

## Fast Fact

### Medical Diagnostic Radiography: An Occupational Exposure Risk

*This Fast Fact is intended to help interested workplace parties understand the general regulatory framework in Ontario, health hazards, and fundamental aims and principles associated with controlling exposures during medical diagnostic radiography.*

### What is Medical Diagnostic Radiography?

- Radiology is a science that uses ionizing radiation (in the form of X-rays) to produce images (radiographs) of various parts of the body. Images produced by X-ray are used for medical diagnoses. X-ray images highlight systems and functions of the body. The predominant test involves simply imaging internal structures such as bones, as well as body tissues or organs.
- Where organs and body functions need to be highlighted, patients often take a contrast material (either by injection or orally) to help medical professionals distinguish areas of soft tissue.
- Examples of procedures that fall in this field include projection radiography, fluoroscopy (angiography, gastro-intestinal fluoroscopy), dual energy X-ray absorptiometry and computer tomography (CT).

### What is the Regulatory Framework for Medical X-Ray Safety in Ontario?

- In the province of Ontario, the use of medical X-ray machines is primarily regulated by the Ministry of Health and Long-Term Care (MoHLTC), under the Healing Arts Radiation Protection (HARP) Act and the X-Ray Safety Code (CMRTO 2004).
- Requirements of the Ministry of Labour's (MoL) Occupational Health and Safety Act (OHSA) and X-Ray Safety Regulation (R.R.O. 1990, Reg. 861) may also apply to medical X-ray machines. Within the X-Ray Safety Regulation, sections 5, 6, 7 and 8 do not apply when an X-ray machine is subject to installation, registration or operation requirements under the HARP Act.
- The standard for the construction and function of X-ray machines is determined by the requirements of the federal Radiation Emitting Devices Act, as well as by Safety Code-20A - X-Ray Equipment in Medical Diagnosis Part A: Recommended Safety Procedures for Installation and Use, published by Health Canada. Safety Code 20A is expected to be replaced by two new codes for small and large facilities.

### What are the Health Effects from Exposure to X-Rays?

#### General

- X-rays, a form of electromagnetic radiation, produce their effect by ionization. The effects of ionizing radiation can be carcinogenic (CNSC 1995).
- Organs are affected differently by radiation because of their differing rates of cell division. In mammals, the organs most sensitive to radiation are embryonic tissue, hematopoietic organs (e.g., bone marrow), gonads, epidermis (e.g., skin) and intestinal mucous membrane (NSC 2005).

The effects on these organs are described as either deterministic or stochastic effects.

#### Deterministic Effects

- Deterministic effects, which are often seen with acute exposures above an apparent threshold (approximately 150 mSv) (UNSCEAR 1993), are those in which the severity of the effect increases with the dose absorbed (RSIC 2002).

- Examples include erythema (skin reddening), burns, skin lesions, ulcers, cataracts, hair loss, gastrointestinal disorders, suppression of the immune system, central nervous system effects, and sterility (NSC 2005). These symptoms can also be accompanied by changes in the blood, nausea, vomiting, malaise and fatigue, and/or increased body temperature (RSIC 2002).

### Stochastic Effects

- Stochastic effects, which have been shown to be produced from chronic exposure, are those in which incidences increase with dose, rather than severity (RSIC 2002).
- Examples of stochastic effects are cancer (e.g., leukemia, bone, lung and thyroid cancer) shortened life span and cataracts (NSC 2005).
- Prudent practice is to assume that there is no threshold (although they have never been shown below 200 mSv) and that any radiation dose involves some additional risk (UNSCEAR 1993). Furthermore, radiation doses are cumulative, and as such, the risk increases with exposure (RSIC 2002).

### What are the fundamental principles?

- The fundamental aims of radiation protection are to avoid injuries, disabilities and fatalities, and to keep radiation exposure “as low as reasonably achievable”, often expressed as the acronym ALARA (RSIC 2002).
- As the basic concept of radiation protection, ALARA means reducing exposure to ionizing radiation as far below regulatory limits as is reasonably achievable, taking economic and societal factors into consideration (ICRP 1991).
- Even though each of us are exposed to background radiation each day, regulatory authorities adopt the view that occupational exposures, which are usually much less than background radiation, are not justified when they can be avoided and where there are no associated benefits (Health Canada 2000).
- It is widely believed that any exposure to ionizing radiation could be potentially harmful to your health (ibid.).

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For more information, please contact:

**Ontario Safety Association for Community & Healthcare**

4950 Yonge Street, Suite 1505, Toronto, Ontario Canada M2N 6K1

Tel. (416) 250-7444 • Toll Free 1-877-250-7444 • Fax (416) 250-7484 • Web Site: [www.osach.ca](http://www.osach.ca)

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