Fax: (65) 6471 1151

**Radiologic Clinic, Breast Imaging Centre**

290 Orchard Road, #07-04/05/06 Paragon Singapore 238859  
Tel: (65) 6732 1166 Fax: (65) 6732 5933

**Radiologic Clinic, Mount Elizabeth Novena Hospital**

38 Irrawaddy Road, #01-03/04  
Mount Elizabeth Novena Hospital  
Singapore 329563  
Tel: (65) 6388 4333 Fax: (65) 6266 3085

**Radiologic Clinic, The Arcade Branch**

11 Collyer Quay, #18-02 The Arcade  
Singapore 049317  
Tel: (65) 6507 9750 Fax: (65) 6224 0861

**Radiologic Clinic, Jurong East**

130 Jurong Gateway Road, #01-219  
Singapore 600130  
Tel: (65) 6569 0300 Fax: (65) 6569 7593

**Radiologic Clinic, Seletar Mall**

33 Sengkang West Avenue #01-54, The Seletar Mall, Singapore 797653  
Tel: (65) 65137715 Fax: (65) 62140390

[www.parkwayhealthradiology.com.sg](http://www.parkwayhealthradiology.com.sg)  
BUSINESS REG NO. 32871800M