TITLE: GUIDELINES FOR RADIATION SAFETY

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Preface

This guideline is to educate endoscopy staff in best practice radiation safety principles. Radiation safety in the practice setting is a shared responsibility. Radiation exposure for staff and patients in the endoscopy setting can be reduced with adherence to departmental radiation safety procedures. Recommended safety procedures are mandated by Health Canada, Safety Code 35. In addition a Ministry of Health and Safety Accreditation is conducted every 3 to 5 years.
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Background

Radiation is found in many forms. We are exposed to natural background radiation every day from the ground, building materials, air, food, outer space (cosmic rays) and even from the elements occurring naturally in your body. A millisievert (mSv) is the unit used to measure the amount of radiation received. The amount of natural background radiation you receive each year in Canada is between 2 and 4 mSv.

Ionizing radiation is the type of radiation to which people who work around X-ray equipment are exposed. The maximum amount of radiation staff are allowed to receive in the workplace is regulated. Health Canada has guidelines that most provinces use, which sets a limit of 50mSv in a single year and 100 mSv over 5 years (a 20mSv per year average). The limit for a pregnant worker, once pregnancy has been declared, is 4mSv for the remainder of the pregnancy. The total dose to the fetus from an occupational exposure should not exceed 10mSv. Each province also has workplace radiation protection regulations and these vary from province to province. Radiation exposure limits are also set under the Canadian Labor Code.

These various regulations and safe practices ensure that most people who are exposed to workplace radiation receive below 20mSv per year. While exposure levels vary by job, the average yearly radiation exposure of a monitor worker is about 0.3 mSv.

Health Risks of Ionizing Radiation

Radiation is a hazard; it can modify molecules within the body cells, causing cell dysfunction, alteration or halt in cell replication. Ionizing radiation has enough energy to damage individual cells. When cells divide the damage is multiplied. That is why radiation exposure is a greater risk during pregnancy, when fetal cells...
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are developing and multiplying. In some cases, cells can repair themselves. When they cannot, there may be a higher risk of cancer or hereditary defects.

Exposure to substantial amounts of radiation during pregnancy may cause birth defects, miscarriages, mental retardation, and decrease in IQ, a higher risk of childhood cancer in adult life, and hereditary defects that can be passed to future generations. The risk of experiencing the first four effects is not increased if the pregnant woman is receiving less than 10mSv during the course of her pregnancy. Hereditary defects and risk of cancer in adult life are unlikely under 100mSv, but there is a small risk of childhood cancer above 10mSv.

Efforts should be made to forgo rotating staff into fluoroscopy areas during pregnancy but complete exclusion is not always possible. If required, ALARA (As Low As Reasonably Achievable) radiation exposure time principal should be applied. The Canadian Nuclear Safety Commission (CNSC) and the provincial radiation safety regulations stipulate that pregnant radiation workers have to be monitored until delivery to ensure the dose received once pregnancy is declared does not exceed 4mSv.

The risk of thyroid and breast cancer from radiation exposure is higher in women than for men, while the risk of leukemia is higher for men than women.

The employee shall be responsible for adhering to the ALARA (As Low As Reasonably Achievable) principle whereby the radiation work is to be performed in accordance with the radiation protection rules and all unnecessary radiation exposure are to be minimized.

Radiation Source in the Endoscopy Setting

X-rays are produced when high velocity electrons are accelerated by a high voltage and allowed to crash into tungsten target in an x-ray tube. This means there are no radioisotopes but the radiation is from the X-ray source and is not radioactive. When the pedal of the fluoroscope
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is pushed this produces a high potential X-ray force from the reaction between tungsten cathode and an anode with a high atomic number.

Three types of radiation exposure within the fluoroscopy room include Primary, Secondary, and Leakage.

- The primary radiation beam produced is focused and directed through the area to be examined. The image of the area being examined is formed on film or in the fluoroscopy image intensifier by the remnant radiation that passes through the patient.
- The personnel in the room are exposed to secondary radiation or scatter radiation. This scatter radiation is the major source of radiation to the endoscopy staff.
- In addition, there is a third source of leakage radiation from the radiographic machine itself.

Minimize Radiation Exposure

Exposure to radiation should be As Low As Reasonably Achievable (ALARA) (Hilger, 1994). Endoscopy personnel can reduce occupational exposure to radiation by using the principles based on distance, time, and shielding.

- Staff must distance themselves as much as possible from radiation source.
- Staff must be mindful of and limit the amount of radiation exposure by minimizing the amount of time in the exam room and the amount of time for imaging.
- Fluoroscopy time should be monitored and kept at minimal optimal time. The pulse generator button should be at 70% rather than at continuous imaging to keep radiation at lower levels.
- Procedure rooms should lead lined as per provincial guidelines.
- Staff assigned to procedures requiring fluoroscopy are rotated.
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Radiation Equipment in Endoscopy

In endoscopy suites, C-ARM X-ray machines are used for ERCP and other therapeutic endoscopic procedures that require fluoroscopic guidance.

For bronchoscopes, a mobile C-arm can be used as long as the room is lead lined.

Standardized “X-ray in Use” Radiation Warning Lights and Sign

- A sign should be on the doors of a lead lined procedure rooms.
- The light is illuminated when the fluoroscopy pedal is depressed to alert personnel that active fluoroscopy is being used. It should be assumed active fluoroscopy is being conducted.
- In some suites there could be a leaded glass viewing area behind connecting procedure room(s), which has a door for easy access by non-shielded personnel.

Protective Shielding Devices

- Lead aprons, thyroid shields and lead glasses are to be worn by all staff during endoscopic procedures using radiation.
- Lead aprons and thyroid shields worn are to contain lead shielding of 0.5 mm thickness and block more than 90% of scattered radiation.
- The fit of the protective garment must be such that all of the organs and parts of the body which the garment is intended to protect, are protected in all postures and attitudes assumed by the worker during procedures involving X-ray use.
- The upper and lateral aspects of the breast must be adequately protected in all postures.
- The skirt of the protective garments must fit so that protection is provided in sitting postures; any slits in skirt must not permit the entry of x-rays during procedure.
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- Wrap around protective garments are garments which close on the body and which allow the two closing portions of the garment overlap (Radiation Protection Service, 1992).
- Gonad shielding should be done on individual patient assessment.

Care of Lead Apron

- The aprons should be hung on heavy-duty chrome hangers.
- Do not fold, crease or drape over machinery/furniture in the room.
- Lead aprons/thyroid shields need to tested annually to ensure no loss of shielding effectiveness due to cracks/holes/tears in the shielding material.

Cleaning of Lead Apron

- Wipe off stains as soon as possible.
- Clean with cold water and a mild detergent. Do not submerge.

Lead Glasses

- Lead glasses provide protection for the eyes from scatter radiation.
- Glasses should be kept in the endoscopy or fluoroscopy room.

Radiation Protective Gloves

- Should be worn when assisting to hold patient or deliver care close to fluoroscopy primary beam and scatter.
- Gloves should be kept in the endoscopy or fluoroscopy room.

Portable Shield

- A portable shield on wheels that has a lead panel can be positioned to reduce scatter to personnel standing to the side.
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Monitoring Radiation Exposure

- Thermo Luminescent Dosimeter (TLD) is a radiation exposure-measuring device.
- All personnel should wear a monitoring device, specifically a TLD, during endoscopy cases requiring fluoroscopy.
- TLDs are worn at the neckline under the leaded apron or on the inside chest pocket of the lead apron to monitor exposure to the neck, head, and eyes. Extremity dosimeters may also be worn on the wrist.
- The TLDs should be stored on a special name specific tag storage area outside the endoscopy suite that is radiation free area where no background radiation that can cause a false reading.
- These TLDs should never be worn outside the unit.
- TLDs must always be stored properly to ensure accurate readings.
- The TLDs should be sent out every three months for readings.
- The readings are reported in mSv.
- A control Dosimeter is included with the shipment of dosimeters as a means to determine radiation doses received during transit to the lab.
- Exposures of the TLD are posted as Body (deep) and Skin (shallow) dose equivalents.
- All results should be reviewed regularly. Results are to be kept confidential but easily assessable.
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Summary

Premise: ALARA (As Low As Reasonably Achievable)

Principles: Exposure can be minimized by implementing the following principles:

- **Time** - exposure should be as minimal as possible.
- **Distance** - maintain a safe distance from the radiation source.
- **Shielding** - appropriate PPE should be supplied in order to provide adequate shielding between the radiation source and the body.

Guidelines

- Pregnant women should not be exposed to any source of radiation, or, if unavoidable, as minimal as possible.
- Protective equipment (PPE) should include lead-lined apron, thyroid collar, gloves, and protective eyewear. Gonadal shielding should be used as appropriate.
- TLDs should be worn during all procedures in which radiation exposure is expected, and radiation exposure analyzed as per hospital protocol.
- Radiation exposure is measured in millisievert (mSv). The Maximum Permissible Doses (MPD) of radiation per year is:
  - Whole body – 50 mSv, not to exceed 100 mSv over a 5 year period
  - Lens of the eye -150 mSv
  - Extremities- 500 mSv
References


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