



## Patient Gonadal and Fetal Shielding in Diagnostic Imaging Frequently Asked Questions

### Introduction

In April of 2019, the American Association of Physicists in Medicine (AAPM) released a position statement outlining reasons for limiting the routine use of fetal and gonadal shielding in medical imaging<sup>1</sup>. This position statement has since been endorsed by the American College of Radiology (ACR)<sup>2</sup>, the Canadian Organization of Medical Physicists (COMP)<sup>3</sup>, the Health Physics Society (HPS)<sup>4</sup>, the Canadian Association of Radiologists (CAR)<sup>5</sup>, the Australasian College of Physical Scientists and Engineers in Medicine (ACPSEM)<sup>6</sup>, and the Image Gently Alliance<sup>7</sup>. Recognizing that removing patient shielding from routine use is a substantial shift in existing clinical practice, AAPM formed a committee to bring together stakeholders to discuss potential changes in the use of patient shielding. The committee includes representatives from many different societies and organizations with specialization in medical imaging and patient safety. The frequently asked questions (FAQs) and answers given in this document are the first part of this effort - Communicating Advances in Radiation Education for Shielding (CARES).

This document contains three sections, each with a different target audience. The first addresses questions and concerns of healthcare professionals, including, but not limited to, radiologic technologists, physicians, advanced practice providers, medical physicists, radiation safety officers, and nurses. This section also includes some suggested wording that can be used when discussing patient shielding with patients and parents or other caregivers of pediatric patients. The second section addresses common concerns among patients and is best suited for adult patient populations. The third section is intended for parents and other caregivers of pediatric patients. The committee recommends that facilities that choose to limit the routine use of patient fetal and gonadal shielding use this document, in part or in whole, to help establish a guideline or policy that meets the needs of their individual practice. Such guidelines or policies are critically important so that any changes in practice are adopted in a consistent manner; inconsistency in the use of shields can imply to patients that not using a shield is a lapse of proper care when they have other exams where shields are used.

**This document was developed by AAPM's Committee on Education and Implementation Efforts for Discontinuing the Use of Patient Gonadal and Fetal Shielding, which is a collaborative effort involving many different stakeholder organizations and individuals. The CARES committee would specifically like to recognize and thank the following contributors:**

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## Frequently Asked Questions

Target Audience: Healthcare Professionals

### **A1. Shouldn't we shield the gonads, especially for children, to minimize the risk of genetic damage to future generations?**

Gonadal shielding was introduced into clinical practice over 70 years ago, when it was believed that exposing the gonads to radiation could damage reproductive cells such as sperm-producing cells and eggs, causing damage to patients' future offspring.<sup>8</sup> However, these genetic effects have not been observed in humans, even 3 to 4 generations after the atomic bombings.<sup>9</sup> International radiation protection organizations have lowered the risk weighting to the gonads in every successive revision of their tissue risk weighting factors since such factors were introduced in 1977.<sup>10,11</sup>

**Suggested Talking Point:**

*There is no evidence that radiation from medical imaging damages reproductive cells such as eggs or those that produce sperm.*

### **A2. Shouldn't we continue to shield the gonads so that we don't increase the risk of infertility?**

The amount of radiation required to cause infertility is more than 100 times the dose from a medical imaging exam.<sup>11</sup> For example, the gonadal dose to an X-ray of the pelvis is less than 0.8 mGy for a teenage boy and less than 0.3 mGy for a teenage girl. Gonadal doses for newborns receiving medical imaging is about 90% lower than this.<sup>12</sup> In comparison, male fertility is not affected below an acute dose of 150 mGy. Permanent sterility does not occur in males below 3500 mGy. Female fertility is not affected below 2500 mGy.<sup>11</sup>

**Suggested Talking Point:**

*The dose required to cause infertility is much higher than that used during a medical imaging exam.*

### **A3. Why should we no longer shield patients routinely?**

Any intended decrease in radiation exposure from shielding is negligible compared to the dose from radiation that is scattered within the patient's body. Shields do little or nothing to benefit the patient.<sup>13-17</sup> As with other areas of medicine, the use of patient shielding should be evaluated from a risk-benefit perspective. For example, any time a shield is used, there is a risk that it will cover and obscure anatomy that is important for an accurate diagnosis.<sup>12,18-30</sup> Since shielding can introduce these risks and provides little or no benefit to the patient, we should discontinue using shields as part of routine practice.

**Suggested Talking Point:**

*Shields may cover up parts of your body that your doctor needs to be able to see. If this happens, we may have to repeat your image.*

### **A4. Why are we doing this now?**

Advances in medical imaging technology, such as better detectors, have greatly reduced the amount of radiation required to create a quality image. However, some of the features of modern imaging equipment (such as automatic exposure control) do not perform as intended when lead shielding is in the path of the beam.<sup>31</sup> As the medical imaging community continues to deepen its understanding about how radiation affects the body, we are recognizing that the risk for the majority of imaging exams is either too small to be determined or may even be zero. These advances have made patient shielding a practice that introduces more risk than benefit.

**Suggested Talking Point:**

*The change in practice is due to improvements in imaging technology and a better understanding of how radiation might affect the body.*

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### **A5. Should we still shield pediatric or pregnant patients?**

Fetal and gonadal shielding should not be used by default, regardless of the patient's age, sex, or pregnancy status. While shielding should not be used routinely, in very limited circumstances, it may be in the best interest of an extremely anxious patient to use shielding. (Please see FAQ A6 for more information.)

### **A6. Patients, and especially parents of pediatric patients, expect us to use shielding. Shouldn't we keep shielding because it makes people feel safer?**

Clinical practice should be based on the best and most recent scientific evidence. Although patients expect to be shielded because it has been common practice for many decades, we should explain to the patient the benefits from shielding are negligible and thus there is no value to continuing this practice. Further, there is a small risk of compromising the exam if the shield enters the imaging field.

There are situations, however, that may require special consideration. For example, if a pregnant patient with a suspected pulmonary embolism refuses to have imaging done without shielding, then the benefit of getting a timely diagnosis outweighs the risk posed by using shielding. Similarly, for the parent of a critically ill pediatric patient, the psychological benefit to anxious parents or caregivers may exceed the risk posed by shielding.

In most situations, it is appropriate for the technologist and/or physician to explain why shielding is not recommended. If the patient or parent continues to insist that shielding be used, shields may be used at the discretion of the technologist, provided that careful attention is given to ensuring that image quality is not compromised and overall dose is not increased. While we propose some general rules for stopping the use of gonadal or fetal shielding, it is important to recognize that there will be situations that require professional judgement based on the individual patient and circumstances.

### **A7. What about pregnant women? Can't even a very small amount of radiation harm a fetus?**

The American College of Obstetricians and Gynecologists (ACOG) has a guideline that states: "With few exceptions, radiation exposure through radiography, computed tomography scan, or nuclear medicine imaging techniques is at a dose much lower than the exposure associated with fetal harm."<sup>32</sup> This is true even for a CT scan of the abdomen and pelvis. If the fetus is outside of the imaging field of view, the dose to the fetus is below 1 mGy<sup>33</sup>, which is about the same as the dose a fetus gets from background radiation during gestation. This is the case for a CT scan of the mother's chest.

#### ***Suggested Talking Point:***

*In almost all cases, the amount of radiation used in medical imaging is much lower than what is known to cause any harm to an unborn baby. Shields will not reduce the amount of radiation to your unborn baby but may cover up parts of your body that your doctor needs to be able to see.*

### **A8. Should I continue to wear a lead (radioprotective) apron at work?**

Absolutely. If you are working in an area with potential exposure to radiation (such as in an imaging exam room) occupational safety standards and regulations require that radiation workers take appropriate action to limit their occupational exposures. These actions include minimizing the time you are exposed to a radiation source, maximizing the distance between you and the radiation source, and placing shielding between yourself and the radiation source. The shielding can be the leaded window or wall of the control area or personal protective devices such as leaded aprons. These universally accepted methods to control occupational radiation exposures are not impacted in any way by recommendations to discontinue the use of shielding on patients.

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### **A9. Even if the dose from one X-ray is small, what about patients who have many X-rays over their lifetime?**

Healthy cells have repair mechanisms to help protect them against small doses of radiation.<sup>34</sup> We take advantage of these repair mechanisms in radiation therapy, where treatments are set up so that there

are multiple treatment sessions. For example, radiation therapy for breast cancer may consist of 20 sessions with 2000 mGy delivered during each session, rather than a single session that delivered 40,000 mGy. This is done because delivering the dose in smaller amounts over a longer period of time, instead of all at once, allows more healthy tissue to recover, while killing cancer cells. Thus, there is evidence that the risk from multiple exams is not cumulative.

#### **A10. On some X-ray images patient anatomy outside of the collimated view is still visible. Does that mean it is still being irradiated?**

Often, a faint signal can be seen outside of the collimated field of view. This is from radiation that exposes anatomy within the collimated field of view and is then scattered within the patient, before reaching parts of the detector that are outside of the field of view. It is important to note that the dose to tissues outside of the collimated field of view is very small - hundreds to thousands of times smaller than the dose to anatomy within the field of view. We can see these regions on images only because modern X-ray detectors are very sensitive to small amounts of radiation. This very small amount of radiation outside the field of view is not justification for shielding patients.

#### **A11. Do lead shields “trap” the radiation in the patient?**

No. Lead, and lead-equivalent materials used in “lead” aprons, are very good at absorbing radiation. A very small amount can be reflected back towards the patient, but this dose is very small (less than 0.01 mGy - or a few hours of background radiation in the US)<sup>35</sup>.  
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**Suggested Talking Point:** *Lead is very good at absorbing X-rays. Although a very small number of X-rays can be reflected back toward the patient, the dose from this effect is negligible.*

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## **Frequently Asked Questions**

### **Target Audience: Patients**

#### **B1. Why do you not shield patients anymore?**

*Patient shielding has been used for more than 70 years. We have better equipment that uses much less radiation and operates differently. We also know more about how radiation affects the human body and that some parts of the body - like the testicles and ovaries - are less sensitive to radiation than we used to think.*

*Most modern X-ray, fluoroscopy, and CT machines can automatically determine how much radiation to use based on the part of the body being imaged. If a shield gets in the way, it could mean an increase in radiation dose.*

*Since we have equipment that can give us better information using less radiation than in the past, patient shields are no longer beneficial.*

#### **B2. Doesn't shielding make me safer?**

*The amount of radiation used in most imaging exams is so small that the risk to you is either very small or zero. Shields provide negligible protection.*

#### **B3. But what's the harm in shielding?**

*When the reproductive organs are far away from the part of your body being imaged, there is no benefit from using shielding. When the part of your body receiving X-rays is close to your reproductive organs, a shield may cover up parts of your body that your doctor needs to be able to see. If this happens, we may have to repeat your exam.*

#### **B4. Won't radiation exposure to my sperm or ovaries harm my future children?**

*Since the 1950s, people were concerned that radiation might damage sperm or eggs and that this damage would be passed down to your future children. However, this has never been seen in humans even after many generations (years) of studying it closely. This is true even for people who have been*

exposed to much larger amounts of radiation than what is used in medical imaging.

### **B5. What if I'm pregnant?**

*We have equipment that can give us better information than ever before and can get good images using much less radiation than in the past. However, placing shielding over your belly can reduce the quality of the exam if it gets into the image and in some cases can increase the overall dose from the exam. Since shielding your belly provides no benefit to your baby, it is better to not do it.*

### **B6. Will you still shield me if I want you to?**

*We do not recommend using lead shielding during imaging exams. Some exams can never be done using a shield because the shield would cover up parts of the body we need to see. But, if you insist that we use a shield, we will honor your request if it is possible to do so without compromising the exam you are having.*

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## **Frequently Asked Questions**

### **Target Audience: Parents and Guardians**

#### **C1. Why is my child not shielded now?**

*Shields have been used in the past, but we know more about radiation now and have imaging equipment that uses much less radiation than in the past. We have also seen that shields can cover up parts of your child's body that are important for your doctor to see.*

#### **C2. Why is my child not shielded if I am required to wear a lead apron while I am in the room with them?**

*Your child's doctor wants an image so that he or she can better see what is going on inside your child's body. This exposes your child to a little bit of radiation. Your doctor has thought about the benefits and risks to your child. He or she has decided that the benefit from having the information from the image is much higher than the risk from the radiation, which is very small or zero. Because you aren't being imaged, there is no need for you to get any radiation and so we give you an apron to wear to make sure that you don't get any dose.*

#### **C3. My child previously had an imaging exam where shielding was used, why the change in practice?**

*Patient shields have been used for more than 70 years. A lot has changed since then. We have better machines that use much less radiation. We also know more about how radiation affects the human body. Some parts of the body - like the testicles and ovaries - are much less sensitive to radiation than we used to think, thus there is no benefit from placing shields on your child.*

#### **C4. Can I ask for a shield for my child?**

*We do not recommend using lead shielding during imaging exams. Some exams can never be done using a shield because it would always cover parts of the body we need to see. But, if you insist that we use a shield, we will honor your request if it is possible to do so without compromising the exam your child is having.*

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