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PURPOSE

To maintain general public and Children's employees radiation exposure ALARA. (As Low As Reasonably Achievable). This policy is designed to protect the general public from excess radiation exposure, and to provide all Children's employees, including those at offsite clinics whose work assignments may expose them to radiation, a safe working environment. These locations include but are not limited to: Children's Hospital & Medical Center Main Radiology Department, OR, Cath Lab, Orthopedic Clinic, Lincoln Clinic, Dundee Clinic, West Village Point Clinic, Val Verde Clinic, Council Bluffs Clinic and COSC.

1. A process for maintaining doses ALARA: ALARA principles
2. A process for radiation personal protective equipment (PPE), also known as a lead apron and a thyroid collar, designed to decrease the risk of occupational radiation exposure. In order to maintain the integrity of the PPE, the following guidelines should be utilized.
3. A process for general public monitoring.
4. A process for distribution and exchange of monitoring devices to insure that the employee's exposure is kept within the regulatory limits.
5. A process for record keeping of radiation exposure reports.

POLICY STATEMENT

1. The following measurements will be put into place to ensure all radiation exposures are ALARA for the patients and employees of all Children's institutions.
 - a. Time
 - i. Time near the source of radiation will be limited to as little as possible. Time directly influences the dose received. Therefore, minimizing the time near the source minimizes the dose received.
 - ii. For exams that utilize radiation generating equipment, Children's employees will rotate holding responsibilities when possible for patients whom require it.
 - b. Distance
 - i. When appropriate, all employees will maximize distance from the source of radiation. Exposure rate decreases by the inverse of the distance squared, therefore increasing ones distance from the radiation source, will decrease ones exposure.

- ii. Patients should not be routinely held. Mechanical or other devices should be utilized whenever possible.
 - c. Shielding
 - i. Lead Shielding is proven to decrease the dose of radiation received. Whenever possible, and as long as it does not interfere with the diagnostic procedure, radiation personal protective equipment (PPE) will be worn or utilized by both the staff and patient in a room with radiation generating equipment. This protective shielding includes but is not limited to: Leaded aprons and thyroid shields, moveable leaded Lucite barriers, leaded protective eyewear, & lead impregnated disposable surgical gloves.
 - ii. Gonadal shielding of not less than 0.5mm lead equivalent shall be used for all patients during radiographic procedures in which the gonads are in the useful beam, except in cases where placement over the gonads would interfere with the diagnostic procedure.
 - iii. Should any body part of an employee be required to be positioned under the useful beam while holding, a lead equivalent of not less than 0.5mm must be used.
- 2. Individuals in a room where an ionizing radiation producing device is being utilized are required to wear radiation personal protective equipment (PPE). In order to maintain the integrity the following procedures should be adhered to
 - a. Procedure:
 - i. Inspect the radiation PPE for any visible defects each time you don a PPE. Notify your supervisor and/or the lead specialist of any defect such as tears, holes, non-functional closures.
 - ii. Make sure the belts, buckles, and Velcro closures are functional and overlapping to assure adequate protection.
 - iii. DO NOT FOLD, CREASE, OR SIT ON THE RADIATION PPE. It is strongly suggested that radiation PPE be hung on a heavy duty chrome hanger or equivalent or laid flat.
 - iv. Radiation PPE should be wiped with Sani-Wipes or equivalent after each use to reduce the risk of cross contamination.
 - v. Casting materials or stains should be promptly cleaned with a mild detergent and cold water. Do not use abrasive cleaners.
 - vi. Should you have questions or problems with the radiation personal protective equipment, please notify the lead specialist at 402-955-5626.
- 3. General public monitoring and protection
 - a. All areas using radiation generating equipment or radioactive material will be inspected or monitored periodically to ensure that members of the general public are not exposed to 2 mRem in any one hour or 100 mRem per year. In the Radiology department, this monitoring is carried out through area monitor badges from Landauer and electronic pocket dosimeters. The electronic pocket dosimeters are manufactured by Rados®, model RAD-60 R. They are periodically calibrated by Cardinal Health. The serial number of the dosimeter used in the Nuclear Medicine department is 280236.
 - b. Two parents or adult (>18 years) relatives are given the option of accompanying

the patient during a radiographic examination for the purpose of soothing and calming the child. Siblings under the age of 18 are not allowed to accompany the patient into the exam room when having a radiographic procedure. Additional adult family members may be allowed to accompany the patient only when deemed appropriate and necessary by a technologist or physician staff member.

- c. Except under extenuating circumstances, pregnant members of the general public shall not be allowed in the room during radiographic exposures in accordance with ALARA principles. Females accompanying patients should be asked directly if they are or could possibly be pregnant.
- d. Leaded protective shielding shall be used by all persons (occupationally exposed workers as well as the general public) in the room during radiation exposures to keep the radiation dose to the general public less than 2mRem in any one hour and less the 100 mRem per year. This protective shielding includes but is not limited to: Leaded aprons and thyroid shields, moveable leaded Lucite barriers, leaded protective eyewear, lead impregnated disposable surgical gloves.

4. Occupational radiation exposure monitoring

- a. All personnel assigned to work in areas of radiation exposure shall be monitored for cumulative radiation exposure according to the guidelines outlined by the State of Nebraska, Department of Health and Human Services, Section 004-022 "Conditions Requiring Individual Monitoring of External and Internal Occupational Dose". These guidelines are as follows: Each licensee or registrant must monitor occupational exposures to radiation from registered, licensed and unlicensed radiation sources under the control of the licensee or registrant and must supply and require the use of individual monitoring devices by:
 - i. Adults likely to receive, in one year from sources external to the body, a dose in excess of 10% of the limits in 180 NAC 4-005.01. The following is a summary of commonly applicable exposure limit:
 - 500mRem per gestational period of a Declared Pregnant Woman (50mRem=10%)
 - 5,000mRem Whole body exposure annually (DDE) (500mRem=10%)
 - 15,000mRem Eye Lens annually (LDE) (1,500mRem=10%)
 - 50,000mRem Skin or Extremity annually (SDE) (5,000mRem=10%)
 - ii. Minors likely to receive, in one year, from sources external to the body, a deep dose equivalent in excess of 0.1 rem (1mSv), a lens dose equivalent in excess of 0.15 rem (1.5mSv), or a shallow dose equivalent to the skin or to the extremities in excess of 0.5 rem (5mSv);
 - iii. Declared pregnant women likely to receive during the entire pregnancy, from radiation sources external to the body, a deep dose equivalent in excess of 0.1 rem (1mSv); and
 - iv. Individuals entering a high or very high radiation area.
 - v. Individuals working with medical fluoroscopic equipment.
- b. If it is determined by the RSO delegate or RSO that an employee could potentially meet any of the exposure criteria outlined in "section a", a radiation badge for exposure monitoring will be assigned to that participant. It is a condition of employment at Children's Hospital and Medical Center, and

the responsibility and requirement of the employee to comply with Children's ALARA program for radiation exposure policy and wear the badges properly once assigned. Failure to wear the badge puts the individual and Children's Hospital & Medical Center in noncompliance with state regulations as regulated in Title 180 NAC 4-022.

- c. Note: Any individual who wishes to be monitored for radiation exposure but is not required to be monitored may be issued a monitoring device (electronic pocket dosimeter) at the individual's request on an informational basis only. This individual must submit a request to their supervisor, the RSO, or the RSO's delegate for a monitoring device. Record of these individual's exposure reports are not required to be kept on file with the other exposure reports.
- d. To ensure that occupational exposures are less than the allowable limits stated in state regulation Title 180 NAC 4, Children's Hospital & Medical Center requires that individuals from outside institutions, i.e. vendors and students, whom are required to be present during procedures utilizing ionizing radiation be badged and monitored by their employer. If the individual is not badged, he/she cannot be present in the room during any radiation exposure. Failure to wear the badge puts the individual and Children's Hospital & Medical Center at risk for noncompliance with state regulations as regulated in Title 180 NAC 4-022. In extenuating circumstances temporary monitoring is available with RAD-60R personal pocket dosimeters. Contact Nuclear Medicine at 955-5617 if needed.
- e. Monitoring shall be accomplished by means of film dosimeter badges and/or ring TLD's on a monthly or quarterly schedule. Badges will be distributed on the following basis*:

Department	Location to be worn	Ring TLD badge	Frequency
Radiology tech's and MD's	Collar and ring finger	Yes	Monthly or Quarterly
Radiology ancillary staff	Collar	No	Quarterly
ER RN's and MD's	Collar	No	Quarterly
OR tech's and RN's	Collar	No	Quarterly
OR MD's	Collar, ring finger	Yes (optional)	Quarterly
Feeding and Growth	Collar and ring finger	Yes	Quarterly
Cardiac cath lab full-time techs and all MDs	Collar and ring finger	Yes (optional)	Monthly or Quarterly
Cardiac cath lab part-time techs	Collar	No	Quarterly
Ortho clinic techs	Collar	No	Monthly or Quarterly
Urgent care clinics	Collar	No	Quarterly

***Note: These badge distribution guidelines are subject to modification at the discretion of the RSO or his/her delegate.**

- i. Radiation film badges for a non-pregnant worker are to be worn at the collar level outside of any leaded protective apron. These badges are worn to measure DDE.
- ii. Ring TLD badges are to be worn on the ring finger of the dominant hand with the writing facing the source of radiation. These badges are worn to measure radiation dose to the extremities or SDE. These badges are suggested for staff members who routinely operate with their extremities closest to the radiation source. TLD badges are suggested for Surgeons and Cath lab MD's but cannot be made mandatory due to the badge's non-compliance with sterile field guidelines.
- iii. Declared pregnant women are given a second badge to be worn at the waist level underneath a lead apron. This badge is worn in association with the collar badge to estimate the radiation dose to the fetus. The fetal badge will be exchanged monthly regardless of the pregnant worker's chest badge frequency
- f. Pregnancy declaration must be made in writing with "form 113" to the RSO or his/her delegate. Form 113 can be found in the "References" section of this policy or obtained by contacting your supervisor or the RSO directly. Pregnancy declaration is voluntary but encouraged so that appropriate safety measures can be taken and education can be provided.
- g. If an employee has lost or misplaced his/her film badge before a new badge can be issued:
 - i. The employee should report the lost badge to his/her supervisor immediately so that the RSO or his/her delegate can:
 - Be notified and attempt to assign a new badge to the employee, and
 - The radiation dose while the badge was missing can be estimated.
 - ii. If a lost film badge is found, turn it in so that the exposure measurement can be recovered.

5. Record maintenance and reporting

- a. Confidential records of all exposure reports will be kept in the Radiology Department by the RSO or his/her delegate.
- b. Monitored workers will receive an annual written report of his/her individual dose.
- c. Written reports will be available to monitored workers within 30 days after his/her dose has been determined for a given period. Radiation exposure records will be kept confidential unless an individual requests that their records be released or if his/her exposure is deemed excessive by the RSO or his/her delegate.
- d. Instances of excessive exposure in an occupationally exposed worker will be determined and handled in the following manner:
 - i. Any exposure that is less than thresholds set by ALARA level I or II but deemed uncharacteristically high given the employee's exposure history may be evaluated by the RSO and appropriate action may be taken if necessary.
 - ii. ALARA Level I – 2.5% of any applicable annual exposure limit in one

- quarter (i.e. 125 mRem DDE per quarter, etc.) will provoke review of the individual's exposure by the RSC at the next quarterly RSC meeting following the observed exposure period. If the exposure does not exceed ALARA level II no further action will be required unless deemed appropriate by the RSC.
- iii. ALARA Level I (DPW) – 8.0% of any applicable gestational exposure limit (i.e. 40mRem in one month or 120mRem in one quarter, etc.) will provoke a review of the individual's fetal badge by the RSO/RSC at the next quarterly meeting.
 - iv. ALARA Level II – 7.5% of any applicable annual exposure limit in one quarter (i.e. 375 mRem DDE per quarter, etc.) will provoke an investigation of the circumstances surrounding the individual's exposure by the RSO or his/her delegate. A report will be generated following the investigation and will be reviewed at the next RSC meeting following the observed exposure. With the guidance of the RSC, the RSO may take action to prevent subsequent excessive exposures when warranted.
 - v. ALARA Level II (DPW)– 24% of any applicable gestational exposure limit (i.e. 120mRem in one month or 360mRem in one quarter, etc.) will provoke an investigation of the circumstances surrounding the individual's exposure by the RSO or his/her delegate. A report will be generated following the investigation and will be reviewed at the next RSC meeting following the observed exposure. With the guidance of the RSC, the RSO may take action to prevent subsequent excessive exposures when warranted.
- e. Upon termination, a copy of employee's cumulative radiation dose record (Form 5) will be sent to the employee. The original record will be kept on file in the Radiology department indefinitely.

PROCESS/PROCEDURE FILM BADGE

1. Coordination of film badge ordering and exchange will be overseen by the RSO's delegate. The RSO's delegate will assign a representative to each department which requires occupational exposure monitoring. This representative will facilitate badge and information exchange so that the department's badge activities stay current.
2. New participant badges are to be ordered in one of two ways:
 - a. The employee will complete survey at the time of initial health screening if their job description necessitates radiation exposure monitoring. As part of the survey, the employee will complete a form which indicates the new employee's Name, DOB, gender, department, job title, employee ID, and contact information of any/all prior employers who are currently monitoring, or may have monitored the employee's radiation exposure prior to signing on with Children's Hospital & Medical Center. This information will be securely received by the RSO's delegate.
 - b. The department representative will have the new employee fill out a form that indicates the following information: Name, DOB, gender, department, job title, employee ID, and contact information of any/all employers who may have monitored the employee's radiation exposure.
3. New employee forms are then sent to the RSO's delegate so that:
 - a. The new employee's badges can be ordered via phone or on-line request.
 - b. The new employee's cumulative lifetime exposure can be compiled into the employee's newly opened record as mandated by Nebraska DHHS regulations.

- c. If an employee works at multiple institutions, a system can be established for combining exposure data into one cumulative report.
 - d. More education on ALARA principals can be provided to the new employee if necessary.
4. Film badges are supplied to measure occupational exposure only.
- a. **Badges should not be taken off-site** unless the participant's work assignment requires him/her to do so.
 - b. Badges should not be worn during radiation exposure from a medically prescribed diagnostic exam.
 - c. While badges are not being worn they should be stored in an area of the facility far removed from any radiation source where the department's representative still has access to it (**not taken home or left in a vehicle**).
 - d. Control badges will be kept far away from any radiation source in each department.
5. The RSO and/or his/her delegate may review any exposure report data to determine if a reading is considered abnormal (falsely high or falsely low).
6. Requests for adjustment of the abnormal readings may be submitted to the badge processing company for correction of the abnormal record.
7. Once exposure reports are received for a monitoring period by the RSO's delegate, they will be brought to the RSO for his/her signature, and then kept on file with past exposure reports.
8. Annual review of radiation safety education is achieved through the Annual Mandatory Review course as mandated by Nebraska DHHS regulations.
- a. One of the most prevalent provisions of the NE DHHS radiologic health regulations is Title 180 NAC 10-003.01 which reads as follows:
 - 1. *10-003.01 All individuals who in the course of employment are likely to receive in a year an occupational dose in excess of 100mrem (1mSv) must be:*
 - a. *Kept informed of the storage, transfer, or use of radiation and/or radioactive material;*
 - b. *Instructed in the health protection problems associated with exposure to radiation and/or radioactive material, precautions or procedures to minimize exposure, and in the purposes and functions of protective devices employed;*
 - c. *Instructed in, and required to observe, to the extent within the worker's control, the applicable provisions of Title 180 and licenses for the protection of personnel from exposures to radiation or radioactive material;*
 - d. *Instructed of their responsibility to report promptly to the licensee or registrant any condition which may lead to, constitute, or cause a violation of the Act, Title 180, and licenses or unnecessary exposure to radiation or radioactive material;*
 - e. *Instructed in the appropriate response to warnings made in the event of any unusual occurrence or malfunction that may involve exposure to radiation or radioactive material; and*
 - f. *Advised as to the radiation exposure reports which workers must be furnished pursuant to 180.*

DEFINITIONS

1. ALARA: As Low As Reasonably Achievable. ALARA principles pertain especially to techniques employed in minimization of radiation exposure.
2. General public: Any individual who may accompany a patient during their radiologic exam or any individual who may be exposed to a radiation source but is not an occupationally exposed worker (i.e. clerical or housekeeping staff, visitors etc.).
3. RSC: Radiation Safety Committee. At Children's Hospital & Medical Center this committee consists of the Radiation Safety Officer (committee chairman), and a representative of upper level management (Vice President), Radiology management, Nursing staff, Nuclear medicine, Surgical staff, Cardiac Cath lab staff (Cardiology), Emergency services, and a physicist. Participation by representatives of other departments is welcomed.
4. RSO: Radiation Safety Officer. The RSO, appointed by the RSC, is responsible for enforcement of the policies and procedures related to radiation use at Children's Hospital & Medical Center

REFERENCES

Reg guide 8.13: <http://pbadupws.nrc.gov/docs/ML0037/ML003739505.pdf>

Reg guide 8.29: <http://pbadupws.nrc.gov/docs/ML0037/ML003739438.pdf>

NE DHHS: http://dhhs.ne.gov/publichealth/Pages/puh_enh_rad_index.aspx

Occupational radiation exposure release form (this link must be copied and pasted into the address bar of your web browser):

<file://chs11/common/Radiation%20Safety%20Committee/Radiation%20safety%20-%20release.pdf>

Pregnancy Declaration form (this link must be copied and pasted into the address bar of your web browser):

<file://chs11/common/Radiation%20Safety%20Committee/Occupational%20pregnancy%20declaration%20-%20form113.pdf>

ALARA program (this link must be copied and pasted into the address bar of your web browser):

[file://chs11/common/Radiation Safety Committee/ALARA program.pdf](file://chs11/common/Radiation%20Safety%20Committee/ALARA%20program.pdf)

