Guideline Implementation: Radiation Safety

CONTINUING EDUCATION

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Continuing Education Contact Hours

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Purpose/Goal

To provide the learner with knowledge specific to implementing the updated AORN “Guideline for radiation safety.”

Objectives

1. Identify topics that should be addressed in policies and procedures as part of a radiation safety program.
2. Identify the principles to observe to keep radiation exposure as low as reasonably achievable (ALARA).
3. Describe measures for minimizing patients’ and health care providers’ exposure to radiation.
4. Discuss proper care of protective devices.
5. Describe additional precautions for patients or personnel who are pregnant and will be exposed to radiation.

Conflict-of-Interest Disclosures

Jennifer L. Fencl, DNP, RN, CNS-BC, CNOR, has no declared affiliation that could be perceived as posing a potential conflict of interest in the publication of this article.

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Guideline Implementation: Radiation Safety 1.4

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ABSTRACT
Because radiologic technology is used in a variety of perioperative procedures and settings, it is essential for perioperative RNs to be knowledgeable of the risks related to radiation and the ways to adequately protect patients and health care providers from unintended radiation exposure. The updated AORN “Guideline for radiation safety” provides guidance on preventing injury from ionizing radiation exposure during therapeutic, diagnostic, and interventional procedures. This article focuses on key points of the guideline to help perioperative personnel practice radiation safety. The key points address the requirements for an organization’s radiation safety program, measures used to keep radiation exposure as low as reasonably achievable, proper handling and testing of radiation protection devices, and considerations for protecting employees and patients who are pregnant and who will be exposed to radiation. Perioperative RNs should review the complete guideline for additional information and for guidance when writing and updating policies and procedures. AORN J 102 (December 2015) 630-636. © AORN, Inc, 2015. http://dx.doi.org/10.1016/j.aorn.2015.10.010

Key words: radiation safety, ALARA, radiation exposure, personal protective equipment, radiologic technology.

Wilhelm Conrad Roentgen, a German physicist, discovered the basic radiologic properties in 1895; today, radiation technologies can be found in virtually all perioperative specialties and in a variety of settings (eg, ORs, ambulatory settings, physician’s offices, catheterization laboratories, endoscopy suites). Radiologic technologies can provide many benefits during a surgical procedure; these include direct imaging of a patient’s anatomy to confirm diagnoses or to locate lesions or malformations, the ability to see movement in real time, confirmation of the progression of surgery, and assistance in accurately placing instrumentation. However, use of radiation is not without risk of consequences that can potentially affect both patients and perioperative team members. These consequences range from swelling and erythema to cancer and genetic effects. Adding to the risk is that radiation itself cannot be seen, felt, or smelled. Therefore, understanding the risks inherent in using radiation technologies during a surgical procedure and knowing how to adequately protect patients and health care providers from unintended radiation exposure is critical to safe practice.

The updated AORN “Guideline for radiation safety” (formerly titled “Guideline for reducing radiological exposure”) was published in June 2015. AORN guideline documents provide guidance based on an evaluation of the strength and quality of the available evidence for a specific subject. The guidelines apply to inpatient and ambulatory settings and are adaptable to all areas where operative and other invasive procedures may be performed.

Topics addressed in the radiation safety guideline include measures that should be a part of an organization’s radiation safety program: keeping radiation exposure as low as reasonably achievable (ALARA) for patients and health care workers, considerations for pregnant employees and pregnant patients who will be exposed to radiologic technologies, proper handling...
and testing of radiation protection devices, and principles for handling therapeutic radionuclides or caring for patients who have received therapeutic radionuclides. This article elaborates on key takeaways from the guideline document; however, perioperative RNs should review the complete guideline for additional information and for guidance when writing and updating policies and procedures.

Key takeaways from the AORN “Guideline for radiation safety” include the following:

- Every location in which diagnostic or therapeutic radiation is administered must have a radiation safety program.
- Measures should be implemented to minimize patient and personnel exposure to radiation.
- Radiation protection devices should be confirmed to be intact.
- Additional precautions should be taken during radiation exposure of patients or personnel who are pregnant (Figure 1).

The following scenario highlights the key takeaways and other aspects of the AORN guideline. Each key takeaway and the nurse’s actions are then discussed in detail following the scenario.

**SCENARIO**

Nurse B is preparing his room for the first procedure of the day, a right tibia intramedullary nailing and an open reduction internal fixation of the right fibula. After thoroughly reviewing the surgeon’s preference card for this procedure, Nurse B begins to gather all the supplies and equipment needed, such as instrumentation, suture, medication, positioning equipment, and radiation safety protective devices, including leaded glasses, lead aprons, thyroid shields, and a mobile lead door.

As he gathers the lead aprons and thyroid shields, he visually inspects them to determine whether there are any defects. He also notes that the last date reflected on the label signifies that these items were inspected by the radiation safety committee less than one year ago. Understanding that all members of the perioperative team are at risk for unintended radiation exposure during this procedure, Nurse B also gathers the lead apron and thyroid shield for the anesthesia professional and places them at the head of the bed on a chair. He places the three pairs of leaded glasses on his nursing station for the surgical technologist, RN first assistant, and surgeon.

Nurse B then calls the radiology department to confirm they are aware of this scheduled procedure and will provide a C-arm fluoroscopy unit and a radiology technologist to operate the C-arm for this procedure. He then helps the surgical technologist don her sterile gown and gloves and confirms that she has what she needs to start the setup of the sterile table.

Nurse B proceeds to the preoperative area to conduct his preoperative nursing assessment. He introduces himself to the patient, Mrs K, a 34-year-old woman. After using two identifiers to confirm she is the correct patient, Nurse B verifies that the surgeon has spoken with her and has marked the operative site. Mrs K tells Nurse B that she has no known medication allergies and has undergone two previous surgeries, a breast biopsy three years ago and an appendectomy when she was a teenager. She has been NPO since midnight, except for a few sips of water to take her birth control pill and pain medication this morning. Nurse B asks Mrs K whether she can state what procedure she is undergoing today, and Mrs K voices an accurate understanding of the procedure and has no questions.

Although Mrs K has said she is currently taking prescribed oral contraceptives, because she is of childbearing age and radio-logic therapy will be used during her procedure, Nurse B confirms with the laboratory results that she is not pregnant. He then verifies that the remainder of the documentation is present for surgery. After the anesthesia professional completes her assessment, the team transports Mrs K to the OR and helps her safely transfer to the OR bed. The anesthesia professional anesthetizes and intubates Mrs K.

The perioperative team participates in positioning Mrs K, taking care to ensure that no extraneous body parts will be in the path of the radiation beam when it is in use. When the positioning is completed, the surgeon and the RN first assistant put on their leaded glasses and leave the room to scrub their hands. During that time, Nurse B places a lead apron over Mrs K’s abdomen, covering her ovaries and breasts, and a thyroid shield over her thyroid, being mindful that the shielding is being placed between the patient and the source of radiation but not in the path of the radiation beam. Lastly, Nurse B places blankets over the lead apron covering Mrs K’s abdomen and another blanket over her arms that are extended on padded arm boards. Nurse B then applies the safety strap across the patient’s abdomen.

Nurse B places a radiation safety sign on the outside of the OR door to alert personnel who may enter at a later time that they should don protective equipment before entering. The surgeon leads the perioperative team in a time out, and the entire surgical team confirms the patient’s identity, the procedure, and the laterality. Because this procedure will
involve radiation, the radiology technologist then performs a radiation time out, confirming that the patient is not pregnant, the patient has shielding in place, and all members of the team are wearing their dosimeters and their personal protective equipment.

During the procedure, all team members implement the elements of ALARA: time, distance, and shielding. The surgeon and radiology technologist deploy the C-arm for the shortest amount of time possible that allows them to adequately see the surgical field, while being mindful to position the C-arm so that the patient is close to the image intensifier and away from the tube side of the C-arm. The radiology technologist alerts the team before activating the C-arm each time. Team members maintain the greatest distance possible from the radiation beam when it is in use, and when feasible, they stand on the image intensifier side. Nurse B has also placed a mobile lead door in the room that surgical team members can stand behind during radiation imaging. All team members wear thyroid shields and protective lead wraparound aprons that cover the body from below the thyroid shield to the knee. In addition, all members of the team scrubbed in at the sterile field wear leaded glasses.

The procedure lasts longer and requires use of the C-arm more than anticipated. As the procedure progresses, the radiology technologist requests a surgical pause to alert the team that a total of 20 minutes of fluoroscopy time has elapsed. Elapsed fluoroscopy time is important to track because longer exposures raise the radiation risk for the patient and surgical team. The surgeon explains that Mrs K’s anatomy is proving to be challenging but the procedure is nearly completed. At the end of the procedure, the surgeon conducts a surgical debriefing, during which the radiology technologist reports that the total amount of fluoroscopy time was 27 minutes.

The anesthesia professional successfully extubates Mrs K, and the team transfers her to a hospital bed. Nurse B and the anesthesia professional then transport her to the postanesthesia care unit (PACU). After Nurse B has given the hand-over report to the PACU nurse, he returns to the OR to assist with room turnover. He gathers all the personal protective equipment used during the procedure, cleans the equipment with a hospital-grade disinfectant according to the manufacturer’s instructions, and takes it back to the storage room. He takes care to hang the lead aprons vertically.
After Nurse B has assisted with room turnover, he calls the charge nurse, requesting time to complete an event report for the radiation safety committee for a procedure that exceeded 20 minutes of fluoroscopy time. Per the hospital’s policy, this event report is completed by the RN circulator and includes information on the patient, the surgery, the surgical team involved in patient care, and the total fluoroscopy time for the procedure. The charge nurse understands that this type of event report is important so that the radiation safety committee can have complete oversight of all procedures in which radiation is used, so she asks Nurse B to complete the report while the details are fresh in his mind. She arranges to have another nurse start Nurse B’s next assigned procedure.

KEY TAKEAWAYS DISCUSSION
The key takeaways from the AORN “Guideline for radiation safety” address radiation safety programs, measures to keep radiation exposure ALARA, proper handling and testing of radiation protection devices, and considerations for employees and patients who are pregnant and who will be exposed to radiation technologies. These takeaways do not cover the entire guideline. Rather, they help the reader focus on important or new information that should be implemented into perioperative practice. The scenario highlights only one type of radiologic technology that can be used. Other modalities of radiologic technology include portable x-ray, radioactive seeds, and computed tomography, so it is important for health care providers to read the updated guideline in its entirety.

Radiation Safety Program
Any organization in which radiologic technology is used must establish a radiation safety program. An interprofessional team that includes a radiation safety officer, perioperative RNs, radiologists, physicians, anesthesia professionals, and other stakeholders should be responsible for establishing the program. An important role of the radiation safety program is to provide essential oversight in regard to patient and staff member safety, encompassing a variety of regulatory safety requirements from the local, state, and federal levels. Radiation safety for patients and staff members can be attained by providing guidance on how to achieve ALARA exposure and by developing specific policies and procedures that address a variety of safety aspects, such as who can operate radiologic technology or diagnostic imaging equipment, documentation requirements, protective measures for patients and staff members, requirements for using radiation monitoring devices, evaluation guidelines for protective devices, educational and competency requirements for personnel, patient education, and quality improvement initiatives.

The scenario provides several examples of the influence of a radiation safety program. As Nurse B gathers the appropriate equipment and supplies for this procedure, he assesses the label found on the lead aprons and thyroid shields to confirm the date the radiation safety committee last inspected the items for defects, demonstrating that the radiation safety committee has an established process for evaluating protective devices.

Nurse B also called to confirm with the radiology department that both a C-arm and a radiology technologist would be available for this procedure because the organization keeps a list of the approved equipment operators and has the documentation required for a variety of regulatory agencies to support that this individual can operate the specific piece of equipment.

The scenario provides three examples of quality improvement initiatives this organization has implemented to evaluate specific elements of their radiation safety program (these are examples only and not specific recommendations in the AORN guideline). These include posting a radiation sign on the OR door as a visual cue for any staff members entering the room in which radiation is being used, conducting a radiation time out before the use of radiologic technology to review and confirm the patient and staff safety elements, and reporting fluoroscopy times longer than 20 minutes to the radiation safety committee in the form of an event report. Another strategy that an organization could decide to implement is to have additional lead aprons available outside the OR or immediately inside the OR for staff members who are entering the room (this is an example only and not a specific recommendation in the AORN guideline).

Radiation Exposure
Although the use of radiologic technology in surgery has many benefits to enhance the surgical procedure, unintended radiation exposure can have detrimental effects for both patients and health care providers. Adverse effects from radiation exposure may be apparent within hours or may not appear until years after the exposure and can manifest in different ways, including pain, swelling, erythema, hair loss, cataracts, cancer, and genetic effects. These known risks underscore the critical nature of implementing safety measures to minimize the risk of radiation exposure.

Implementing the principles of ALARA, which encompass the elements of time, distance, and shielding, helps achieve the lowest dose of radiation exposure for both the patient and staff members. In this scenario, the health care team took proactive measures to help protect both the patient and the team from unintended effects.
radiation exposure. Nurse B gathered the appropriate leaded glasses, lead aprons, and thyroid shields for the entire surgical team, including the anesthesia professional, to wear for protection. Wearing protective lead devices can dramatically decrease exposure to radiation and should be worn by all health care workers present in the room while radiation is being used. He also brought in the mobile lead door for surgical team members to stand behind during radiation imaging when possible.

During the radiation time out, the team also confirmed they were all wearing their dosimeters. Thus, the radiation safety officer can monitor the radiation exposure of each individual and intervene (ie, limit radiation exposure) if levels of radiation exposure are nearing recommended maximum levels. For accurate readings of the monitoring devices, the dosimeter should be worn in a consistent location for each procedure (eg, one dosimeter worn inside the lead apron and one on the collar or shoulder region outside the lead apron) and stored in an area of the facility free from excessive heat or other radiation exposure so the device does not collect ionizing radiation from other sources. In addition, the radiology technologist alerts the team before activating the C-arm. This allows the team members to proactively take measures to protect themselves, such as by maintaining a greater distance from the beam to decrease their radiation exposure.

The scenario included a specific passage articulating the principles of ALARA with examples of how time, distance, and shielding were present. This is reflected in

- the surgeon and radiology technologist deploying the C-arm for the shortest amount of time needed to adequately view the operative field (ie, ALARA principle of time);
- team members maintaining the greatest distance possible from the radiation beam when it was in use and, when feasible, standing on the image intensifier side (ie, ALARA principle of distance); and
- all team members wearing protective lead shielding that included wraparound lead aprons, thyroid shields, and leaded glasses for those at the surgical field (ie, ALARA principle of shielding).

The scenario also identified interventions to decrease radiation exposure to the patient. The team took care during positioning to ensure that areas of the patient’s body that did not require radiation exposure (ie, any area outside the surgical site) would not be in the path of the radiation beam. In addition, Nurse B placed a lead apron over the patient’s abdomen and placed a thyroid shield, ensuring that the shielding was between the patient and source of radiation but not in the path of the radiation beam. The surgeon and radiology technologist were mindful during the procedure to keep the patient close to the image intensifier and away from the tube side of the C-arm while the radiation was in use.

**Protective Devices**

Protective devices used to shield patients and staff members from unintended radiation exposure may become damaged at any time during their lifetime, even before use; therefore, it is important for organizations to establish a standardized process for routine testing to ensure the integrity of these vital pieces of safety equipment. Important elements to include in this standardized process are

- visually inspecting the protective device and x-raying for defects at the time of purchase,
- visually inspecting the devices before use,
- annually x-raying protective devices for defects related to normal wear and tear,
- affixing a label to the protective device that clearly notes the last date the device was tested, and
- x-raying the protective device whenever there is a question about whether damage is present.

While gathering the lead aprons and thyroid shield for this procedure, Nurse B visually inspected the protective devices for any defects and also checked the label affixed to them that denoted the last time they were x-rayed.

In addition, caring for these protective devices after the procedure is important in maintaining their integrity. Protective devices should be stored flat or hung vertically and never folded because folding could lead to damage such as cracking, rendering the device less effective. Nurse B took care to collect all the lead aprons and thyroid shields after the procedure, clean them appropriately, and hang them properly in the storeroom.

**Pregnancy Precautions**

Care should be taken to avoid exposing an embryo or fetus to radiation. The perioperative RN should verify the pregnancy status of all premenopausal patients. If the patient is pregnant at the time of surgery, the perioperative RN should communicate these findings to both the surgeon and anesthesia professional, and the surgeon should perform a risk-benefit analysis to determine how best to proceed. If the surgeon makes the determination to continue with the procedure, an important intervention would be to place lead shielding between the fetus and the source of radiation as long as the shielding will not impede or restrict the
During his preoperative assessment, Nurse B noted that Mrs K had taken her birth control pill that morning, but he also confirmed with the laboratory results that Mrs K was not pregnant. The patient’s pregnancy status was also verified during the radiation time out.

Not highlighted in this scenario and also important for pregnancy precautions are considerations for staff members who know or suspect they are pregnant. Although it is not legally required, an important first step is for the pregnant health care worker to turn in an official voluntary declaration of pregnancy, which includes an estimated date of conception from which the safety protocol will be established. Additional safety measures for the pregnant health care provider include that:

- radiation exposure must not exceed 0.5 rem during the entire gestational period,
- an additional dosimeter should be worn under shielding at the waist and be read monthly, and
- a maternity or double-thickness apron or wraparound apron that provides coverage for the entire abdomen may be worn.

CONCLUSION

Radiologic technologies offer many benefits for surgery, but use of radiation in the OR is not without risk. Essential for perioperative RNs working with any type of radiologic technology is a thorough understanding of how to adequately protect patients and staff members from unintended radiation exposure. Perioperative RNs should proactively seek information about their organization’s radiation safety program, how best to implement the ALARA principles, appropriate care and handling of radiation safety devices, and additional precautions to reduce radiation exposure for patients and staff members who are pregnant. By having a thorough understanding of radiation safety, perioperative RNs can deliver exceptional and safe patient care and help keep their team members safe.

References


Resources for Implementation


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What Else Is in the Guideline?

Read the AORN “Guideline for radiation safety”1 to learn what the evidence says about the following:

- What are the responsibilities of the interprofessional team developing a radiation safety program? (Recommendation I)
- How should peak values for radiation dose be expressed? (Recommendation II.e.)
- What should be included in patient education? (Recommendation II.f.1.)
- When should equipment-mounted and mobile shields be used? (Recommendation V.c.)
- When should protective gloves be worn? (Recommendation V.i.)
- What precautions should be taken for handling therapeutic radionuclides? (Recommendation VII.)
- What are the recommendations for disposing of radioactive waste? (Recommendation VII.f.)


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Continuing Education: Guideline Implementation: Radiation Safety 1.4

PURPOSE/GOAL
To provide the learner with knowledge specific to implementing the updated AORN “Guideline for radiation safety.”

OBJECTIVES
1. Identify topics that should be addressed in policies and procedures as part of a radiation safety program.
2. Identify the principles to observe to keep radiation exposure as low as reasonably achievable (ALARA).
3. Describe measures for minimizing patients’ and health care providers’ exposure to radiation.
4. Discuss proper care of protective devices.
5. Describe additional precautions for patients or personnel who are pregnant and will be exposed to radiation.

The Examination and Learner Evaluation are printed here for your convenience. To receive continuing education credit, you must complete the online Examination and Learner Evaluation at http://www.aorn.org/CE.

QUESTIONS
1. The principles that health care providers should observe to keep radiation exposure ALARA are
   1. distance.
   2. laterality.
   3. shielding.
   4. time.
      a. 1 and 2
      b. 3 and 4
      c. 1, 3, and 4
      d. 1, 2, 3, and 4

2. In observing the ALARA principles, the surgeon
   1. deploys the C-arm for the shortest amount of time possible.
   2. stands behind a mobile lead door during radiation imaging.
   3. stands on the tube side of the C-arm.
   4. wears leaded glasses.
      a. 1 and 3
      b. 2 and 4
      c. 1, 2, and 4
      d. 1, 2, 3, and 4

3. In observing the ALARA principles, the surgical team members
   1. verify the patient’s identity, the procedure, and the laterality during the time out.
   2. place a lead apron and thyroid shield over the patient.
   3. maintain the greatest distance possible from the radiation beam when the C-arm is in use.
   4. wear thyroid shields and lead aprons that cover them from below the thyroid shield to the knee.
      a. 1 and 2
      b. 3 and 4
      c. 2, 3, and 4
      d. 1, 2, 3, and 4

4. To protect the patient, the surgeon positions the C-arm so that the patient is close to the image intensifier and away from the tube side of the C-arm.
   a. true
   b. false

5. Topics that should be addressed in policies and procedures developed as part of a radiation safety program include
   1. who can operate radiologic technology.
   2. documentation requirements.
   3. protective measures for patients and staff members.
   4. educational and competency requirements.
6. To help ensure accurate readings, health care providers should wear their dosimeters in a different location for each procedure.
   a. true          b. false

7. Protective devices used to shield patients and staff members from unintended radiation exposure should be x-rayed for defects
   1. at the time of purchase.
   2. before every use.
   3. annually.
   4. whenever there is a question about whether damage is present.
   a. 1 and 2          b. 3 and 4
   c. 1, 3, and 4      d. 1, 2, 3, and 4

8. Which of the following storage options would be appropriate for lead aprons and thyroid shields?
   1. folded loosely.
   2. hung vertically.
   3. rolled tightly.
   4. stored flat.
   a. 1 and 3          b. 2 and 4
   c. 1, 2, and 3      d. 1, 2, 3, and 4

9. If a patient is pregnant at the time of surgery, the surgical team should place lead shielding between the fetus and the source of radiation when the shielding will not impede or restrict the procedure.
   a. true          b. false

10. A health care provider who is pregnant and will be exposed to radiation
    1. must not be exposed to radiation in excess of 0.5 rem during the entire gestational period.
    2. may voluntarily declare the pregnancy and provide an estimated date of conception.
    3. should wear an additional dosimeter under shielding at the waist.
    4. may wear a maternity, wraparound, or double-thickness apron that covers the entire abdomen.
    a. 1 and 2          b. 3 and 4
    c. 2, 3, and 4      d. 1, 2, 3, and 4
LEARNER EVALUATION

Continuing Education: Guideline Implementation: Radiation Safety 1.4

This evaluation is used to determine the extent to which this continuing education program met your learning needs. The evaluation is printed here for your convenience. To receive continuing education credit, you must complete the online Examination and Learner Evaluation at http://www.aorn.org/CE. Rate the items as described below.

OBJECTIVES
To what extent were the following objectives of this continuing education program achieved?
1. Identify topics that should be addressed in policies and procedures as part of a radiation safety program.
   Low 1. 2. 3. 4. 5. High
2. Identify the principles to observe to keep radiation exposure as low as reasonably achievable (ALARA).
   Low 1. 2. 3. 4. 5. High
3. Describe measures for minimizing patients’ and health care providers’ exposure to radiation.
   Low 1. 2. 3. 4. 5. High
4. Discuss proper care of protective devices.
   Low 1. 2. 3. 4. 5. High
5. Describe additional precautions for patients or personnel who are pregnant and will be exposed to radiation.
   Low 1. 2. 3. 4. 5. High

CONTENT
6. To what extent did this article increase your knowledge of the subject matter?
   Low 1. 2. 3. 4. 5. High
7. To what extent were your individual objectives met?
   Low 1. 2. 3. 4. 5. High

8. Will you be able to use the information from this article in your work setting?
   1. Yes 2. No

9. Will you change your practice as a result of reading this article? (If yes, answer question #9A. If no, answer question #9B.)
   9A. How will you change your practice? (Select all that apply)
      1. I will provide education to my team regarding why change is needed.
      2. I will work with management to change/implement a policy and procedure.
      3. I will plan an informational meeting with physicians to seek their input and acceptance of the need for change.
      4. I will implement change and evaluate the effect of the change at regular intervals until the change is incorporated as best practice.
      5. Other: __________________________________

   9B. If you will not change your practice as a result of reading this article, why? (Select all that apply)
      1. The content of the article is not relevant to my practice.
      2. I do not have enough time to teach others about the purpose of the needed change.
      3. I do not have management support to make a change.
      4. Other: ________________________________

10. Our accrediting body requires that we verify the time you needed to complete the 1.4 continuing education contact hour (84-minute) program: _______________