

RADIATION PROTECTION IN NUCLEAR MEDICINE

EDITOR'S NOTE: This special issue of NEXUS addresses concerns arising from the practice of nuclear medicine and compiles expert opinion from a variety of sources.

Nexus: How can practitioners in nuclear medicine best achieve application of the basic principles of radiation protection and ensure that their occupational exposure to radiation is kept As Low As Reasonably Achievable (ALARA)?

Advisor: Humans are creatures of habit. We can optimize ALARA through self-examination of our habits in the nuclear pharmacy, injection room and imaging room. For example, we should make a habit of proper use of shielding in the nuclear pharmacy; using syringe shields during injections; carrying loaded syringes in a carrier or on a tray, not in our hands; maximizing distance between us and the patient during imaging; concentrating on our work to decrease contamination and time near the source; and surveying ourselves, removing protective clothing, and washing our hands before leaving the department.

Nexus: How can we determine whether a change in technique affects radiation exposure?

Advisor: Consistent, proper use of personal dosimeters will provide data to observe the trend in our radiation exposures. The ring badge should be worn facing the inside of the hand nearest to the radiation source. The body badge should be worn in the same position each day, again nearest to the source of radiation. Care must be taken to prevent contamination of badges, and during off hours they

must be stored with a control badge in an area of normal background radiation.



Nexus: Is external radiation the only source of radiation exposure in nuclear medicine?

Advisor: No. Any radioactive material that is ingested, inhaled or absorbed through the skin also contributes to occupational radiation exposure. We must be careful to avoid internal contamination. A well designed bioassay program will detect internal radioactivity and will serve as a basis for controlling internal contamination and calculating internal radiation exposure.

Nexus: Is a whole-body counter necessary for a nuclear medicine bioassay program?

Advisor: A properly calibrated whole-body counter will provide valuable information on the identity, quantity and biokinetics of internal radioactivity. However,

periodic urinalysis is sufficient for most programs since the primary purpose is to determine whether routine procedures are resulting in internal contamination, which is rare. If preset action levels are exceeded, repeated urinalysis and thorough investigation of the cause will usually be sufficient to determine whether dose calculations must be made and whether changes in procedures are required.

Nexus: Is a bioassay program necessary for those who dispense radioiodine?

Advisor: A thyroid monitoring program is not necessary if diagnostic doses of radioiodine are ordered in unit dose capsules. However, thyroid monitoring should be performed routinely in programs where radioiodine is dispensed or administered in liquid form or whenever a capsule is accidentally broken. Liquid radioiodine is easily absorbed through the skin and is potentially volatile. Extreme care is required when handling therapy doses of liquid iodine-131, and thyroid monitoring should be performed within three days after dispensing or administering therapy doses.

Nexus: What are some devices that can be utilized in the nuclear pharmacy to reduce radiation exposure?

Advisor: L-blocks (body shields), syringe and vial shields, remote handling tools, and syringe or vial carriers are effective in minimiz-

ing external exposure. Disposable plastic or latex gloves, plastic-backed absorbent paper, lab coats, and fume hoods minimize internal exposure.



Nexus: How often should nuclear medicine facilities be surveyed?

Advisor: Any area where radioactive materials are prepared or injected should be surveyed for contamination with a survey meter at the end of each day of use. Storage areas for stock, unit dose, or multidose vials; generators; or radioactive waste should be surveyed weekly to determine that dose rates are acceptable. All these areas should be wipe tested weekly. Wipe tests will detect low levels of contamination that may not be detected with a survey instrument.

Nexus: How often should the dose calibrator be checked to be sure it is operating correctly?

Advisor: Every day of use. Background and a long-lived reference source should be counted and recorded early on each day of use. The reference source should be counted on each channel that will be used that day to verify proper operation of the dose calibrator. In addition, appropriate quarterly and annual calibrations must be

performed to assure adequate linearity and accuracy. It is necessary to check geometric variation only when the dose calibrator is installed or repaired.

Nexus: The National Council on Radiation Protection and Measurements (NCRP Report No. 91) recommends a limit of 100 mrem per year to the public. Does this require a reduction in nuclear medicine dosages?

Advisor: No. This recommendation applies to man-made sources, but excludes exposures from medical diagnosis or treatment. However, both this report and current regulations require that radiation exposures in public areas, such as waiting rooms, be limited to 100 mrem per year. These exposures can be confirmed by placing a dosimeter in public areas for a period of time, such as a calendar quarter.

Nexus: Should a nuclear medicine technologist who becomes pregnant be transferred to another job?

Advisor: Transfer of a pregnant worker should not be necessary. Even in nuclear medicine departments where the work load is



higher than average, use of proper technique should keep occupational exposure below 500 mrem, the maximum permissible dose to the fetus. If necessary, the pregnant technologist could be assigned to low-dose procedures, i.e., avoid therapy procedures and high dose diagnostic procedures such as radionuclide angiograms.

A 0.5-mm lead-equivalent apron can be worn during positioning of patients, but care of the back must not be neglected. It must be stressed that proper technique should be sufficient to keep occupational exposure below 500 mrem during the pregnancy. An abdominal dosimeter should be assigned to monitor and confirm radiation exposure. (EDITOR'S NOTE: See S. Bushong's Nexus, "Radiation Protection for the Pregnant Worker.")

Nexus: How does the risk in nuclear medicine compare to other professions?

Advisor: A reasonable level of risk is approximately 1 in 100,000 or 0.001% annually. The annual risk of dying in a car accident is about 1 in 5,000 or 0.02%. Annual risk of death is approximately 0.05% for workers in agriculture, construction, and mining and 0.005% in trade professions. Assuming a 50-year career, the lifetime risk in these professions is about 2.5% and 0.25%, respectively. The most recent estimate by The National Research Council (Committee on Biological Effects of Ionizing Radiation) places the risk of death from cancer due to acute radiation exposure at 0.08% per rem. For chronic radiation exposure, the risk is 0.04% or less. The average occupational exposure in nuclear medicine technology is approximately 0.2 rem per year, or 10 rem in 50 years. The estimated lifetime risk of death from cancer due to this radiation exposure will be about 0.4%. Therefore, risks in nuclear medicine compare favorably with those in the safest professions.