ACR PRACTICE PARAMETER FOR THE PERFORMANCE OF MOLECULAR BREAST IMAGING (MBI) USING A DEDICATED GAMMA CAMERA

PREAMBLE

This document is an educational tool designed to assist practitioners in providing appropriate radiologic care for patients. Practice Parameters and Technical Standards are not inflexible rules or requirements of practice and are not intended, nor should they be used, to establish a legal standard of care[1]. For these reasons and those set forth below, the American College of Radiology and our collaborating medical specialty societies caution against the use of these documents in litigation in which the clinical decisions of a practitioner are called into question.

The ultimate judgment regarding the propriety of any specific procedure or course of action must be made by the practitioner considering all the circumstances presented. Thus, an approach that differs from the guidance in this document, standing alone, does not necessarily imply that the approach was below the standard of care. To the contrary, a conscientious practitioner may responsibly adopt a course of action different from that set forth in this document when, in the reasonable judgment of the practitioner, such course of action is indicated by variables such as the condition of the patient, limitations of available resources, or advances in knowledge or technology after publication of this document. However, a practitioner who employs an approach substantially different from the guidance in this document may consider documenting in the patient record information sufficient to explain the approach taken.

The practice of medicine involves the science, and the art of dealing with the prevention, diagnosis, alleviation, and treatment of disease. The variety and complexity of human conditions make it impossible to always reach the most appropriate diagnosis or to predict with certainty a particular response to treatment. Therefore, it should be recognized that adherence to the guidance in this document will not assure an accurate diagnosis or a successful outcome. All that should be expected is that the practitioner will follow a reasonable course of action based on current knowledge, available resources, and the needs of the patient to deliver effective and safe medical care. The purpose of this document is to assist practitioners in achieving this objective.

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1 *Iowa Medical Society and Iowa Society of Anesthesiologists v. Iowa Board of Nursing, 831 N.W.2d 826 (Iowa 2013) Iowa Supreme Court refuses to find that the "ACR Technical Standard for Management of the Use of Radiation in Fluoroscopic Procedures (Revised 2008)" sets a national standard for who may perform fluoroscopic procedures in light of the standard's stated purpose that ACR standards are educational tools and not intended to establish a legal standard of care. See also, Stanley v. McCarver, 63 P.3d 1076 (Ariz. App. 2003) where in a concurring opinion the Court stated that "published standards or guidelines of specialty medical organizations are useful in determining the duty owed or the standard of care applicable in a given situation" even though ACR standards themselves do not establish the standard of care.*

I. INTRODUCTION

This practice parameter has been developed to guide physicians performing and interpreting nuclear breast imaging studies using intravenous technetium-99m (Tc-99m) sestamibi and dedicated gamma camera**s**, referred to subsequently in this document as molecular breast imaging (MBI).

This technology has been referred to as both MBI and breast-specific gamma imaging (BSGI), depending on the type of camera used. For consistency, this document will use the term MBI to refer to these techniques, which

use small field-of-view gamma cameras designed specifically for breast imaging using Tc-99m sestamibi, unless directly referencing an article discussing BSGI.

In 1997, the Food and Drug Administration (FDA) approved the use of Tc-99m sestamibi for scintimammography, which used a conventional gamma camera to image the breast. Scintimammography with conventional gamma cameras initially showed good sensitivity and specificity for larger tumors, but more recent studies have shown that MBI identifies tumors as small as 2 mm in size [1-5].

MBI requires the intravenous injection of Tc-99m sestamibi. Scintigraphic images are acquired while each breast is gently compressed using conventional mammographic positioning. Typically, two images are obtained of each breast, mirroring the standard mammographic positions of craniocaudal (CC) and mediolateral oblique (MLO) projections. Each image is acquired for approximately 10 minutes or 175,000 counts (range of 7-10 minutes based on sensitivity of camera system and injected dose) for a total examination time of about 28 to 40 minutes [6]. Two types of gamma cameras are currently available: 1) multicrystal array detectors using sodium iodide or cesium iodide and 2) cadmium zinc telluride (CZT) direct conversion detectors, which have a higher sensitivity for detecting subcentimeter lesions than a single detector [1].

The FDA originally approved an administered activity of 740 to 1100 megabecquerels (MBq) (20-30 millicuries (mCi)) of Tc-99m sestamibi; however, a range of administered activity of 300 to 555 MBq (8-15 mCi) is now being used with currently available camera systems. With CZT-based dual-head MBI, even lower administered activities of 240 to 300 MBq (6.5-8 mCi) of Tc-99m sestamibi are routinely used [3,7-9] with the actual injected radiation dose even lower at 6 to 7 mCi (222-259 MBq) for an 8 mCi dose due to the adhesion of radiotracer to the syringe surface [3,9,10].

A 2013 meta-analysis of MBI showed high sensitivity (95%) and specificity (80%) for detecting malignancy [11]. For malignant lesions <1 cm in size and ductal carcinoma in situ (DCIS), sensitivities are slightly lower at 84% and 88%, respectively [6]. In a 2017 meta-analysis of MBI compared with MRI, BSGI had similar sensitivity (84% versus 89%) and higher specificity (82% versus 39%) [12]. Similar to MRI, contrast-enhanced mammography (CEM) and ultrasound (US) show improved sensitivity compared with mammography alone [13-16]. Unlike mammography, sensitivity of MBI is not affected by dense breast tissue or the presence of breast implants [17].

II. INDICATIONS AND CONTRAINDICATIONS

The clinical indications for MBI, particularly when MRI is not feasible, currently include, but are not limited to:

II. INDICATIONS AND CONTRAINDICATIONS

A. Indications

1. Breast Cancer Screening

Mammography is the first line tool for breast cancer screening in women at all risk levels [18]. However, mammography has known limitations, including decreased sensitivity in dense breast tissue and lower sensitivity compared with breast MRI in high-risk women (>20% lifetime risk of breast cancer) [19]. DBT has been shown to decrease recall rates and improves sensitivity in the screening setting compared with full-field digital mammography (FFDM) [20,21]. The addition of screening breast MRI to mammography is recommended for high-risk women and may be considered for women with a 15% to 19% lifetime risk of breast cancer [22]. Approximately 15% of patients cannot undergo MRI for various reasons, including claustrophobia, renal disease, certain metallic implants, and body habitus [23,24]. MBI is a potential supplemental screening option for high-risk women and women with dense breast tissue who cannot undergo MRI, given comparable sensitivity for lesions as small as 3 mm and its improved specificity.

Unlike MRI, MBI involves ionizing radiation and provides less morphologic detail [25]. The radiation absorbed dose and target organ distribution of MBI differ from mammography. MBI has a lower absorbed dose to the breast than mammography but a higher effective (whole-body) dose. The risk-to-benefit ratio of MBI, including radiation dose and cancer detection rate, must be considered if it is to be used as a screening tool.

A study by Rhodes et al [3] of supplemental screening with MBI in women with dense breasts yielded an

additional 8.8 cancers/1000 using an effective dose of 2.4 mSv. Supplemental screening MBI may be used as an alternative in women with dense breast tissue who cannot undergo MRI based on consensus recommendations from an expert review panel [26]. However, the panel noted continued barriers to the use of MBI, including whole-body radiation exposure and total length of examination of up to 40 minutes.

Finally, background parenchymal uptake on MBI, which refers to the amount of Tc-99m sestamibi uptake of normal fibroglandular tissue, has been identified as a breast cancer risk factor independent of mammographic breast density and thus may serve as a potential imaging biomarker [27,28].

II. INDICATIONS AND CONTRAINDICATIONS

A. Indications

2. Extent of Disease

Preoperative Staging in Newly Diagnosed Breast Cancer – Breast MRI is commonly employed as a supplemental modality to evaluate the extent of disease in newly diagnosed breast cancer patients. MBI can be helpful in such patients who cannot undergo MRI. Studies have shown that MBI can identify mammographically occult, multifocal, and multicentric malignancy in newly diagnosed breast cancer patients [15,25,29-31]. MBI has a higher specificity and MRI has higher sensitivity for subcentimeter cancers and DCIS [11,15,25,29-32]. In a single institution study by Sumkin and colleagues [33], CEM, MBI, and MRI all showed similar cancer detection with MRI having lower specificity. However, it remains to be shown conclusively whether increased accuracy in determining the full extent of disease results in any reduction in recurrence rates or mortality following surgery, radiation, or systemic therapy.

For invasive lobular carcinoma (ILC), MBI has been shown to have similar sensitivity and specificity to MRI [34]. A retrospective multicenter study comparing mammography, US, MRI, and MBI [35] showed that MBI had the highest sensitivity for the detection of ILC compared with the other modalities.

Yoo and colleagues evaluated MBI in upstaging DCIS to invasive disease [36]. In their study, a combination of US tumor size, Ki-67, and MBI predicted upstaging, an important consideration in the era of de-escalation therapy.

MBI has limited anatomic coverage. Therefore, compared with MRI, its utility in loco-regional staging is inferior. Positioning for MBI is the same as conventional mammography; thus, the extreme posterior medial breast, chest wall, and axillae will be incompletely imaged. In contrast, MRI covers the entire breast, chest wall, all axillary lymph node levels, and internal mammary lymph nodes.

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A. Indications

3. Evaluation of Response to Neoadjuvant Chemotherapy

Neoadjuvant chemotherapy (NAC) in women with newly diagnosed breast cancer can decrease tumor size to allow less extensive surgery, and response to NAC can predict disease-free survival [37]. Breast MRI has superior accuracy in assessing residual disease compared with mammography, sonography, and palpation [38-40]. MBI has been proposed as an alternative for patients who cannot undergo MRI examination for this indication. An earlier study (n = 122) found that MBI performed with comparable sensitivity and specificity to MRI in assessing residual tumor after NAC [41]. A 503 subject meta-analysis of MBI for predicting response to NAC showed MBI to have a pooled sensitivity of 86% for residual disease but a lower specificity of 69%. Given the lower specificity, the authors indicate that additional imaging modalities would still be needed to fully evaluate NAC response. In a study of 90 patients, performed by Hunt and colleagues [42], both MRI and MBI [42] showed a similar extent of disease before NAC, but neither were accurate enough at predicting complete response after NAC to eliminate the need for surgery. There are limited data regarding the ability of MBI to predict early treatment response to NAC [43,44]. Collarino et al [45] suggests that MBI may be better suited to predict nonresponsiveness. MBI may be used in this setting when patients cannot tolerate MRI; however, MRI is considered the standard for evaluation of NAC [42]

II. INDICATIONS AND CONTRAINDICATIONS

A. Indications

4. Additional Evaluation of Clinical or Imaging Findings

Detection of Local Breast Cancer Recurrence – Early detection of breast cancer recurrence is important in improving survival [41]. Mammography is the first-line imaging modality to monitor women following breast conserving surgery. However, the detection of recurrence using mammography can be limited by morphologic changes in the posttreatment breast following surgery, radiation, and/or chemotherapy and within dense tissue. MRI has proven highly sensitive for detecting tumor recurrence and has a high negative predictive value for differentiating scar from recurrence [46-48]. In addition to mammography, screening breast MRI improves early detection of loco-regional recurrence and/or new primary tumors in these patients [49].

Given the similar sensitivities of MBI and MRI for detecting breast cancer, MBI may be useful in evaluating women with suspected local breast cancer recurrence. Although specific data on current MBI technology are lacking, previous studies evaluating scintimammography showed superior sensitivity for detecting recurrence compared with mammography, indicating that MBI is not adversely affected by posttreatment morphologic changes in the breast [43,50]. MBI can be considered when a patient suspected to have local recurrence cannot undergo MRI.

II. INDICATIONS AND CONTRAINDICATIONS

A. Indications

5. Metastatic Axillary Lymphadenopathy of Unknown Primary

Breast cancer may present with axillary or distant metastatic malignancy without evidence of a primary malignancy within the breasts on mammography, sonography, or clinical examination. MRI helps detect primary occult malignancy [44]. There are no current studies evaluating MBI for this indication. However, in light of its similar performance compared with MRI for cancer detection, it is anticipated that MBI may be a reasonable option for such patients who cannot undergo MRI.

II. INDICATIONS AND CONTRAINDICATIONS

A. Indications

6. Lesion Characterization

Infrequently, mammographic findings may be indeterminate or challenging to localize for biopsy after a complete conventional mammographic and sonographic diagnostic evaluation.

MBI has been proposed as useful in such cases when MRI is contraindicated or not available. As with MRI, there is limited evidence for the use of MBI for lesion characterization. In 2012, Siegel and colleagues reported their institution's experience in using MBI for this indication. In their retrospective review (n = 416), the majority (56%) of patients undergoing MBI for problem-solving consisted of those with indeterminate mammographic asymmetries that were either seen on only 1 view, seen on 2 views with negative US, or multifocal asymmetries, including cases that were difficult to target for biopsy. Sixty-eight patients (14%) subsequently underwent biopsy based on MBI findings; 43% were malignant, and 15% were high-risk lesions, with 29 of 68 (42.6%) being false positive cases and 2 of 289 (0.07%) being false-negative cases [51].

Weigert and colleagues subsequently reported a larger multicenter clinical patient registry analysis evaluating the impact of adjunctive imaging with MBI compared with US on patient management (n = 1042). Management changes included proceeding to biopsy for positive adjunctive imaging and follow-up imaging or return to screening for negative imaging. A subset of 119 patients with indeterminate mammographic findings (BI-RADS 0) was evaluated. Compared with US, MBI changed management in 92% of these patients, versus 40% for US. Performance measures of positive predictive value, false negative rate and accuracy for MBI were 50%, 0%, and 84% compared with 26%, 9%, and 56% for US [52]. Additionally, they found that neither US nor MBI provided sufficiently high negative predictive value to obviate biopsy when biopsy was already recommended based on mammographic findings (BI-RADS 4 and 5). Shermis and colleagues illustrate the use of MBI as problem-solving in patients with multiple findings when conventional imaging is indeterminate or when biopsy is not possible [6]. Additional indications for problem-solving or challenging clinical situations may include imaging of the

augmented breast or imaging in patients with silicone injections [53].

MBI-guided biopsy – Recently developed biopsy capability is now available for single- and double-headed camera MBI systems as an add-on accessory to the camera [54]. The time of biopsy is 70 to 90 minutes. MBI-guided biopsy is a safe procedure and less expensive than MRI-guided biopsy [54,55]. In a study of 104 MBI-guided biopsies by Brem, 16.3% revealed breast cancer undetected by mammogram or US [56]. MBI biopsy allows specimen imaging whereby the biopsy cores are imaged with a gamma camera to confirm the area of radiotracer uptake has been appropriately sampled. Specimen imaging is not available with MRI-guided biopsy.

II. INDICATIONS AND CONTRAINDICATIONS

B. Contraindications

1. Pregnancy
   The ACR–SPR Practice Parameter for Imaging Pregnant or Potentially Pregnant Patients with Ionizing Radiation [57] provides useful information on radiation risks to the fetus regardless of source. Information on managing pregnant or potentially pregnant patients undergoing nuclear medicine procedures is available from the International Commission on Radiological Protection.
2. Allergy
   Allergy to technetium is rare [58,59].

III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

A. Physician

Qualified physicians should perform MBI. The physician should meet the qualifications outlined in the ACR Practice Parameter for the Performance of Screening and Diagnostic Mammography [60] or should review the mammographic, sonographic, and/or MRI findings with a physician who meets the qualifications specified in the FDA Mammography Quality Standards Act (MQSA) Final Regulations.

1. Initial Qualifications
   Training in medical physics, interpretation of MBI, and hands-on training are imperative to successful performance.

   The initial qualifications outlined for the Nuclear Medicine Accreditation Program Requirements provide this foundation [61].

2. Maintenance of Competence
   The physician should perform a sufficient number of examinations to maintain appropriate skills. Continued competence depends on participation in a quality control program as defined in section IX.

3. Continuing Medical Education
   The physician's continuing education should be in accordance with the ACR Practice Parameter for Continuing Medical Education (CME) [62].

B. Qualified Medical Physicist

For qualifications of the Qualified Medical Physicist, see the ACR–AAPM–SIIM Practice Parameter for Determinants of Image Quality in Mammography [63] and the ACR–AAPM Technical Standard for Nuclear Medical Physics Performance Monitoring of Gamma Cameras [64].

C. Radiologic Technologist

Technologists administering radiopharmaceuticals to the patient must meet the qualifications specified in the ACR–ACNM–SNMMI–SPR Practice Parameter for the Use of Radiopharmaceuticals in Diagnostic

Procedures [65]. Positioning patients and acquiring the images must be performed either by mammography technologists meeting the qualifications specified in the ACR Practice Parameter for the Performance of Screening and Diagnostic Mammography [60] or by certified nuclear medicine technologists with special training in mammographic positioning techniques.

IV. SPECIFICATIONS OF THE EXAMINATION

The written or electronic request for MBI should provide sufficient information to demonstrate the medical necessity of the examination and allow for its proper performance and interpretation.

Documentation that satisfies medical necessity includes 1) signs and symptoms and/or 2) relevant history (including known diagnoses). Additional information regarding the specific reason for the examination or a provisional diagnosis would be helpful and may at times be needed to allow for the proper performance and interpretation of the examination.

The request for the examination must be originated by a physician or other appropriately licensed health care provider. The accompanying clinical information should be provided by a physician or other appropriately licensed health care provider familiar with the patient's clinical problem or question and consistent with the state's scope of practice requirements. (ACR Resolution 35 adopted in 2006 – revised in 2016, Resolution 12-b)

IV. SPECIFICATIONS OF THE EXAMINATION

A. Radiopharmaceuticals

Tc-99m sestamibi accumulates in the mitochondria of the cells aided by the negative membrane potential, which facilitates passive diffusion of the radiotracer and increased blood flow in breast malignancies [53,66,67].

Administered activities of 740 to 1100 MBq (20-30 mCi) are standard; however, an administered activity as low as 300 MBq (8 mCi) may be appropriate depending on the imaging system [3,9]. Note that properties of Tc-99m sestamibi promote adhesion to the syringe surface, which leads to decreased administered activity [68]. Low adhesion syringes are available for this issue. The lower dosage range improves the risk-to-benefit ratio [69]. The radiopharmaceutical is administered through an indwelling venous catheter or a butterfly needle, followed by 10 mL of saline to flush the vein. The administered activity does not have to be adjusted based on the patient's weight or breast size [70]. An upper extremity vein on the contralateral side to a suspected abnormality is preferred; either side is acceptable for those having screening MBI.

IV. SPECIFICATIONS OF THE EXAMINATION

B. Patient Factors

Although no special preparation is necessary, measures to promote sestamibi uptake in the breast are encouraged. Patients are asked to fast except for coffee, diet beverages, or water for 3 hours before the examination, and they are covered with a warm blanket for at least 5 minutes before injection [68,71].

A thorough explanation of MBI should be provided to the patient by the technologist or physician.

The patient should remove all clothing above the waist. Wearing a mammography cape or gown is recommended. Unlike mammography, deodorant, lotions, and jewelry do not affect the examination.

IV. SPECIFICATIONS OF THE EXAMINATION

C. Images

Imaging begins 5 to 10 minutes after intravenous administration of the radiopharmaceutical. Each image is acquired for approximately 5 to 10 minutes or 175,000 counts (minimum of 5 minutes).

The patient is seated for the examination. MBI views correspond to standard mammographic views.

For diagnostic imaging, the breast with the suspected abnormality is imaged first. Standard views include left craniocaudal, left mediolateral oblique, right craniocaudal, and right mediolateral oblique. If needed, additional views may be requested by the interpreting physician to be performed the same day as the standard projections

when possible to minimize radiation exposure.

V. DOCUMENTATION

Reporting should be in accordance with the ACR Practice Parameter for Communication of Diagnostic Imaging Findings [72].

The report should include the radiopharmaceutical used and the dosage and route of administration, as well as any other pharmaceuticals administered, including the dosages and routes of administration.

A. Image interpretation should be performed in a timely fashion by a qualified physician.

A standardized MBI lexicon has been proposed, but there have been no updates to the BI-RADS lexicon to date [73]. The proposed lexicon is analogous to the MRI BI-RADS lexicon. A recent retrospective study by Ching and Brem [74] evaluated the association between PPV3 and MBI descriptors (mass versus nonmass findings, and homogeneous versus heterogeneous background parenchymal uptake) and showed that the MBI descriptors were not useful determinants for the probability of malignancy. Another study by Choi et al [75] showed that feature analysis including shape of masses and distribution on nonmass uptake are helpful in predicting benign versus malignant lesions. Further research in this area is needed, but, in the meantime, a BI-RADS assessment category can be included in the conclusion of the report.

MBI should be correlated to other available breast imaging studies, and if additional MBI images are needed, they should be performed on the same day if possible to avoid additional radiation exposure [76].

B. Image labeling should include the following:
   1. Patient's first and last names
   2. Unique identification number and/or date of birth
   3. Examination date
   4. Facility name and location, including address
   5. Laterality and view

C. Other information that can be annotated on the images includes the technologist's and physician's initials.

D. Retention of the procedure images, including specimen images if obtained, should be consistent with the facility's policies for retention of images and in compliance with federal and state

VI. RADIATION DOSIMETRY

The radiation absorbed dose to the patient during MBI is directly proportional to the administered activity of Tc-99m sestamibi. The originally recommended range was 740 to 1100 MBq (20-30 mCi). Currently, administered activities of 300 to 555 MBq (8-15 mCi) are being used with dedicated dual-detected gamma camera systems. It is possible to achieve diagnostic images with this lower administered activity [4], especially given improvements in CZT purity and collimators [3,9].

The average radiation absorbed dose to the breast with intravenous Tc-99m sestamibi is estimated to be approximately 0.07 mGy/mCi [77], which calculates to approximately 0.53 mGy for an administered activity of 300 MBq (8 mCi); this level is lower than the mean glandular dose for a 2-view screening mammogram of 2 mGy for a 5-cm thick compressed breast. However, because of the whole-body distribution of Tc-99m sestamibi, organs outside the breast receive radiation with MBI examinations. Organs that receive the highest doses are the kidneys and walls of the colon, small intestine bladder and gallbladder. The effective (whole-body) dose is estimated to be approximately 0.325 mSv/mCi, which calculates to 2.6 mSv for an administered activity of 300 MBq (8 mCi) [77]. The overall radiation dose needs to be taken into account when evaluating the risks of MBI. Injected activity should be consciously chosen, taking advantage of the sensitivity of the given system and adjusting the timing of acquisition with the ultimate goal of administering the lowest possible dose.

VII. EQUIPMENT SPECIFICATIONS

See the ACR–AAPM Technical Standard for Nuclear Medical Physics Performance Monitoring of Gamma Cameras

[64].

Routine physicist testing of MBI equipment is not currently mandated but is important. Nardinger and colleagues [78] suggest the following quality control tests be adopted: uniformity, spatial resolution, sensitivity, energy resolution, and lesion contrast.

VIII. RADIATION SAFETY IN IMAGING

Radiologists, medical physicists, non-physician radiology providers**,** radiologic technologists, and all supervising physicians have a responsibility for safety in the workplace by keeping radiation exposure to staff, and to society as a whole, "as low as reasonably achievable" (ALARA) and to assure that radiation doses to individual patients are appropriate, taking into account the possible risk from radiation exposure and the diagnostic image quality necessary to achieve the clinical objective. All personnel who work with ionizing radiation must understand the key principles of occupational and public radiation protection (justification, optimization of protection, application of dose constraints and limits) and the principles of proper management of radiation dose to patients (justification, optimization including the use of dose reference levels). https://www-pub.iaea.org/MTCD/Publications/PDF/PUB1775_web.pdf

Facilities and their responsible staff should consult with the radiation safety officer to ensure that there are policies and procedures for the safe handling and administration of radiopharmaceuticals in accordance with ALARA principles. These policies and procedures must comply with all applicable radiation safety regulations and conditions of licensure imposed by the Nuclear Regulatory Commission (NRC) and by applicable state, local, or other relevant regulatory agencies and accrediting bodies, as appropriate. Quantities of radiopharmaceuticals should be tailored to the individual patient by prescription or protocol, using body habitus or other customized method when such guidance is available.

Nationally developed guidelines, such as the ACR's Appropriateness Criteria®, should be used to help choose the most appropriate imaging procedures to prevent unnecessary radiation exposure.

Additional information regarding patient radiation safety in imaging is available from the following websites – Image Gently® for children (www.imagegently.org) and Image Wisely® for adults (www.imagewisely.org). These advocacy and awareness campaigns provide free educational materials for all stakeholders involved in imaging (patients, technologists, referring providers, medical physicists, and radiologists).

Radiation exposures or other dose indices should be periodically measured by a Qualified Medical Physicist in accordance with the applicable ACR Technical Standards. Monitoring or regular review of dose indices from patient imaging should be performed by comparing the facility's dose information with national benchmarks, such as the ACR Dose Index Registry and relevant publications relying on its data, applicable ACR Practice Parameters, NCRP Report No. 172, Reference Levels and Achievable Doses in Medical and Dental Imaging: Recommendations for the United States or the Conference of Radiation Control Program Director's National Evaluation of X-ray Trends; 2006, 2009, amended 2013, revised 2023 (Res. 2d).

IX. QUALITY CONTROL AND IMPROVEMENT, SAFETY, INFECTION CONTROL, AND PATIENT EDUCATION

Policies and procedures related to quality, patient education, infection control, and safety should be developed and implemented in accordance with the ACR Policy on Quality Control and Improvement, Safety, Infection Control, and Patient Education appearing under the heading *Position Statement on Quality Control & Improvement, Safety, Infection Control*, *and Patient Education* on the ACR website (https://www.acr.org/Advocacy-and-Economics/ACR-Position-Statements/Quality-Control-and-Improvement)

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