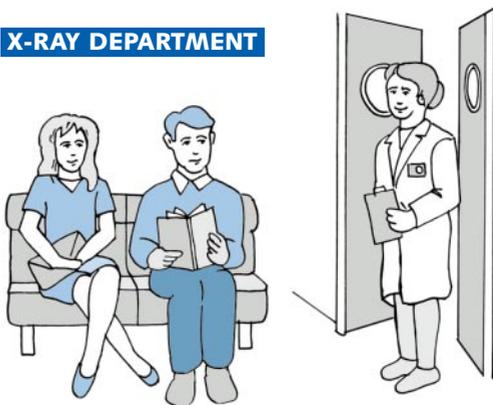


# X-rays

## How safe are they?

### X-RAY DEPARTMENT



**T**hirty years ago, X-rays were the only way to see what was going on inside your body. Now other methods of medical imaging are available, some using different types of radiation from X-rays. They are briefly described on the next two pages. Patients are sometimes concerned about the possible harmful effects of radiation, so this leaflet goes on to explain the risks and to put them into perspective.

# Imaging methods which use X-rays

## Radiography

**T**his is the familiar X-ray which most of us will have had at some time during our lives, usually for looking at broken bones or at the chest or teeth. A machine directs a beam of X-rays through the part of your body that is being examined and on to a special film. A picture is produced on the film of the structures the X-rays have passed through in your body.

Simple radiographs such as these involve extremely low amounts of radiation (as shown in the table on page 5).



## Fluoroscopy

**T**his is sometimes called 'screening'. After passing through your body, the X-ray beam is viewed by a special camera which produces a moving picture on a TV screen. The radiologist or radiographer (see definitions at the end of this leaflet) performing the examination can take snapshots of any important findings, or record the whole thing on video.

Fluoroscopy is often used to look at the gut. For example, in a 'barium meal' you will be asked to swallow a drink of barium, which is shown up well by X-rays, to give moving pictures of your stomach and intestine.

Fluoroscopic examinations usually involve higher radiation doses than simple radiography.

## Computed tomography (CT) scan

**T**his is a more sophisticated way of using X-rays. You lie on a narrow table which passes through a circular hole in the middle of the machine. A fan-shaped beam of X-rays passes through a slice of your body on to a bank of detectors. The X-ray source and the detectors rotate around inside the machine.

An image of the slice is formed by a computer and displayed on a TV screen. You are moved slowly through the hole to take pictures of different slices of your body and sometimes to produce 3D pictures.

If many slices are imaged, the radiation dose can be as high or higher than that for fluoroscopy.



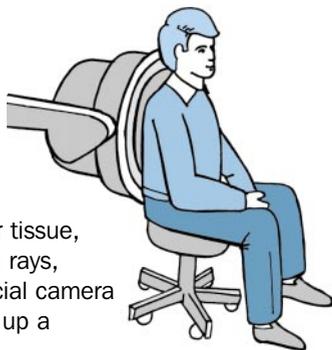
# Imaging using radioactivity

## Nuclear medicine or isotope scan

**T**his is another way of using radiation to produce pictures. Instead of using an X-ray machine, a small amount of radioactive material (isotope) is injected into a vein (occasionally it is swallowed or inhaled).

The radioactive material concentrates in a particular organ or tissue, for example in the skeleton for a bone scan. It emits gamma rays, which are a type of radiation that behaves like X-rays. A special camera detects the gamma rays coming out of your body and builds up a picture of what is happening inside you.

The radioactivity in your body falls to insignificant levels in a few days. The total radiation dose you receive while it is there will be similar to or less than that from fluoroscopy.



## Ultrasound and magnetic resonance imaging (MRI)

**T**hese are two of the most exciting advances in medical imaging of the past thirty years. They do not use X-rays or gamma rays and, so far, no ill-effects have been seen from ultrasound or from the high magnetic fields used in MRI examinations.

So why not use them for all pictures, then there will be no concern about possible radiation risks and this leaflet wouldn't be necessary? The answer is that, although they can give beautifully detailed pictures of some parts of the body, they are unable to provide useful pictures to replace all types of X-ray examination. Also, MRI scanners, being very expensive, are not always available and they cannot be used on some patients who have pieces of metal in their body.

So, although these new methods are used wherever possible, X-rays and gamma rays will be with us for a long time yet.

## Don't forget the benefits

**A**ll the methods of medical imaging can bring very real benefits to patients. The overriding concern of your doctor and the hospital radiology department 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.

If, after reading this leaflet, you are still concerned about the possible risks from having an X-ray examination, ask your doctor how the information gained will help to improve your treatment. If treatment decisions depend on the findings, then the risk to your health from not having the examination is likely to be much greater than that from the radiation itself.

# X-ray doses in perspective

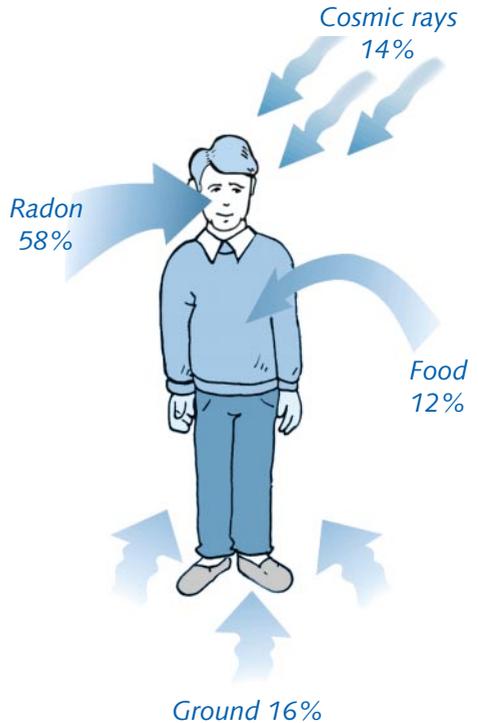
**W**e are all exposed to natural background radiation every day of our lives. This comes from the ground and building materials around us, the air we breathe, the food we eat and even from outer space (cosmic rays). In most of the UK the largest contribution is from radon gas which seeps out of the ground and accumulates in our houses.

Each medical X-ray or nuclear medicine examination gives us a small additional dose on top of this natural background 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, as shown in the table on page 5.

The most common X-ray examinations are those of the teeth, the chest and the 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 of the body or bone isotope scans, involve higher doses. Even these represent only a fraction of our lifetime dose from natural radiation.

## Natural radiation



# What are the effects of radiation?

**Y**ou will be glad to know that the radiation doses used for X-ray examinations or isotope scans are many thousands of times too low to produce immediate harmful effects, such as skin burns or radiation sickness. The only effect on the patient that is known to be possible at these low doses is a very slight increase in the chance of cancer occurring many years or even decades after the exposure.

Approximate estimates of the chance or risk that a particular examination or scan might result in a radiation-induced cancer later in the lifetime of the patient are shown in the last column of the table.

# Broad levels of risk for common X-ray examinations and isotope scans

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

\* These risk levels represent very small additions to the 1 in 3 chance we all have of getting cancer

# Radiation risks in perspective

Just about everything we do in our daily lives carries some level of risk. We tend to regard activities as being “safe” when the risk of something unpleasant happening falls below a certain level.

The lower the level of risk, the “safer” the activity becomes. For example, most people would regard activities involving a risk of below 1 in 1,000,000 as exceedingly safe.

The radiation risks for simple X-ray examinations of the teeth, chest or limbs, can be seen to fall into 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 body scans or isotope bone scans fall into the low risk category (1 in 10,000 to 1 in 1,000 risk). As we all have a 1 in 3 chance of getting cancer even if we never have an X-ray, these higher dose examinations still represent a very small addition to this underlying cancer risk from all causes.

As long as it is clearly necessary to help make the correct treatment decision for a patient, the benefits from any X-ray examination or isotope scan should usually outweigh these small radiation risks. It should be remembered that the higher dose examinations are normally used to diagnose more serious conditions when a greater benefit to the patient is to be expected.



*Airline flights are very safe with the risk of a crash being well below 1 in 1,000,000. Incidentally, a four hour flight exposes you to the same radiation dose (from cosmic rays) as a chest X-ray*

## What is the effect of having many X-rays?

Each individual X-ray examination or isotope scan carries the level of risk indicated in the table on page 5. To estimate the effect of having many examinations, the risks for each one are simply added together. It does not make any difference whether you have a number of X-rays in one day or spread over many years, the total risk is just the same.

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. Before going ahead, your doctor must be able to reassure you that there is no other way of providing new information that is essential for the effective management of your medical problem.

**Make sure your doctor is aware of other X-rays or scans you have had, in case they make additional examinations unnecessary.**



## Radiation risks for older and younger patients

**A**s you get older you are more likely to need an X-ray examination. Fortunately radiation risks for older people are lower than those shown in the table on page 5. 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 also kept as low as possible without detracting from the information the examination can provide.

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. 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. However, special precautions are required for examinations where the womb is in, or near, the beam of radiation, or for isotope scans where the radioactive material could reach the baby through the mother's circulating blood.

If you are about to have such an examination and are a woman of childbearing age, the radiographer or radiologist (see definitions on the last page) will ask you if there is any chance of your being pregnant.

If this is a possibility, your case will be discussed with the doctors looking after you to decide whether or not to recommend postponing the investigation. 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 discussing all the options with you.



## Radiation risks for future generations

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

## Important points to remember

- In radiology departments, every effort is made to keep radiation doses low and, wherever possible, to use ultrasound or MRI which involve no hazardous radiation.
- The radiation doses from X-ray examinations or isotope scans are small in relation to those we receive from natural background radiation, ranging from the equivalent of a few days worth to a few years.
- The health risks from these doses are very small in relation to the underlying risks of cancer, but are not entirely negligible for some procedures involving fluoroscopy or computed tomography (CT).
- You should make your doctor aware of any other recent X-rays or scans you may have had, in case they make further examinations unnecessary.
- The risks are much lower for older people and a little higher for children and unborn babies, so extra care is taken with young or pregnant patients.
- If you are concerned about the possible risks from an investigation using radiation, you should ask your doctor whether the examination is really necessary. If it is, then the risk to your health from not having the examination is likely to be very much greater than that from the radiation itself.

## Radiology department staff

**Radiographers** are the health-care professionals who carry out many of these X-ray examinations and other imaging procedures. They have undergone specialised education and training to enable them to care for you and to use the imaging equipment safely in all areas of the radiology department.

**Radiologists** are doctors who are specially trained to decide on the appropriate investigation, to carry out some of the more complex ones and to interpret the X-ray pictures or isotope scans. They will write a report on your examination that will be sent back to the specialist or GP who asked for your examination to be done.

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This is an information leaflet for patients prepared by the:  
National Radiological Protection Board [www.nrpb.org.uk](http://www.nrpb.org.uk)  
College of Radiographers [www.sor.org](http://www.sor.org)  
Royal College of Radiologists [www.rcr.ac.uk](http://www.rcr.ac.uk)  
Royal College of General Practitioners [www.rcgp.org.uk](http://www.rcgp.org.uk)