PAEDIATRIC IMAGING PROCEDURES – HOW SAFE ARE THEY?
INFORMATION FOR PARENTS AND GUARDIANS

THE RADIOLOGICAL PROTECTION CENTRE
Incorporating The John Perry Laboratory

BENEFIT VERSUS RISK

Paediatric X-ray examinations are “prescribed” by the referring doctor in much the same way that pharmaceutical drugs and medicines are prescribed. The “prescribing” of X-ray examinations is, therefore, based on clinical need.

The doctor who requests the X-ray does so on the principle that the benefit of having a certain X-ray examination outweighs the risk of not having that examination. X-ray examinations are therefore only performed when necessary.

X-RAY MODALITIES AND EQUIPMENT SAFETY

- **Paediatric Radiography:** The images are formed by passing an X-ray beam through some section of your child’s body such as bones, chest or teeth and are recorded on some form of digital media. Most radiography examinations involve extremely low amounts of radiation (please see Table 1).

- **Paediatric Fluoroscopy:** This is an imaging technique using a continuous X-ray beam to obtain real-time moving images of the internal structures of your child’s body. In most fluoroscopy examinations your child will be given a contrast agent, which is shown up well by X-rays. This contrast agent can be swallowed, injected, or given by an enema, depending on the type of exam and what part of the body in being studied. Fluoroscopy examinations usually involve higher radiation doses compared to radiography (please see Table 1).

- **Paediatric Computed Tomography (CT):** Paediatric CT is a fast, painless exam that uses a CT scanner to create detailed images of your child's internal organs, bones, soft tissues and blood vessels. It may be used to help diagnose abdominal pain or evaluate for injury after trauma. During a CT scan, your child will lie on a table that is attached to the CT scanner, which is a large doughnut-shaped machine. The CT scanner sends X-rays through a slice of their body on to a bank of detectors. The X-ray source and the detectors rotate around inside the machine. Each rotation of the scanner provides a picture of a thin slice of the organ or area. The images can be reformatted in multiple planes. They can even generate three-dimensional images. The radiation dose of a CT scan can be as high as or higher than that for a fluoroscopy (please see Table 1).

- **Paediatric Nuclear Medicine:** In this modality, a controlled amount of radioactive material (radiopharmaceutical) is injected into your child’s vein to diagnose and treat disease. The radioactive material emits gamma rays, which are detected by special types of cameras that work with computer to provide pictures of the area of the body being imaged. Paediatric nuclear imaging can help diagnose childhood disorders that are present at birth or that develop during childhood. It provides unique information that often cannot be obtained using other imaging procedures. Please see Table 2 for radiation doses.

All the X-ray equipment is constantly being improved and updated. It has become more sensitive over the years and this ensures that radiation doses are kept to the minimum necessary to achieve a diagnostic result. The X-ray equipment in this establishment is subject to annual, independent safety tests by the Radiological Protection Centre. It is maintained regularly by the manufacturer and the staff undertakes their own programme of quality control. All these steps are national requirements in the interests of patient and staff safety.

RADIATION DOSE

When X-rays are taken, some of the energy in the X-ray beam is absorbed in the body. This is called the radiation dose, often shortened to ‘dose’. It can be expressed in a number of different ways. The most common quantity is the ‘effective dose’ measured in Sievert (Sv). Because diagnostic X-ray examinations involve relatively low doses, these doses are stated in milliSievert (mSv); in other words, one thousandth of a Sievert.

NATIONAL STANDARDS

The use of X-rays in hospitals is subject to both national regulations and department rules. An indication of the dose is recorded for every X-ray examination and these are routinely audited against national and local reference levels.

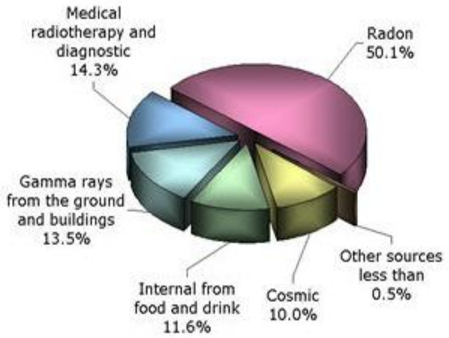
PAEDIATRIC DOSES AND RISK

National studies have enabled average doses for paediatrics for different examinations to be estimated as shown in Tables 1 and 2. Doses are expressed in units of mSv and also in terms of the equivalent number of years of background radiation. This helps to put the dose you child receives from X-ray examination into context.

Radiation induced cancers typically takes years to develop so risks are slightly lower for older patients than they are for children and unborn babies, however, the doses that are used in diagnostic X-rays are very low and are thought to be very safe. As stated before if the examination is considered to be necessary then the risk to health from not performing it is likely to be much greater than the risk from the radiation itself.

BACKGROUND RADIATION

Background radiation comes from the sun, the food we eat, building materials and natural surroundings like earth and rocks.



The dose varies in different parts of the United Kingdom but on average it amounts to an effective dose of about 2.3 mSv per year, but varies. For example background radiation dose in London is also about **2.3 mSv per year**, whereas in Cornwall, the background radiation dose is about **7 mSv per year**.

It could therefore be argued that a one year old patient who undergoes an examination such as CT of the chest receives a radiation dose equivalent to the dose they would receive if they moved from London to live in Cornwall for about a year.

A simpler examination, such as an abdomen X-ray, would involve a much smaller dose of radiation equivalent to about 3 days of average background radiation for a one year old patient.

RADIATION RISK IN PERSPECTIVE

There is a theoretical possibility that an X-ray examination can induce cancer. However, low dose examinations like Radiography and Fluoroscopy present a risk of only about 1 in 10,000 to in 1,000,000. When we compare the risk of cancer induction from high dose procedures like CT and Nuclear Medicine (approximately 1 in 10,000 to 1 in 1,000 risk) with the natural lifetime risk of cancer of 1 in 4, we can see that the risks from these examinations are very small compared to the natural risk of the disease.

FURTHER INFORMATION

We hope you find this information useful. If you would like any additional information or have any concerns, ask to speak to the Radiation Protection Supervisor (RPS).

Alternatively, you may contact the Radiological Protection Centre.

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Table 1: Effective Dose (in mSv) for Paediatrics from Diagnostic X-ray Examinations[1]

	Examination	Age (y)				
		0	1	5	10	15
Radiography	**Chest**	**0.007**	**0.003**	**0.004**	**0.006**	**0.006**
	Average Background Radiation	1 day	Few hours	Few hours	1 day	1 day
	Abdomen	**0.01**	**0.02**	**0.03**	**0.08**	**0.08**
	Average Background Radiation	2 days	3 days	5 days	2 weeks	2 weeks
	Pelvis/hips	**0.007**	**0.01**	**0.06**	**0.08**	**0.08**
	Average Background Radiation	1 day	2 days	10 days	2 weeks	2 weeks
Fluoroscopy	**MCU**	**0.35**	**0.31**	**0.34**	**0.38**	**0.38**
	Average Background Radiation	2 months	7 weeks	2 months	2 months	2 months
	Barium Meal	**0.52**	**0.42**	**0.35**	**0.52**	**0.6**
	Average Background Radiation	3 months	2 months	2 months	3 months	3 months
	Barium Swallow	**1.2**	**0.84**	**0.49**	**0.92**	**0.68**
	Average Background Radiation	6 months	4 months	3 months	5 months	4 months
CT	**Chest**	**5.3**	**5.3**	**3.6**	**3.9**	**-**
	Average Background Radiation	2.3 years	2.3 years	1.5 years	1.7 years	
	Head	**2.0**	**2.0**	**1.5**	**1.6**	**-**
	Average Background Radiation	10 months	10 months	8 months	8 months	

Table 2: Effective Dose (in mSv) for Various Radiopharmaceuticals Based on Weight (Models Based on ICRP Publication 128[2])

	Age (Y)			
	1	5	10	15
Weight (kg)	9.7	19.8	33.2	56.8
99mTc DMSA (130 MBq*)	**0.7**	**0.8**	**0.9**	**1.2**
Average Background Radiation	4 months	4 months	5 months	6 months
99mTc-MDP (740 MBq*)	**2.8**	**2.9**	**3.9**	**4.2**
Average Background Radiation	1.2 years	1.3 years	1.7 years	1.8 years
Tc-ECD (740 MBq*)	**4.1**	**4.6**	**5.3**	**5.9**
Average Background Radiation	1.8 years	2 years	2.3 years	2.5 years
Tc-MAG3 (370 MBq*)	**1.1**	**1.3**	**2.1**	**2.7**
Average Background Radiation	6 months	7 months	11 months	1.2 years
18-FDG (370 MBq*)	**4.8**	**5.9**	**6.5**	**7.2**
Average Background Radiation	2.1 years	2.5 years	2.8 years	3.1 years

*Maximum administered activity.

References

1. B F Wall, R Haylock, J T M Jansen, M C Hillier, D Hart and P C Shrimpton. Radiation Risks from Medical X-ray Examinations as a function of the Age and Sex of the patient. Report HPA-CRCE-028.

2. ICRP. Radiation dose to patients from radiopharmaceuticals: A compendium of current information related to frequently used substances. ICRP publication 128. Ann ICRP. 2015:44