With more minimally invasive surgery, the C-arm has become a regular resident in the OR. Surgeons rely on imaging during cases to guide implant placement and other critical aspects of surgery.

How much radiation are OR teams being exposed to, and what safety measures should they be taking?

Safety pointers were offered by 2 radiology managers: Jeff Palmucci, CRA, director of radiology services at Children’s Hospital of Wisconsin, Milwaukee, past president of the American Healthcare Radiology Administrators (AHRA), and Debra Lopez, CRA, FAHRA, RT(R), president-elect of AHRA and director of diagnostic imaging at Santa Clara Valley Medical Center, San Jose, California.

Radiation use in health care is regulated by federal, state, and local agencies. The Nuclear Regulatory Commission (NRC) has regulations for radiation and safety, which are typically carried out by the states.

AORN’s Recommended Practices for Reducing Radiological Exposure in the Perioperative Practice Setting provide specific advice for OR staff.

A good resource is your radiation safety officer (RSO), who is responsible for the facility’s radiation safety program.

How low can you go?

A key concept in radiation safety is ALARA—“as low as reasonably achievable.” The idea is that you can never have zero radiation exposure because of natural background radioactivity, so the best you can do is to keep exposures ALARA.

Radiation safety organizations recommend that adults working with radioactive material not receive more than 5 rems (5,000 millirems, or mrem) of exposure per year. Americans average about 0.3 rems (300 mrem) a year just from natural radiation.

Fluoroscopy with a regular C-arm exposes a patient to about 1,200 to 4,000 mrem/minute. Exposure from a mini-C-arm is 120 to 400 mrem/minute, according to a review article by Gordon Singer, MD.

Surgeons are the most exposed team members because they are nearest the source. An orthopedic surgeon using a regular C-arm without protection is exposed to as much as 20 mrem/minute to the torso and 30 mrem to hands. For a 5-minute fluoroscopy, this would be about 100 mrem to the torso and 150 mrem to the hands per case, notes Dr Singer. The recommended exposure limit for hands is 50 rem (50,000 mrem) a year.

Exposure for spine surgeons is estimated to be 10 to 12 times the dose of other surgeons who use fluoroscopy.

There have been few studies of exposure to the rest of the OR team. A 1997 simulation study found a first assistant 2 feet away received 6 mrem/minute to the body. No exposure was detected for the scrub person 3 feet away or anesthesiologist 5 feet away.

Protection principles

“Distance and shielding are two of the biggest safety measures,” Lopez says. Protection centers on 3 principles:

• Time: Minimizing exposure time reduces the dose.
• Distance: The farther from the radiation source, the less the exposure.
• **Shielding**: A solid material, such as lead, between a person and the source greatly reduces the dose.
  
  Raising awareness about radiation safety is probably the best step a manager can take, Palmucci emphasizes.

**Distance reduces exposure**

Make the staff aware of the distance rule. Doubling the distance from the source reduces exposure by a factor of 4, for example. Stepping back from the surgical field even a step or two can greatly reduce exposure.

**Shielding for staff**

Have lead aprons available whenever radiation is used.

“When our x-ray technologists go into the OR, they check to make sure everyone who needs to is wearing lead aprons,” Lopez notes.

Are there any solutions for the ergonomic stress lead aprons place on the body?

“We try to buy the lightest aprons we can but still maintain safety with the appropriate thickness of lead,” Palmucci notes. Two-piece lead garments (skirt and vest) are available for staff who work around radiation all day, but these are not as easy to put on and take off, Lopez notes. Glasses, gloves, and thyroid shields are available to protect extremities, eyes, and thyroid.

**Monitoring exposure**

Under NRC rules, persons who have potential to receive 10% (500 mrems a year) of the maximum permissible dose must wear a dosimeter badge.

Children’s Hospital doesn’t issue badges to employees receiving less than 500 mrems. Because OR staff are under that amount, they do not routinely receive badges unless they request one. Orthopedic surgeons and anesthesiologists wear badges, as do radiologic technologists and cath lab employees.

“We have measured exposure in the OR for many years, and no one has come close to 500 millirems,” Palmucci says. “However, if an employee requests to wear a badge, we provide it at no cost.”

Santa Clara provides dosimeter badges to some OR personnel, but exposure is minimal, Lopez says.

“We are a Level 1 trauma center and do a lot of x-rays in the OR, but I can’t think of a time when anyone in the OR came close to the limit,” she says.

Both hospitals provide pregnant employees with an additional “baby badge” to monitor exposure in the abdominal area.

Badge exposure results are reviewed by the hospital’s RSO. Once the reports are reviewed, the RSO speaks to any employee who has had a noteworthy dose to determine the reason and review procedures.

Make sure the RSO or someone reviews badge reports, Lopez adds. “The Joint Commission has specifically asked to see our radiation dosage reports because they want to be sure someone is reviewing them.”

**Education and awareness**

At Children’s Hospital, radiation safety is part of annual mandatory staff safety education. Additional education is required for employees who work around radiation and those who wish to wear a dosimeter badge.

Raising awareness is a key safety strategy. “The less you know, the more you worry,” Lopez says.

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**References**


