HRET
HEALTH RESEARCH & EDUCATIONAL TRUST

2017 UPDATE

UNDUE EXPOSURE TO RADIATION

>>>

UNDUE RADIATION EXPOSURE *CHANGE PACKAGE*

ACKNOWLEDGEMENTS

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How to Use this Change Package

This change package is intended for hospitals participating in the Hospital Improvement Innovation Network (HIIN) project led by the Centers for Medicare & Medicaid Services (CMS) and Partnership for Patients (PFP); it is meant to be a tool to help you make patient care safer and improve care transitions. This change package is a summary of themes from the successful practices of high performing health organizations across the country. It was developed through clinical practice sharing, organization site visits and subject matter expert contributions. This change package includes a menu of strategies, change concepts and specific actionable items that any hospital can implement based on need or for purposes of improving patient quality of life and care. This change package is intended to be complementary to literature reviews and other evidence-based tools and resources.

PART 1: ADVERSE EVENT AREA (AEA) DEFINITION AND SCOPE

Medical uses of ionizing radiation, such as X-ray diagnostics, interventional radiology, nuclear medicine and radiotherapy, can provide significant health benefits for many patients. However, improperly applied or elevated doses of radiation in diagnosis and treatment can result in well-documented side effects and negative outcomes, including DNA damage. Unfortunately, even small radiation doses may carry a risk of deleterious effects.[1] Exposure to ionizing radiation may increase a person's lifetime risk of developing cancer.[2]

Magnitude of the Problem and Why this Matters

The science of medicine has evolved from simple visual observation to the use of technology to help diagnose and monitor patients. Diagnostic radiology, nuclear medicine and radiation therapy have become routine diagnostic and therapeutic tools in the fight to identify and eradicate disease.[3] However, radiation used for early disease detection, more effective diagnosis, and improved monitoring of therapy may also be harmful. Many interventions using ionizing radiation are performed by clinicians who have minimal or no training in radiation effects and safety. Unnecessary and preventable injuries to patients and staff may result. Additionally, most patients are not counseled on the risks of radiation, nor receive appropriate follow-up to detect if an injury has occurred.[4]

The variety and complexity of human conditions make it difficult to predict with certainty a specific patient's response to radiation. However, recommendations from the research literature and evidence-based practice suggest that optimized and effective doses of radiation were successful in achieving specific outcomes in diagnosis and therapy. In March 2009, the National Council on Radiation Protection and Measurements (NCRP) reported that patients' exposure to radiation has nearly doubled over the previous 20 years.[5] Questions continue to be raised about the risks associated with exposure to radiation from medical imaging. Because ionizing radiation can cause damage to DNA, repeated exposures may increase an individual's lifetime risk of developing cancer. Although the risk to a patient from a single exam may not be great, multiple exams can significantly increase the chances of morbidity. Additionally, risks from medical imaging are not only a concern for each individual; with millions of ionizing radiation examinations performed in the U.S. every year, the negative impact of radiation overuse is becoming a public health issue.

> HIIN Reduction Goals:

- Reduce the incidence of harm due to radiation by 20 percent by September 27, 2018.

PART 2: MEASUREMENT

A key component to making patient care safer in your hospital is to track your progress toward improvement. This section outlines the nationally recognized process and outcome measures that you will be collecting and submitting data as part of HRET HIIN. Collecting these monthly data points at your hospital will guide your quality improvement efforts as part of the Plan-Do-Study-Act (PDSA) process. Tracking your data in this manner will provide valuable information needed to study your data across time and help determine the effect your improvement strategies are having in your hospital at reducing patient harm. Furthermore, collecting these standardized metrics will allow the HRET HIIN to aggregate, analyze and report its progress toward reaching the project's 20/12 goals across all AEAs by September 2018.

Nationally Recognized Measures: Process and Outcome

Please download and reference the encyclopedia of measures (EOM) on the HRET HIIN website for additional measure specifications and for any updates after publication at: http://www.hret-hiin.org/data/hiin_eom_core_eval_and_add_req_topics.pdf

> HIIN Evaluation Measures

- Reduce the number of CT angiography tests to rule out pulmonary embolism in adults
- Reduce the number of CT scans performed on pediatric patients to rule out appendicitis
- Reduce the average dose length product (DLP) per pediatric head CT

> Suggested Process Measures

- Determine procedural justification for diagnostic radiology, nuclear medicine procedures or radiation therapy
- Document doses for all diagnostic radiology, CT scans or nuclear medicine
- Document evidence of the use of a pediatric-radiation protocol or checklist
- Establish pediatric patient abdominal, head and thorax diagnostic reference levels (DRLs)
- Scan parameters for all CT scanners in the hospital

- ACR Appropriateness Criteria. Retrieved at: http://www.acr.org/Quality-Safety/Appropriateness-Criteria
- Diagnostic Radiology: Radiography Practice Parameters and Technical Standards. Retrieved at: http://www.acr.org/Quality-Safety/Standards-Guidelines/Practice-Guidelines-by-Modality/Radiography
- Diagnostic Radiology: General Practice Parameters. Retrieved at: http://www.acr.org/Quality-Safety/Standards-Guidelines/Practice-Guidelines-by-Modality/General-Diagnostic
- EPA Radiation Protection Document Library. Retrieved at: http://www.epa.gov/radiation/federal/fgr-14.html
- Radiation Dose to Patients for Common Imaging Examinations. Retrieved at: https://www.acr.org/~/media/ACR/Documents/PDF/QualitySafety/Radiation-Safety/Dose-Reference-Card.pdf?la=en
- Choosing Wisely Campaign. Website: http://www.choosingwisely.org/
- Image Gently. Website: http://www.imagegently.org/
- RadiologyInfo.org for Patients. Website: http://www.radiologyinfo.org/
- For other key tools and resources related to preventing and reducing undue exposure to radiation, visit www.hret-hiin.org.

Investigate Your Problem and Implement Best Practices

DRIVER DIAGRAMS: A driver diagram visually demonstrates the causal relationship between your change ideas, secondary drivers, primary drivers and your overall aim. A description of each of these components is outlined in the table below. This change package reviews the components of the driver diagram to help you and your care team identify potential change ideas to implement at your facility and to show how this quality improvement tool can be used by your team to tackle new process problems.

AIM	PRIMARY DRIVER	SECONDARY DRIVER	**Change Idea**
		SECONDARY DRIVER	**Change Idea**
	PRIMARY DRIVER	SECONDARY DRIVER	**Change Idea**

AIM: *A clearly articulated goal or objective describing the desired outcome. It should be specific, measurable and time-bound.*

PRIMARY DRIVER: *System components or factors that contribute directly to achieving the aim.*

SECONDARY DRIVER: *Action, interventions or lower-level components necessary to achieve the primary driver.*

CHANGE IDEAS: *Specific change ideas which will support or achieve the secondary driver.*

Drivers in This Change Package

PREVENT UNDUE RADIATION	CREATE AWARENESS	DEVELOP EDUCATIONAL MATERIALS ON RADIATION SAFETY	**Change Idea**
	MANAGE THE DOSE	DEVELOP PROCESS TO COLLECT, STORE AND ANALYZE PATIENT DOSIMETRY DATA	**Change Idea**
		EVALUATE EQUIPMENT PERFORMANCE	**Change Idea**
		CONSIDER USING CLOUD-BASED TECHNOLOGIES FOR DATA COLLECTION AND ANALYSIS	**Change Idea**
	ENSURE PROPER UTILIZATION	DEVELOP A RADIATION SAFETY COMMITEE	**Change Idea**
		DISSEMINATE BEST PRACTICES AND GUIDELINES THAT ARE SUPPORTED BY EVIDENCE	**Change Idea**
		HARD STOP SPECIFIC ORDER SETS TO REQUIRE DOCUMENTATION OF CLINICAL INDICATIONS	**Change Idea**
		MONITOR PERFORMANCE ON A REGULAR AND ONGOING BASIS	**Change Idea**
	AVOID THE "DON'TS"	DON'T ORDER DIAGNOSTIC STUDIES THAT HAVE NO PROVEN VALUE OR WILL NOT IMPACT THE COURSE OF TREATMENT	**Change Idea**
	PROTECT THE PATIENT	DEVELOP A SPECIFIC INFORMED-CONSENT PROCESS FOR ALL EXAMS AND PROCEDURES	**Change Idea**
		EDUCATE PATIENTS AND THEIR FAMILIES ON RISKS	**Change Idea**
		MINIMIZE THE DOSE	**Change Idea**

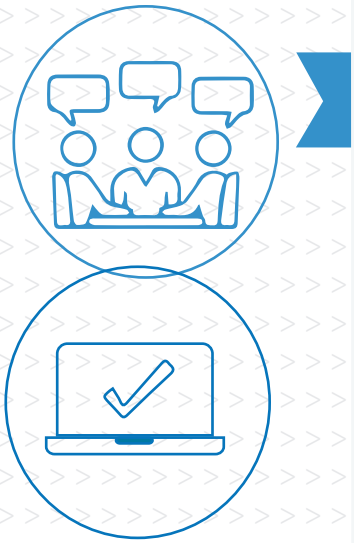
AIM

REDUCE UNNECESSARY RADIATION EXPOSURE.

Primary Driver:

CREATE AWARENESS

Deficiencies in the awareness and understanding of radiation exposure risk by health care staff can adversely affect patient safety. Provider education about the risks of radiation exposure will help to improve clinical practice and reduce unnecessary radiation exposure.



Without understanding the risks of radiation overuse, physicians may order unnecessary imaging procedures (e.g., they may repeat a test instead of reviewing the results of tests already performed). Ordering physicians may be unaware of recommended criteria to guide their decisions about whether or not a particular imaging procedure is medically necessary or effective and may order high-risk imaging procedures without sufficient justification. The development and dissemination of guidelines by themselves are insufficient to alter long-standing clinical practices. To effectively reduce unnecessary radiation exposure, educational programs for all clinicians involved in the ordering process are necessary. These programs can update providers on the latest research about patient safety and test effectiveness, familiarize providers with the institution's guidelines and recommendations, offer guidance on the specific roles of each provider and outline resources and tools available to support decision making and mitigate perceived challenges.

Secondary Driver > DEVELOP RADIATION SAFETY EDUCATIONAL MATERIALS

A number of respected professional organizations, including the American College of Radiology (ACR) and the American College of Cardiology (ACC), have developed and are disseminating appropriateness criteria for medical imaging referral for a variety of medical conditions. Links to these helpful resources are noted in the bibliography and under Suggested Bundles and Toolkits listed on page 3.

Change Ideas

> Educate ordering practitioners about the risks of ionizing radiation.

> Provide ordering practitioners with resources that outline appropriate diagnostic imaging methods to address common clinical diagnostic and treatment issues.

> Ask ordering practitioners to collaborate with a medical physicist to develop guidelines for a screening program that includes testing recommendations, testing efficacy analyses and risk/benefit analyses.

> Periodically assess practitioner knowledge and competency in this arena, and provide opportunities for educational updates.

Suggested Process Measures for Your Test of Change

- Percent of ordering practitioners who have completed a knowledge assessment
- Gap analysis on the availability and use of diagnostic-imaging utilization and radiation-dosing guidelines

Hardwire the Process

Regular education and assessments of performance are keys to successfully hardwiring awareness into an organization's culture. Communicate the results of the ongoing assessments to relevant stakeholders in the organization, and provide the necessary education and training to improve performance. Include the knowledge assessment as part of ongoing professional practice evaluations for all ordering physicians.

Primary Driver:

MANAGE THE DOSE

Professional organizations, such as the ACR, the American Association of Physicists in Medicine (AAPM) and the National Council on Radiation Protection and Measurements, have endeavored to develop, with the support of the Federal Drug Administration (FDA), nationally established diagnostic reference levels (DRL) for many imaging procedures.[3] These DRLs can be used as benchmarks to compare a facility's practice as part of its radiation protection quality assurance program. If a national DRL is exceeded during any specific examination, the facility can investigate whether exposure can be reduced in the future without adversely affecting image quality. Additionally, ordering physicians may not have access to patients' medical imaging or radiation dose histories, records or results. Without such information, physicians may reorder imaging procedures that had previously been performed, increasing patients' radiation exposure.

It is therefore critical for health care facilities to develop systems to obtain and record accessible histories of imaging and radiation exposure for every patient admitted.

Secondary Driver > DEVELOP PROCESSES TO COLLECT, STORE AND ANALYZE PATIENT DOSIMETRY DATA

A robust platform that facilitates radiation dose monitoring includes six major components: dose capture, effective dose conversion, patient-specific storage, dose analytics, dose communication and data export.[6]

Change Ideas

> Review the key literature in radiation dosage, administration and safety.

> Participate in the National Dose Index Registry.

> Use technology to notify key staff in real-time when alerts have been triggered.

Suggested Process Measure for Your Test of Change

- Percent of exams (radiation therapy, nuclear medicine procedures or radiation therapy) that have the dose of radiation documented

Secondary Driver > EVALUATE EQUIPMENT PERFORMANCE

To ensure that radiographic and fluoroscopic equipment is functioning properly, the performance should be evaluated upon installation and monitored at least annually by a qualified medical physicist. Additional or more frequent monitoring may be necessary if repairs are conducted that might affect the imaging performance of the equipment and the radiation exposure of patients.[7]

Change Ideas

> Launch a Radiation Safety Committee (RSC) that meets on a regular basis to develop guidelines based on the literature and research.

> Ask the RSC to assess compliance with the standards and guidelines that are developed and implemented.

> Ask the RSC to develop quality indicators (process, outcome and balancing measures) for ongoing assessment.

> Use technology to notify key staff in real time when alerts have been triggered.

> Complete a performance evaluation of equipment and personnel at least annually and include an exposure analysis for patients and employees.

Suggested Process Measure for Your Test of Change

- Percent of equipment that is evaluated annually and evaluated after each repair that may affect performance

Secondary Driver > CONSIDER USING CLOUD-BASED TECHNOLOGIES FOR DATA COLLECTION AND ANALYSIS

The Radiology Business Management Association (RBMA) and ACR have supported the concept of clinical decision support in their Best Practice Guidelines on Radiology Benefit Management Programs. Cloud technology offers clinical decision support that allows providers to receive information in real time, via online and mobile apps. Several commercially available products are available that provide immediate information and feedback regarding recommendations for best practices that are accessible, user-friendly, and up-to-date.[8] A list of sample products is provided in Appendix II.

Change Ideas

> Participate in a multi-center, standardized data collection and feedback program to establish national dose index benchmarks for designated examinations.

> Make cloud-based, clinical decision support tools available to radiologists and radiology technologists.

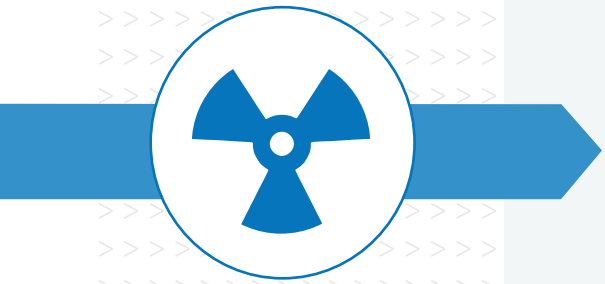
> Review clinical, decision support tools at least annually for usefulness and ease of use.

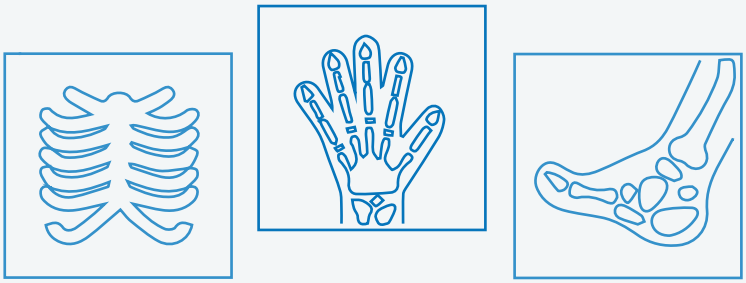
Suggested Process Measure for Your Test of Change

- Percent of patients receiving radiation therapy, nuclear medicine procedures or radiation therapy who meet the designated criteria for appropriate ordering

Hardwire the Process

Provide access to and require the use of real-time, decision making tools that are user-friendly to promote compliance with recommendations for limiting radiation exposure. Make the six major components required fields to ensure consistent documentation and accomplish radiation-dose monitoring. Monitor practitioner utilization of clinical decision-making tools as they are adopted, and share results.





Primary Driver:

ENSURE PROPER UTILIZATION

The RSC in your facility should develop policies, processes and procedures to ensure the capture, assessment, investigation and monitoring of non-compliance with its guidelines and standards. Ionizing-radiation-examination protocols should aim to recommend doses for each cohort of patients and type of examination as low as reasonably achievable (ALARA) to obtain adequate image quality. For example, as people age, their risk of radiation-induced cancer decreases. As a result, when compared to a 40-year-old, an 80-year-old is three to four times less likely to develop cancer from radiation exposure.[9] In addition, radiation levels required to image in children of smaller size tend to be lower than those of adults.

Secondary Driver > DEVELOP A RADIATION SAFETY COMMITTEE (RSC)

To promote effective guideline development, performance management, and quality improvement, the RSC should be multidisciplinary. Members should be drawn from a breadth of relevant fields, including medicine, nursing, radiology, medical physics and quality improvement.

Change Ideas

> Identify subject matter experts within the organization to provide input and guidance.

> Develop criteria for appropriate utilization of ionizing radiation for adults and children.

Suggested Process Measure for Your Test of Change

- Percent of radiology examinations that have developed criteria for appropriate utilization

Secondary Driver > DISSEMINATE BEST PRACTICES AND GUIDELINES THAT ARE SUPPORTED BY EVIDENCE

To promote and enhance knowledge and awareness of best practices and provide initial and ongoing education on the recommended guidelines and processes. Members of the RSC and well-respected clinician champions can serve as effective educators in hospital meetings.

Change Ideas

> Create — and make accessible — real time reference tools for ordering practitioners.

> Provide the ordering practitioners with resources regarding appropriate diagnostic imaging methods at the time of ordering. These resources should help the provider address the clinical questions and optimize the dose of the procedure ordered.

Suggested Process Measure for Your Test of Change

- Percent of ordering practitioners who are educated on recommended guidelines and processes

Secondary Driver > HARD STOP SPECIFIC ORDER SETS TO REQUIRE DOCUMENTATION OF CLINICAL INDICATIONS

To promote and enhance knowledge and awareness of best practices and provide initial and ongoing education on the recommended guidelines and processes. Members of the RSC and well-respected clinician champions can serve as effective educators in hospital meetings.

Change Ideas

> Use alerts to prompt reconsideration and justification for choices. Help providers "choose wisely."

> Implement required fields for the documentation of indications and justification for certain high-dose radiologic procedures identified by the RSC.

Suggested Process Measure for Your Test of Change

- Percent of non-compliant orders that resulted in follow-up with the ordering practitioner

Secondary Driver > MONITOR PERFORMANCE ON A REGULAR AND ONGOING BASIS

After the RSC develops standards and guidelines for ordering radiologic procedures, it should meet on a regular basis to review application of and compliance with these standards, as well as to make necessary revisions in guidelines and recommendations based on these assessments and analyses.

Change Ideas

> Reassess and modify standard orders as necessary and appropriate.

> Include physician radiation practices in Ongoing Professional Practice Evaluations (OPPE).

Suggested Process Measure for Your Test of Change

- Percent of patients who had a high-risk radiologic examination performed without documented clinical justification

Hardwire the Process

Implement hard stops. They are by nature a hardwiring technique. Require ordering physicians to use real time decision making tools to ensure compliance with recommendations for limiting radiation exposure.

Primary Driver:

AVOID THE "DON'TS"

Each institution's radiation safety program should develop and implement policies, processes and procedures to ensure the capture, assessment, investigation and monitoring of noncompliance with the standards set by its RSC. Ordering physicians may be unaware of the recommended criteria to guide their decisions and may lack updated, evidence-based information about the clinical effectiveness of specific imaging procedures.

Secondary Driver > DON'T ORDER DIAGNOSTIC STUDIES THAT HAVE NO PROVEN VALUE OR WILL NOT IMPACT THE COURSE OF TREATMENT

The choice of imaging procedures is sometimes made by physicians who may not have access to previous patient records or pertinent patient history, especially if patients present with impaired levels of consciousness or acute life-threatening emergencies. When such information is unavailable, physicians often decide which imaging procedures are most appropriate by considering patients' clinical conditions and by consulting with radiologists, hospitalists or surgeons.[10]

The American College of Radiology recommends five things Physicians and Patients Should Question:

1. Don't do imaging for uncomplicated headache.
2. Don't image for suspected pulmonary embolism without moderate or high pre-test probability of PE.
3. Avoid admission or preoperative chest x-rays for ambulatory patients with unremarkable history and physical exam.
4. Don't do CT for the evaluation of suspected appendicitis in children until after ultrasound has been considered as an option.
5. Don't recommend follow-up imaging for clinically inconsequential adnexal cysts.[11]

Change Ideas

> Use the criteria for appropriate utilization of ionizing radiation to identify the procedures for which it will be necessary and advisable to institute hard stops (i.e., "choose wisely" reminders).

> Develop and recommend alternate options to avoid frequent provider selection of procedures that trigger hard stops.

Suggested Process Measure for Your Test of Change

- Percent of emergency department patients who had CT scans of the thorax to rule out pulmonary embolism without appropriate justification

Hardwire the Process

Involve ordering physicians in the development of the hard-stop list and processes to enhance the understanding of the rationale behind these improvement changes and to

Primary Driver:

PROTECT THE PATIENT

Patient protection must remain at the forefront of all quality improvement efforts. When ordering any exam or procedure that will expose a patient to ionizing radiation, practitioners must weigh the clinical need with the potential for harm. Providers must also ensure that the correct patient receives a radiation dose that is as low as reasonably achievable (ALARA) to achieve the desired diagnostic or therapeutic result. Involvement of the patient and family in the decision-making process is beneficial and encouraged.

Secondary Driver > DEVELOP A SPECIFIC INFORMED CONSENT PROCESS FOR ALL EXAMS/PROCEDURES

A recent survey found that approximately 25 percent of all written complaints involved poor communication between providers and patients. Research evidence has demonstrated that patients wish to be more engaged in their health care and involved in decision making with their providers. Patients and their caregivers must understand the risks and benefits of radiological procedures and understand the cumulative effect of radiation so that they can be fully engaged in shared decision-making as appropriate.

Change Ideas

> Develop a process to obtain informed consent from all patients before exposure to ionizing radiation.

> Engage patients and their family members in the development of the informed consent materials and process; solicit feedback on readability and comprehension.

Suggested Process Measure for Your Test of Change

- The percentage of diagnostic radiology, nuclear medicine and radiation exams and procedures that did not have a signed, radiation-specific informed consent

Secondary Driver > EDUCATE PATIENTS AND FAMILY ON RISK

There is little evidence that identifies patient willingness to engage in the ordering process for radiologic examinations. However, research clearly demonstrates that patients desire "the right care, at the right time and in the right place." Before patients or family members can effectively participate in decision making about care, they need to be provided with the necessary background and knowledge about their conditions and diagnostic and therapeutic options — in a language and at a literacy level that is appropriate for their understanding.

Change Ideas

> Provide patients and families with access to information and tools that describe radiological procedures, risks and alternatives.

> Develop a process to educate patients and their families utilizing teach-back.

Suggested Process Measure for Your Test of Change

- Percent of patients undergoing a diagnostic radiology, nuclear medicine or radiation exam or procedure who did not receive educational materials

Secondary Driver > MINIMIZE THE DOSE

One size does not fit all.[12] ALARA means making every reasonable effort to maintain exposures to ionizing radiation as far below the dose limits as practical.[12] This goal can be achieved by tailoring the examination to the age and condition of the patient, as well as by examining each radiograph as it is taken and terminating the procedure when a diagnosis is attained.

Change Ideas

> Develop a platform to record and document radiation-dose information in the patient's health record.

> Provide the patient with a patient medical imaging record card that contains documentation of the radiation exposure.

> Develop a system to obtain a history of and to track previous examinations and procedures that have been performed in your facility and in other facilities.

> Complete a critical analysis of your screening processes.

Suggested Process Measures for Your Test of Change

- Percent of patients who received a patient medical imaging record card
- Percent of medical records that include documentation of the consideration of previous radiological procedures for specific patient populations (e.g., pediatrics) as recommended by your RSC

Hardwire the Process

Include the absence of informed consent for radiation procedures in OPPE to ensure that patients are informed about the potential risks. Prompt patients for their medical-imaging record to reinforce its importance and encourage its use.

PDSA In Action | Tips on How to Use the Model for Improvement

IMPLEMENT SMALL TESTS OF CHANGE	Test of Change Example
PLAN	Assemble a team (radiologist, ordering practitioner, radiology technologist, nurse and educator) to review current practices and patient education materials. As a group, develop patient education materials to be given to patients and families.
DO	Test the education materials with one physician and one patient.
STUDY	Solicit feedback from both the physician and patient and family member. Use teach-back to validate the educational materials.
ACT	Revise the educational materials as recommended. Test again with another physician and patient.

Potential Barriers

- Recognize that for many physicians, evolving technology will demand changes in their practice. The use of alerts, hard stops and decision support tools may be unsettling for many providers. Some practitioners may perceive that they may be losing control or believe they are being told how to practice medicine. To help engage physicians in the use of technology, recruit one or two early adopting physicians champions to serve as ambassadors and mentors for these changes among their colleagues and peers.
- Technology use requires a learning curve; different practitioners will adapt to new technologies and processes at different rates. Provide adequate training, support and encouragement for practitioners unfamiliar with new technologies and systems.
- Physicians may resist using standard orders, believing these represent cookbook medicine. Educating physicians regarding the proven value of standard order sets in reducing unnecessary imaging can mitigate this resistance and increase adoption. Presenting options for customization of orders and allowing opt-outs for patients with special needs can promote acceptance.
- Physicians may be cautious about supporting protocols implemented by non-physician staff. Educating physicians about the benefits of such quality of care protocols and patient outcomes, including physicians in the protocol-development process can accelerate acceptance.

Enlist administrative leadership as sponsors to help remove or mitigate barriers

- Administrative leadership can aid in the efforts to prevent undue radiation exposure by: clearly communicating to physicians and staff the importance and direction of the initiative; soliciting input from physicians, staff and patients; providing access to educational materials (e.g., physician-communication modules)[14]; supplying the necessary real-time resources to physicians and staff; and instilling accountability with program monitoring and use of OPPE.

Change not only the practice, but also the culture

- Weighing the clinical need against the potential negative effects of diagnostic radiology, nuclear medicine and radiation exams and procedures requires not only changes in practice but also a change in culture. The hardwiring suggestions provided in this document will accelerate the adoption, but successful implementation of these practices to prevent undue radiation exposure requires strong leadership commitment and buy-in from physicians and other staff.

PART 4: CONCLUSION AND ACTION PLANNING

Radiology tests that diagnose and treat medical conditions can also be harmful to patients through improperly applied or elevated doses of radiation, or through repeated exposure to small amounts of radiation. Exposure to ionizing radiation may increase a person's lifetime risk of developing cancer.[3] Increasing awareness for both patients and providers of the risks, ensuring proper utilization of the technologies, managing and minimizing the radiation dose, involving the patient in decisions and creating a patient-specific tracking system of tests and dosages will help to prevent undue radiation exposure. Physician and leadership support of the initiatives, as well as hardwiring techniques are essential to a successful implementation.

PART 5: APPENDICES

APPENDIX I: UNDUE RADIATION EXPOSURE TOP TEN CHECKLIST

Associated Hospital/Organization: HRET HIIN

Purpose of Tool: A checklist to assess current practices to prevent undue radiation exposure in your facility

Reference: www.hret-hiin.org

2017 Undue Radiation Exposure Top Ten Checklist

PROCESS CHANGE	IN PLACE	NOT DONE	WILL ADOPT	NOTES *(Responsible and By When?)*
1. Develop a process to collect, store, and analyze patient dosimetry data. Provide patients with tools to track their personal medical-imaging history.	☐	☐	☐	
2. Establish a Radiation Safety Committee that is responsible for evaluating performance of equipment and establishing and monitoring adherence to dosing and utilization protocols.	☐	☐	☐	
3. Create and implement a "Don't" list of exams that have little proven value or do not change the course of treatment.	☐	☐	☐	
4. Participate in the National Dose Index Registry.	☐	☐	☐	
5. Require informed consents specific to ionizing-radiation examinations.	☐	☐	☐	
6. Eliminate routine ionizing-radiation orders (e.g., a daily chest x-ray).	☐	☐	☐	
7. Assess staff or practitioner knowledge about the risks and benefits of ionizing radiation.	☐	☐	☐	
8. Develop a toolkit with educational materials about radiation safety for ordering practitioners.	☐	☐	☐	
9. Analyze data and information from EMR alerts and redesign and improve standardized processes.	☐	☐	☐	
10. Develop specific criteria for the use of ionizing radiation in special cases (e.g., for infants, small children and pregnant women).	☐	☐	☐	

APPENDIX II: EXAMPLES OF RADIOLOGY DECISION-SUPPORT SYSTEMS

Associated Hospital/Organization: Multiple hospitals/associations

Purpose of Tool: A non-exhaustive list of cloud-based reference tools available to patients, radiologists, radiology technologists and ordering physicians

Reference: see below

Reference tools:

1. Radiation Passport (iOS – Cost): An education/tracking tool for patients.
   Retrieved at: www.tidalpool.ca/radiationpassport/
2. iCat Medical Software (iOS – Cost): Reference tools for radiologists and other health care providers.
   Retrieved at: www.icatsoftware.co.uk/
3. Radiology Toolbox (iOS – Free): Radiologist's reference tool/calculator.
   Retrieved at: http://itunes.apple.com/us/app/radiology-toolbox/id415176373?mt=8
4. RadX Mobile (iOS –Cost): Radiology technologist's mobile positioning guide.
   Retrieved at: https:/itunes.apple.com/us/app/radx-mobile/id375114750?mt=8
5. Radiographic Calculator (iOS – Cost): Calculator for radiology technologist.
   http:/itunes.apple.com/us/app/radiographic-calculator/id427543626?mt=8
6. Appropriate Use Criteria (AUC) for Cardiac Radionuclide Imaging (iOS–Free): Reference tool for ordering physicians. https://itunes.apple.com/us/app/appropriate-use-criteria-auc/id391068250?mt=8

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