

PRACTICAL TIPS IN ENSURING RADIATION SAFETY IN THE USE OF MEDICAL DIAGNOSTIC X-RAY EQUIPMENT

Although the medical uses of X-rays to examine a patient without surgery became an amazing medical breakthrough, X-rays have negative side effects due to its use of radiation. During X-ray examination, not only the patient gets exposed to radiation but also the persons around the X-ray equipment, albeit low, get exposed to radiation.

AERB has the responsibility to promote the safe use of the equipment in order to minimize radiation hazard to patient, operator and members of public. One of the ways to ensure radiation safety is to create awareness among everyone concerned. It must be realized that responsibility of ensuring radiation safety in the use of X-ray equipment lies with the owner of the facility.

Given below are handy tips for each modality that conveys the responsibilities of facility owner, operating personnel and the public.

GENERAL PURPOSE RADIOGRAPHY

The general purpose radiography equipment are routinely used (nearly 70% of the times) for x-rays of chest and extremities. The other important examinations are abdomen, hip joints, lumbar spine etc.



What the personnel (doctors, radiographers) who are operating the equipment need to know:

- 1) Always operate the unit from the control room or standing behind the Mobile Protective Barrier (1.5 mm lead equivalent) or fixed protective barrier (such as a wall).
- 2) Always use the TLD at chest level while X-ray unit is being operated.
- 3) In the absence of Protective Barrier (such as operating Mobile X-ray equipment) always use Lead apron (0.25 mm lead equivalent) and wear TLD below the apron.
- 4) Always use collimator (diaphragm) to limit the field size to the area of interest in order to minimize the radiation exposure to other organs.
- 5) While operating mobile X-ray equipment, operate from a minimum distance of 2m from the equipment by stretching the connecting wire and don't allow anybody to be nearby.
- 6) In no case, except patient anybody shall come in the direction of the primary beam.
- 7) Ensure that Lead apron is worn by the person assisting an infirm patient during exposure.
- 8) Portable x-ray equipment shall always be positioned on a stand and not to be held in hand during exposure.
- 9) For mobile and portable X-ray equipments, cassette shall not be held in hand by any person.
- 10) Unless necessary use of bucky should be avoided.
- 11) During X-ray examinations of pregnant woman, abdomen must be covered with minimum 0.25 mm lead equivalent apron.
- 12) Avoid crowding of patients/relatives/ staff inside the X-ray room.
- 13) X-ray room door (lead lined with 1.7 mm lead equivalent) should be closed during exposure.

What the public need to know:

- 1) Get X-ray examination done only in hospitals/facilities having registration from AERB.
- 2) Do not crowd the room where X-ray is taken. Wait for your turn.
- 3) Co-operate with the radiographer, to avoid repeat X-ray examination.
- 4) Always wear a lead apron, if you need to assist the patient during X-ray examination. In no case pregnant woman should assist the patient during exposure.
- 5) Female patient, if pregnant, must inform the radiographer so that necessary precaution can be taken during X-ray examination.
- 6) Carry your old X-ray/CT records.

What the owner/ employer/ Radiation Safety Officer need to know:

- 1) Only AERB Type approved X-ray equipment shall be installed /used.
- 2) AERB registration certificate shall be displayed at prominent place near the X-ray room for public information.
- 3) Quality Assurance tests of the X-ray equipment is carried out periodically and after any maintenance and the records thereof are maintained.
- 4) Sufficient number of lead aprons (0.25 mm lead equivalent) is available for use with fixed and mobile X-ray equipment.
- 5) Lead aprons shall be stored either on a hanger or on a flat surface without crumpling.
- 6) Consistency of lead aprons shall be checked once in two years. Qualitative check can be done by taking radiograph of lead aprons.
- 7) The operators are instructed on all the requirements of radiation safety.
- 8) Charts of standard exposure parameters to achieve good image quality should be prepared for pediatric and adult patients separately and displayed at a prominent location such as control console.
- 9) TLD badges are provided to all the operators and workers involved during X-ray examination.
- 10) During non-working hours, TLD cards must be stored along with Control TLD card outside the X-ray room (in a radiation free area).
- 11) The owner shall ensure that the operator of the X-ray equipment is well conversant with clinical requirements of the examinations. Chest stand should always be provided with X-ray equipment for chest radiography.
- 12) Routine maintenance of the Radiography equipment is carried out. Particularly, it should be ensured that the field light (collimator bulb) is always functional.
- 13) Radiation symbol and warning placards in local languages are placed outside the X-ray room door
- 14) The chest stand and the control console should always be placed opposite to each other. If this is not possible, at least a partition wall with viewing window should be made between the control console and the chest stand.
- 15) Permanent occupancy of staff behind the chest stand wall (for e.g. Doctors, Receptionists or helpers) should be avoided.

COMPUTED TOMOGRAPHY EQUIPMENT

The use of CT equipment has increased many-fold during the past decade. The CT equipment has a higher radiation hazard potential as compared to the general X-ray equipment. Owing to this reason, a greater amount of discretion is required while prescribing/ performing CT scans.



What the personnel (doctors, radiographers) who are operating the equipment need to know:

- 1) All personnel associated with the use of the CT-Scan equipment, shall attend the training sessions provided by the application specialist of the company and incorporate in practice all the radiation safety measures provided by design, in the equipment.
- 2) Always work from the control room.
- 3) Always use the TLD at chest level while CT unit is being operated.
- 4) Do not allow any person, other than the patient, inside the CT-scan room.
- 5) CT-scan doors (preferably with automatic closure) must be lead lined with 1.5 mm lead equivalent and closed during exposures.
- 6) Ensure that Lead apron, with minimum 0.25 mm lead equivalent, is worn by the person assisting an infirm patient during exposure.
- 7) Shall always use the paediatric protocols of exposures, while exposing child patients.

What the general public need to know:

- 1) Get CT scans done only in hospitals/facilities having licence from AERB.
- 2) Do not crowd the room where CT is taken. Wait for your turn.
- 3) Co-operate with the Technologist, to avoid repeat CT-scans.
- 4) Always wear a lead apron, if you need to assist the patient during CT examination. In no case pregnant woman should assist the patient during exposure.

- 5) Female patient, if pregnant, must inform the CT Technologist so that necessary precaution can be taken during CT examination.
- 6) Carry your old X-ray/ CT records.

What the owner/ employer/ Radiation Safety Officer need to know:

- 1) Only AERB Type approved CT equipment shall be installed /used.
- 2) AERB licence shall be displayed at prominent place near the CT room for public information.
- 3) The couch shall be placed such that it enables the operator to complete view of the patient from the control room window.
- 4) Quality Assurance tests of the CT-scan equipment is carried out periodically and after any maintenance and the records thereof are maintained.
- 5) At least one lead apron (0.25 mm lead equivalent) shall be available.
- 6) Lead apron(s) shall be stored either on a hanger or on a flat surface without crumpling.
- 7) Consistency of lead aprons shall be checked once in two years. Qualitative check can be done by taking radiograph of lead aprons.
- 8) Shall ensure that the application specialists demonstrate all radiation safety features provided by design, in the equipment.
- 9) Charts of standard exposure parameters to achieve good image quality should be prepared for pediatric and adult patients separately and displayed at a prominent location such as control console.
- 10) TLD badges are provided to all the operators and workers involved during CT examination.
- 11) During non-working hours, TLD cards must be stored along with Control TLD card outside the CT room (in a radiation free area).
- 12) The owner shall ensure that the operator of the CT equipment is well conversant with clinical requirements of the examinations.
- 13) Radiation symbol and warning placards in local languages are placed outside the X-ray room door.
- 14) Routine maintenance of the CT equipment is carried out and record thereof is maintained.

INTERVENTIONAL RADIOLOGY PROCEDURES ON CATH LAB EQUIPMENT/ FLUOROSCOPY PROCEDURES ON R&F EQUIPMENT:



Interventional radiology is a medical sub-specialty of radiology which utilizes minimally-invasive image-guided procedures to diagnose and treat diseases in nearly every organ system. Using X-rays, CT, ultrasound, MRI, and other imaging modalities, interventional radiologists obtain images which are then used to direct interventional instruments throughout the body.

Fluoroscopy is an imaging technique that uses X-rays to obtain real-time moving images of the internal structures of a patient through the use of a fluoroscope. The most commonly used procedure is the gastrointestinal fluoroscopy (barium meal test).

The radiation during the long lasting procedures can constitute an occupational hazard for the physicians, allied medical professionals if proper care is not taken.

What the general public need to know:

- 1) Get IR/ Fluoroscopy procedures done in hospitals/facilities having licence from AERB.
- 2) Keep a record of the exposures you have received, for future reference.
- 3) Inform the Technologist if you are pregnant.
- 4) Carry your old CT/X-ray records

What the personnel (doctors, radiographers) who are operating the equipment need to know:

- 1) Use ceiling suspended screens, lateral shields and table curtains. They provide more than 90% protection from scattered radiation in fluoroscopy / IR procedures.

- 2) The positioning of the IITV and the tube, affect the radiation dose to patient and the doctor/ associated personnel. The IITV shall be positioned as close to the patient surface, as possible.
- 3) For fluoroscopic procedures under-couch x-ray tube and over couch IITV system should be used.
- 4) Always wear the TLD badges on the chest, over which the lead (or equivalent) apron to be worn.
- 6) Aperture opening should be adjusted as per the procedural requirement so as to optimize the exposures to the patient.
- 8) Patient dose records to be maintained and should be incorporated in the medical report.
- 9) Selection of magnification mode to be appropriate to the procedural requirement.
- 10) In a lateral or oblique orientation, the x-ray tube should be positioned opposite the area where the operator and other personnel are working.
- 11) Keep hands out of and away from the x-ray field when the beam is on unless physician control of invasive devices is required for patient care during fluoroscopy
- 12) If image quality is not compromised, remove the grid during procedures on small patients or when the image receptor cannot be placed close to the patient.
- 13) Remember that high kV and low mAs techniques and choice of additional filters reduced patient doses, without compromising on diagnostic information.

What the owner/ employer/ Radiation Safety Officer need to know:

- 1) Only AERB Type approved X-ray equipment shall be installed /used
- 2) AERB Licence certificate shall be displayed noticeably at the reception counter.
- 3) Quality Assurance tests of the IR equipment is carried out periodically and after any maintenance and the records are maintained
- 4) Sufficient number of lead (or equivalent) aprons of 0.25mm lead equivalent shall be available.
- 5) Lead aprons shall be stored either on a hanger or on a flat surface without crumpling.
- 6) Consistency of lead aprons shall be checked once in two years.
- 7) Shall ensure that the application specialists demonstrate all radiation safety features provided by design, in the equipment.
- 8) The RSO should inform all doctors and associated personnel about the design features incorporated for dose reduction.

MAMMOGRAPHY



Mammography is the process of using low-energy X-rays to examine the human breast and is used as a diagnostic and a screening tool. The goal of mammography is the early detection of breast cancer, typically through detection of characteristic masses and/or micro-calcifications.

What the general public need to know

Get the mammography procedures done only in hospitals/facilities having registration from AERB.

What the owner/ employer/ Radiation Safety Officer need to know:

- 1) Only AERB Type approved X-ray equipment shall be installed /used
- 2) AERB Registration certificate will be displayed noticeably at the reception counter.
- 3) Quality Assurance tests of the mammography equipment is carried out periodically and after any maintenance, and the records are maintained.
- 4) CR and DR detection systems should be preferably used
- 5) If film- based system is used, film auto- processor should be used.
- 6) Preferably all filter-target combinations should be present, by design, in the mammography equipment.

What the doctor & radiographer need to know:

- 1) The operators are required to use the benefit of the 2 m wire given along with the exposure switch when the control board is provided on the column of mammography equipment.
- 2) Operator should always work behind the barrier.
- 3) Viewing box requirements for mammography should be of double the luminescence(lux) required for general purpose radiography and the illumination where the viewing box is kept should be minimum.

DENTAL RADIOGRAPHY

Dentists use dental radiography equipment for many reasons: to find hidden dental structures, malignant or benign masses, bone loss, and cavities.



What the personnel (dentist, radiographers) who are operating the equipment need to know:

- 1) While operating dental X-ray equipment, operate from a distance as far away as possible from the equipment
- 2) Always use the TLD at chest level while dental X-ray unit is being operated.
- 3) Always use Lead apron (0.25 mm lead equivalent) and wear TLD below the apron.
- 4) For intra-oral radiography, the angle of emission should be so adjusted that the patient's eyes / thyroid should not come in the primary X-ray beam.
- 5) When it is necessary that separate films of the maxillary (related to upper jaw) and mandible (related to lower jaw) regions to be exposed, the angle of emission should be so adjusted that maxillary region is not irradiated during radiography of the mandibular region and vice versa.
- 6) Ensure that Lead apron is worn by the person assisting an infirm patient or holding film during exposure.

What the general public need to know:

- 1) Get the dental X-ray procedures done only in hospitals/facilities having registration from AERB.
- 2) Co-operate with the operator, to avoid repeat dental X-ray examination.
- 3) Female patient, if pregnant, must inform the operator so that necessary precaution can be taken during dental X-ray examination.
- 4) Carry your old dental X-ray records.

What the owner/ employer/ Radiation Safety Officer need to know:

- 1) Only AERB Type approved dental X-ray equipment shall be installed /used.
- 2) AERB Registration certificate shall be displayed at prominent place for public information.
- 3) Quality Assurance tests of dental X-ray equipment is carried out periodically and after any maintenance and the records thereof are maintained.
- 4) TLD badges are provided to all the operators and workers involved during X-ray examination.

