

1 **Clinical Practice Guideline:** **Radiographic Quality and Safety Parameters**

2
3 **Date of Implementation:** **October 26, 2006**

4
5 **Product:** **Specialty**

6
7
8 **Related Policies:**

- 9
10
11
12
13
- CPG 1: X-Ray Guidelines
 - CPG 58: Nasium & Vertex X-Ray Views
 - CPG 110: Medical Record Maintenance and Documentation Practices

14 The information presented in this Clinical Practice Guideline is not all-inclusive, however,
15 it highlights pertinent radiographic (conventional and/or digital) industry and professional
16 practice parameters and technical standards intended to ensure optimum diagnostic quality,
17 while minimizing radiation exposure to patients, practitioners/technicians, and support
18 personnel.

19
20 **RADIATION SAFETY IN RADIOGRAPHY**

21 According to the American College of Radiology, radiography is a proven and useful
22 diagnostic procedure that uses differences in x-ray attenuation to evaluate human anatomy
23 and pathology. The goal is to establish the presence or absence and nature of disease by
24 demonstrating normal anatomy or the effects of a disease process on anatomical structures.
25 Radiographic studies should be performed only when they are expected to yield clinically
26 important information beyond that obtained from the history and clinical examination that
27 can potentially alter patient management and improve patient outcomes. American
28 Specialty Health – Specialty (ASH) has developed guidelines [*X-Ray Guidelines (CPG 1*
29 *– S)*] that may help inform the decision to obtain plain-film radiographs.

30
31 ASH Clinical Quality Administration and Clinical Quality Evaluation consistently apply
32 the current body of knowledge to the decisions made regarding quality improvement
33 initiatives, verification of medical necessity, and the credentialing and re-credentialing of
34 practitioners for its networks. Information has been provided to American Specialty Health
35 regarding the relative risks and benefits of performing an examination that requires
36 exposure to ionizing radiation. Conclusions from these reviews are still valid and are
37 consistent with information shared within this CPG and the *X-Ray Guidelines (CPG 1 - S)*
38 clinical practice guideline.

39
40 A principle of value-based health care is that clinical interventions should be free from
41 harm, or at the very least, the benefits of the intervention must substantially outweigh the

1 risks. A known risk for ionizing exposure is the increased frequency of cancer beyond that
2 occurring spontaneously and non-cancer diseases (i.e., cataracts, cardiovascular diseases).
3 The current widely used theory on radiation accumulation is based on the linear no-
4 threshold (LNT) model which in simple terms states: no dose of radiation exists without
5 risk and that risk increases proportionally with dose. Currently, the argument remains that
6 radiographic studies should not be considered in isolation but viewed as part of the patient’s
7 lifetime exposure. Ionizing radiation is a cumulative process that occurs from natural
8 sources, such as sunlight, and decay of elements in our environment, as well as man-made
9 sources, such as medical imaging (i.e., radiographs, computed tomography (CT) and
10 nuclear medicine scans). It is therefore recommended by the International Commission on
11 Radiological Protection (ICRP) and the Canadian Nuclear Safety Commission (CNSC),
12 that in the absence of information pertaining to low-dose risks, to follow the “as low as
13 reasonably achievable” (ALARA) principle. ALARA is not a dose limit, but a practice that
14 aims to keep the dose levels as far as possible below the regulatory limit. (Corso, 2020)
15 Clinicians therefore should strive for exposures that are aligned with the ALARA principle.
16 This effort includes the use of appropriate equipment and technology (digital imaging, high
17 speed screens, etc.), use of minimum necessary views, and appropriate assessment of
18 “medical necessity” for Radiological Imaging.

19
20 Additional information regarding patient radiation safety in imaging is available from the
21 following websites – Image Gently® for children (www.imagegently.org) and Image
22 Wisely® for adults (www.imagewisely.org). These advocacy and awareness campaigns
23 provide free educational materials for all stakeholders involved in imaging (patients,
24 technologists, referring providers, medical physicists, and radiologists).

25 26 **EDUCATION AND TRAINING OF PRACTITIONER**

27 A practitioner performing radiographic examinations must have documented training and
28 understanding of the physics of diagnostic radiography, experience with the equipment,
29 demonstrate an understanding of the principles of radiation protection, knowledge of the
30 hazards of radiation exposure to both patients and radiology personnel, and utilize
31 appropriate radiation monitoring devices in the facility, as recommended by state and
32 federal radiation control and regulatory agencies. The practitioner should also possess
33 knowledge and competency in the principles and procedures of general radiography,
34 screen-film combinations, and image processing (conventional and/or digital as applicable
35 to the facility).

36
37 The practitioner should perform, interpret, and report radiographic examinations in
38 accordance with nationally recognized standards of practice. The practitioner’s continuing
39 clinical education should include ongoing professional competency maintenance and

1 improvement as is appropriate to his/her practice and in accordance with applicable state
2 law.

3
4 If a radiology technologist or qualified assistant performs radiographic examinations, the
5 technologist/assistant must maintain state approved license/certification, as required.
6

7 **QUALITY ASSURANCE, SAFETY, AND INFECTION CONTROL**

- 8 • All imaging equipment, including hardware, imaging interfaces (imaging
9 film/digital plates, cassettes, intensifying screens), software and a picture archiving
10 and communications system (PACS) must comply with state and federal regulatory
11 requirements and be in sound operational and mechanical condition and be working
12 properly and reliably.
- 13 • Appropriate collimation and shielding (where applicable) should be utilized to limit
14 exposure to the anatomical area(s) of interest and improve image quality by limiting
15 scatter radiation. A properly centered and focused square-leaf collimator with light
16 must be employed. Collimation must be used to exclude the eyes and other sensitive
17 organs whenever possible and should not be any wider than necessary to view the
18 region of interest. Evidence of collimation should be evident on at least three sides
19 of the film. Masking, shuttering or cropping should not be used as a replacement
20 for beam restriction achieved through collimation of the x-ray exposure field size.
21 Electronic masking should match the outer edge of the actual exposure field to
22 document appropriate collimation. Masking should only cover the areas outside of
23 the collimated exposure field and should never be used to cover anatomy that is
24 contained within the exposure field.
- 25 • Because there is a decrease in radiation dose with digital imaging systems
26 compared with conventional radiography, digital systems should be preferentially
27 employed for imaging especially of known or suspected scoliosis.
- 28 • All imaging examinations involving ionizing radiation should be performed using
29 technical factors offering the lowest radiation exposure to the patient that is
30 consistent with image quality requirements.
- 31 • Pediatric patients are more sensitive to ionizing radiation than adults. Information
32 regarding pediatric imaging best practices can be found at the Image Gently
33 website: www.imagegently.org and the ACR-AAPM-SIIM-SPR Practice
34 Parameter for Digital Radiography
35 (<https://www.acr.org/-/media/ACR/Files/Practice-Parameters/rad-digital.pdf>).
- 36 • Routine use of gonadal shielding is no longer recommended. The International
37 Commission on Radiological Protection (ICRP) tissue-weighting factor for gonads
38 has substantially decreased, from 0.25 in Publication 26 in 1977 to 0.20 in
39 Publication 60 in 1990 and, most recently, to 0.08 in Publication 103 in 2007.
40 Gonadal shields cannot protect against internal scatter, may be positioned

1 incorrectly, may inadvertently move between positioning and exposure, may
2 obscure the area of interest and necessitate repeat imaging, and, if they cover the
3 active automatic exposure control (AEC) region(s), may substantially increase
4 radiation exposure. Patient shielding may be an effective means of alleviating
5 patient anxiety. In those cases, the priority should be to ensure that the shielding
6 device does not adversely impact the quality of the examination. One general
7 technique that can help ensure that shielding does not adversely impact the quality
8 of the examination is to ensure the shield is not within the bounds of the collimation
9 light.

- 10 • Use the highest kVp within the optimal range for the position and part, coupled
11 with the lowest milliampere-seconds (mAs) needed to provide an adequate
12 exposure to the image receptor.
- 13 • Use of AEC modules is indicated when the AEC has been calibrated to the type of
14 image receptor to provide consistent exposure to the image receptor. The use of
15 AEC should be carefully monitored when used in conjunction with appropriate
16 shielding. When combined, a beam absorbing material such as lead should not
17 routinely lie within the primary beam field of view.
- 18 • All facilities producing radiographs should have policies and procedures for
19 appropriate shielding of patients and healthcare workers.
- 20 • Monitoring exposure of healthcare workers with radiation badges is strongly
21 encouraged to recognize when the dose limit is exceeded and there is a need to
22 reduce exposure and safeguard the worker's health. If individual monitoring is not
23 feasible, radiation exposure should be passively measured with a dosimeter placed
24 near the X-ray source.
- 25 • Facilities should have policies and procedures to reasonably attempt to identify
26 pregnant patients prior to the performance of any diagnostic examination involving
27 ionizing radiation. Over-the-Counter pregnancy test kits may be considered in this
28 process. Pregnancy, especially in the early trimesters, significantly impacts the
29 benefit: risk ratio and the decision whether to obtain radiographs needs to be
30 carefully considered. If a decision is made to obtain radiographs of a pregnant or a
31 potentially pregnant patient, a written informed consent should be obtained prior to
32 performing the procedure.
- 33 • Notices regarding pregnancy should be posted in compliance with all applicable
34 state regulatory requirements, and include language such as, “If it is possible that
35 you might be pregnant, notify the physician or other staff before your x-ray
36 examination.” If patients frequent the practice that do not speak English well,
37 consideration for language-appropriate notices in addition to English language
38 notices should be given.
- 39 • Facilities providing radiographic services should have documented policies and
40 procedures related to quality control, patient education, infection control, and
41 safety.

- 1 • Implement a comprehensive quality assurance program that involves all aspects of
2 quality control and continuous quality improvement, including repeat analyses
3 specific to the digital imaging system. The quality control program should include
4 documented protocols and procedures for maintaining imaging equipment;
5 maintenance and cleaning of film processors; and orientation and training of staff.
6 All applicable state regulatory requirements must also be maintained.
- 7 • The use of DICOM (ACR– National Electrical Manufacturers Association Digital
8 Imaging and Communications in Medicine) modality work lists is recommended to
9 help ensure the quality and accuracy of the information captured in the DICOM
10 header.

11 **SPECIFICATIONS OF RADIOGRAPHIC EXAMINATION**

- 12 • Be familiar with the specific exposure indicator/index (EI) standards for equipment
13 and with the standardized EI as it becomes available in new and upgraded
14 equipment used for digital radiography.
- 15 • Effectively use the EI and deviation index to determine whether adequate exposure
16 has reached the image receptor.
- 17 • Regularly evaluate EI values, along with image quality to determine whether the
18 digital image meets quality standards.
- 19 • Digital radiographic devices must provide images that conform to the DICOM
20 standard computed radiography (CR) or direct radiography (DR) service class
21 objects. These objects' header fields specify information such as accession number,
22 patient name, identification number, date and time of examination, name of facility
23 or institution of acquisition, type of examination, patient or body part orientation
24 (e.g., right, left, superior, inferior), amount and method of data compression, and
25 total number of images acquired in the study.
- 26 • Use anti-scatter grids when appropriate (e.g., when body parts measure greater than
27 12cm in thickness). Scattered radiation reduces contrast in radiography, limiting
28 the available dynamic range of x-ray intensities at the beam exit side of the patient.
- 29 • In digital radiography, excessive exposure to the detector can produce high-quality
30 images with improved noise properties. Unless there is an understanding that these
31 higher quality images come at the cost of increased patient exposure and strategies
32 are in place to control patient exposure, a radiologic practice may experience
33 “exposure creep.” A method to prevent exposure creep is to develop validated
34 radiographic techniques as a function of patient size for all performed examinations
35 and perform regular quality control analysis. Technique charts should encourage
36 the use of appropriate automatic exposure control (AEC) settings (single cell versus
37 a combination of multiple AEC cells) for most of the body radiographic
38 examinations. The AEC system is designed to deliver calibrated and reproducible
39

- 1 doses to the image receptor across a wide range of operating conditions, including
 2 x-ray beam quality and patient size. Often these factors are entered into the
 3 anatomical programming of x-ray generator controls. If the technologist uses these
 4 programs, the facility is very likely to use appropriate radiographic technique
 5 factors with the appropriate level of radiation exposure. Consistent and optimal
 6 AEC performance is critical to radiation dose management and image quality.
- 7 • Objects which may produce unacceptable artifacts (e.g., jewelry, hair ornaments,
 8 patient’s clothing in the area of the study) should be removed before exposure is
 9 made. A supply of clean, appropriately sized gowns should be available to avoid
 10 clothing artifacts such as zippers and buttons.
 - 11 • All radiographic studies should be permanently imprinted with patient’s complete
 12 name; date of birth or age; facility name and location; and date of the examination.
 13 The side (right or left) of the anatomic site radiographed should be permanently
 14 labeled (e.g., use of Mitchel marker).
 - 15 • All facilities performing radiography should have written protocols for standard
 16 views of each anatomic area that will be imaged. These should be designed to
 17 optimize diagnostic information while minimizing radiation exposure.
 - 18 • All facilities performing radiography should have technique charts, or protocols in
 19 generator memory, for all anatomic parts, listing exposure factors that will reliably
 20 produce diagnostic-quality images of patients of different sizes, to minimize the
 21 need for repeat exposures. Repeat rates should be part of the routine quality control
 22 process.
 - 23 • Determining proper technique charts for standard examinations exposure
 24 (technique) charts are part of the standard of care expected by the Joint Commission
 25 and are required by regulations in many states. It is necessary to check state and/or
 26 local regulations for any specific requirements. Computation of estimates for
 27 entrance skin exposures for these charts may also be required.
 - 28 • Because of the wide latitude of digital image receptors and the availability of image
 29 processing to alter the brightness and contrast of images, the visual appearance of
 30 images can be made similar over a wide range of acquisition techniques. The
 31 primary effects of modifying an acquisition technique are changes in:
 - 32 1. The level of noise in the image
 - 33 2. The exposure duration and potential for patient motion artifacts
 - 34 3. Patient radiation exposure, and
 - 35 4. Potential artifacts (in digital radiography) related to detector saturation and
 36 image lag.
 - 37 • All radiographs should be reviewed for positioning and diagnostic quality at the
 38 facility before the patient is released for the day. X-rays must be of diagnostic
 39 quality.

- 1 • All facilities performing radiography should have protocols for the standard view
2 or views of each anatomic area of interest. These should be designed to optimize
3 diagnostic information while minimizing radiation exposure.
- 4 • Supplemental views should be obtained only when clinically indicated or when
5 abnormal findings are found on an initial study.
- 6 • Opposing (orthogonal) views are generally required for a diagnostic assessment
7 when choosing to image any area; single plane views are usually insufficient.
- 8 • Radiographic examinations of the spine or extremities should completely
9 demonstrate the designated regions, or the levels of clinical interest in a limited
10 examination.
- 11 • Appropriate immobilization and assistance procedures should be available to
12 ensure that images of diagnostic quality can be obtained in patients who are unable
13 to cooperate or unable to be positioned in the usual manner due to age or physical
14 limitations, while avoiding unnecessary irradiation of health care workers.

15 **RADIOGRAPHIC REPORTING DOCUMENTATION STANDARDS**

16 The written or electronic request for a Radiograph should provide sufficient information to
17 demonstrate the medical necessity of the examination and allow for its proper performance
18 and interpretation. Documentation that satisfies medical necessity includes 1) signs and
19 symptoms and/or 2) relevant history (including known diagnoses). Additional information
20 regarding the specific reason for the examination or a provisional diagnosis would be
21 helpful and may at times be needed to allow for the proper performance and interpretation
22 of the examination (American College of Radiology, 2022).
23

24
25 All radiography examinations must include a documented interpretation of the findings
26 (radiology report). This report must be maintained as a permanent part of the patient's
27 medical record, and include information, such as:

- 28 • Patient name or other identifier;
- 29 • Patient's date of birth or age;
- 30 • Patient's gender; Name(s) of ordering physician(s) or other health care provider(s).
31 If the patient is self-referred (a patient who seeks medical care without referral from
32 a physician/health care provider), that should be stated;
- 33 • Facility name and location;
- 34 • Date of the examination;
- 35 • Time of the examination, if relevant (e.g., for patients who are likely to have more
36 than one of a given examination per day);
- 37 • Relevant clinical information and diagnosis;
- 38 • Description of the studies (anatomical location and views taken);
- 39 • Any known significant adverse event involving the patient that occurred in relation
40 to performance of the study should be briefly noted in the impression;;

- 1 • Electronically record exposure techniques, EI and dose data with the radiographic
2 image to allow for assessment and refinement of technique selection practices.
3 Details related to image acquisition, such as tube potential (kV), tube current (mA),
4 exposure time, beam filtration, source image distance, the International
5 Electrotechnical Commission (IEC) 62494-1 detector exposure indicator (EI),
6 target exposure index (EIT), deviation index (DI), and organ-specific
7 postprocessing algorithm employed, should be recorded in the DICOM header.
8 These elements should be exportable using the DICOM Structured Report;
- 9 • Report should include appropriate anatomic, pathologic, and radiologic
10 terminology to describe all findings;
- 11 • The report should, when appropriate, identify factors that may compromise the
12 sensitivity and specificity of the examination;
- 13 • The final report is the definitive documentation of the results of an imaging
14 examination or procedure. Use of abbreviations or acronyms should be limited to
15 avoid ambiguity;
- 16 • The final report should be completed in accordance with appropriate state and
17 federal requirements. Electronic or rubber-stamp signature devices, instead of a
18 written signature, are acceptable unless contrary to state law, if access to such
19 devices is secure;
- 20 • When feasible, a copy of the final report should accompany the transmittal of
21 relevant images to other health care professionals, when such images are requested.
- 22 • A copy of the final report should be archived by the imaging facility as part of the
23 patient's medical record and be retrievable for future reference. Retention and
24 distribution of these records must be in accordance with state and federal
25 regulations and facility policies;
- 26 • Limitations impacting the ability to read/interpret radiographic findings should be
27 identified (e.g., artifacts, poor quality of film, technical factors);
- 28 • The report should address any specific clinical questions; if there are factors that
29 prevent answering the clinical question, this should be stated explicitly;
- 30 • Comparison with relevant examinations and reports (e.g., previous x-rays, CT,
31 MRI) should be included in the radiologic report when appropriate;
- 32 • Impression should include a precise differential diagnosis, any significant patient
33 reaction, and recommendations for follow-up or additional diagnostic studies to
34 clarify or confirm the impression when appropriate;
- 35 • Person providing the interpretation of the study must be identified on the report;
- 36 • Inclusion of the following items is encouraged:
 - 37 ○ Date of dictation
 - 38 ○ Date and time of transcription

39
40 For more detailed information regarding Communication of Diagnostic Imaging Findings,
41 see the American College of Radiology (2020). ACR Practice Parameter for

1 Communication of Diagnostic Imaging Findings, retrieved November 16, 2023 from
2 [https://www.acr.org/-/media/ACR/Files/Practice-](https://www.acr.org/-/media/ACR/Files/Practice-Parameters/communicationdiag.pdf?la=en)
3 [Parameters/communicationdiag.pdf?la=en](https://www.acr.org/-/media/ACR/Files/Practice-Parameters/communicationdiag.pdf?la=en)
4

5 **SPECIFICATIONS OF EQUIPMENT**

- 6 • The diagnostic radiographic equipment and facility should meet all applicable
7 federal and state radiation standards.
- 8 • Recognize image artifacts and prevent future artifacts by properly maintaining and
9 acquiring service for the digital radiography equipment.
- 10 • To ensure the enterprise-wide availability of features and performance when
11 purchasing digital radiographic and connected equipment, consideration of the
12 manufacturers' statements of conformance with the current ACR– National
13 Electrical Manufacturers Association Digital Imaging and Communications in
14 Medicine (DICOM) standard is strongly recommended.
- 15 • The use of the DICOM “DX” service class object is recommended instead of the
16 more limited “CR” object for digital radiography.
- 17 • It is recommended to use DICOM grayscale soft-copy presentation state (GSPS)
18 objects to transmit annotations, shutter, and display lookup tables (LUTs). Where
19 GSPS is not available or not supported by a picture archiving and communication
20 system (PACS), the use of a values-of-interest lookup table (VOI-LUT) within the
21 CR or DR service class object is suggested.
- 22 • Presently, new Digital Radiography systems and upgraded software versions for
23 existing equipment are incorporating the Electro-technical Commission (IEC)
24 standard. In addition to the traditional exposure index, a deviation index is reported
25 that describes how the exposure index deviates from a target value. Users should
26 review the target values for all views of all body parts that the system will be used
27 to image. Target values should be selected to minimize the exposure to the patient
28 while providing diagnostic images (i.e., with sufficiently low noise) for
29 interpretation.
- 30 • All digital software and image production hardware should be in proper working
31 order, serviceable with new (current) parts and possess up to date software versions
32 to ensure optimal function and quality.
- 33 • For non-digital (analog) imaging, automated film processing is preferred. Carefully
34 controlled temperature and regularly scheduled processor maintenance should be
35 included in a quality control program. A constant time and temperature should be
36 maintained for manual processing. The chemicals must also be replenished
37 appropriately.

- 1 • For digital imaging, image processing can be divided into two (2) parts.
- 2 ○ Preprocessing is performed on the raw output of the digital detector and
- 3 accounts for various performance and engineering deficiencies of the image
- 4 receptor.
- 5 ○ Postprocessing is used to optimize the contrast, sharpness, and latitude of the
- 6 image to be displayed at the radiologist review workstation.

7
8 For detailed information including but not limited to information about image processing
9 for Digital imaging, see the American College of Radiology. (2022). ACR–AAPM–SIIM–
10 SPR practice parameter for digital radiography. Resolution. Retrieved on November 16,
11 2023 from <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Rad-Digital.pdf>
12

13 **References**

14 American College of Radiology. (2022). ACR-ASSR-SPR-SSR *practice parameter for the*
15 *performance of spine radiography. Resolution 37.* Retrieved November 20, 2023 from
16 <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Rad-Spine.pdf?la=en>
17

18 American College of Radiology. (2022). ACR–AAPM–SIIM technical standard for
19 electronic practice of medical imaging. Resolution 48. Retrieved on November 20,
20 2023 from [https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Elec-](https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Elec-Practice-MedImag.pdf)
21 [Practice-MedImag.pdf](https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Elec-Practice-MedImag.pdf)
22

23 American College of Radiology. (2022). ACR–AAPM–SIIM–SPR practice parameter for
24 digital radiography. Resolution. Retrieved on November 20, 2023 from
25 <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Rad-Digital.pdf>
26

27 American College of Radiology. (2023). ACR–SPR practice parameter for imaging
28 pregnant or potentially pregnant patients with ionizing radiation. Resolution 31.
29 Retrieved on November 20, 2023 from [Clean Copy \(acr.org\)](#)
30

31 American College of Radiology. (2019). ACR–SPR–SSR practice parameter for the
32 performance of radiography for scoliosis in children. Resolution 7. Retrieved on
33 November 20, 2023 from [https://www.acr.org/-/media/ACR/Files/Practice-](https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Scoliosis.pdf)
34 [Parameters/Scoliosis.pdf](https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Scoliosis.pdf)

35 American College of Radiology. (2020). ACR Practice Parameter For Communication of
36 diagnostic imaging findings. Resolution 37. Retrieved November 20, 2023 from
37 [https://www.acr.org/-/media/ACR/Files/Practice-](https://www.acr.org/-/media/ACR/Files/Practice-Parameters/communicationdiag.pdf?la=en)
38 [Parameters/communicationdiag.pdf?la=en](https://www.acr.org/-/media/ACR/Files/Practice-Parameters/communicationdiag.pdf?la=en)
39

40 Best Practices in Digital Radiography, Radiologic Technology, September/October 2012,
41 Volume 84, Number 1, pp. 83-89

- 1 Corso M, Cancelliere C, Mior S, Kumar V, Smith A, Côté P. The clinical utility of routine
2 spinal radiographs by chiropractors: a rapid review of the literature. *Chiropr Man*
3 *Therap.* 2020;28(1):33. Published 2020 Jul 9. doi:10.1186/s12998-020-00323-8
4
- 5 Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII – Phase 2
6 Committee to Assess Health Risks from Exposure to Low Levels of Ionizing Radiation.
7 National Research Council. Copyright 2015 by the National Academy of Sciences
8
- 9 Holmberg O, Malone J, Rehani M, McLean D, Czarwinski R. Current issues and actions
10 in radiation protection of patients. *Eur J Radiol.* 2010 Oct;76(1):15-9
11
- 12 Image Gently Alliance. Retrieved on November 16, 2023 from
13 <http://www.imagegently.org/About-Us/The-Alliance>
14
- 15 National Council of Radiation Protection and Measurements. (2021). NCRP
16 Recommendations for ending routine gonadal shielding during abdominal and pelvic
17 radiography (NCRP Statement No. 13). Retrieved November 16, 2023 from
18 <https://ncrponline.org/wp-content/themes/ncrp/PDFs/Statement13.pdf>
19
- 20 Radiation safety for healthcare workers. CE4RT.com Retrieved November 16, 2023 from
21 <https://ce4rt.com/rad-tech-talk/radiation-safety-for-healthcare-workers/>