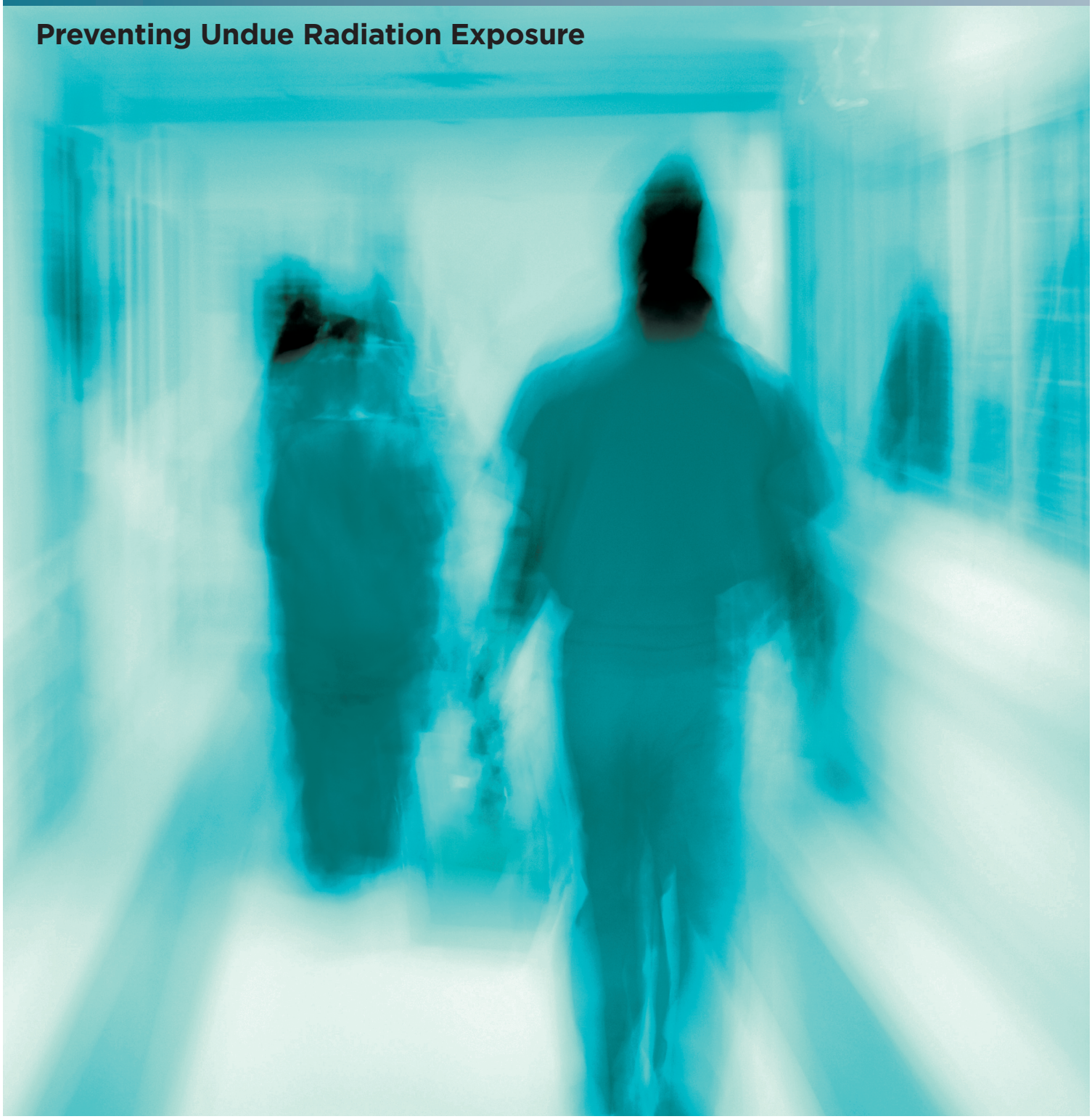
UNDUE RADIATION EXPOSURE CHANGE PACKAGE

Preventing Undue Radiation Exposure



American Hospital Association®

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HRET
HEALTH RESEARCH & EDUCATIONAL TRUST
In Partnership with AHA

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UNDUE RADIATION EXPOSURE OVERVIEW

Background

- Diagnostic radiology, nuclear medicine, and radiation therapy have become routine diagnostic and therapeutic tools in the fight to identify and eradicate disease.[13, 16]
- Many of these procedures are performed by clinicians who have not had formal training in radiation effects and safety. As a result, a few patients and staff may suffer unnecessary injuries.[13]
- The negative effects of ionizing radiation can include damage to DNA. Exposure to such radiation may increase a person's lifetime risk of developing cancer.[16]
- Most patients are not counseled on the risks of radiation, nor have appropriate follow-up to detect if an injury has occurred.[13, 14]

Suggested AIM

- Reduce the incidence of unnecessary radiation exposure by 40%, by December 8, 2014.

Potential Measures

Outcome Measures:

Indicator Name: **Head CT scans in the ER** (EOM: OPT-HEN-RADIATION-28)
Numerator: Total number of head CT scans performed in the ER
Denominator: Total number of emergency department visits

Indicator Name: **CT scans (Thorax) in the ER** (EOM: OPT-HEN-RADIATION-31)
Numerator: Total number of CT scans of the thorax to R/O Pulmonary embolism in adults (>18 years of age)
Denominator: Total number of emergency department visits

Indicator Name: **CT scans (Abdomen/Pelvis) in the ER** (EOM: OPT-HEN-RADIATION-32)
Numerator: Total number of CT scans of the abdomen/pelvis in the ER in patients < 18 years of age
Denominator: Total number of emergency department visits

Suggested Process Measures:

Indicator Name: **Procedural Justification** (EOM: OPT-HEN-RADIATION-29)
Numerator: All patients with documented justification for one of the procedures below. (Diagnostic radiology, nuclear medicine procedures, or radiation therapy.)
Denominator: Inpatients receiving diagnostic radiology, nuclear medicine procedures, or radiation therapy.

Indicator Name: **Dose Documentation** (EOM: OPT-HEN-RADIATION-30)
Numerator: All patients with documentation of radiation dose
Denominator: All diagnostic radiology, CT Scans, or Nuclear Medicine.

KEY ELEMENTS	IDEAS TO TEST
Create Awareness	• Educate ordering practitioners about the risks of ionizing radiation. • Provide ordering practitioners with resources that suggest 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 test recommendations, test efficacy analyses, and risk/benefit analyses. • Periodically assess practitioner knowledge and competency in this arena, and provide opportunities for educational updates.
Ensure Proper Utilization	• Identify subject matter experts within the organization to provide input and guidance. • Develop criteria for appropriate utilization of ionizing radiation. • Create – and make accessible – real-time reference tools for ordering practitioners. • Use alerts to prompt reconsideration and justification for choices. (Help providers "choose wisely.") www.choosingwisely.org • 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. • Reassess and modify standard orders, as necessary and appropriate. • Include physician radiation practice in Ongoing Professional Practice Evaluations (OPPE).
Avoid the *"Don'ts"*	• 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. "Choosing Wisely" reminders. • Visit www.choosingwisely.org and review which specialty-specific exams have little proven value. • Develop and recommend alternate options to avoid frequent provider selection of procedures that trigger hard stops.
Manage the Dose	• Review the key literature in radiation dosage, administration, and safety. • Launch a Radiation Safety Committee that meets on a regular basis to develop guidelines based on the literature/research. • Ask the Radiation Safety Committee to assess compliance with the standards and guidelines developed and implemented. • Use technology to notify key staff in real-time when alerts have been triggered. • Ask the Radiation Safety Committee to develop quality indicators (process, outcome, and balancing measures) for ongoing assessment. • Participate in a multi-center, standardized data collection and feedback program to establish national dose index benchmarks for designated examinations. • Complete a performance evaluation of equipment and personnel at least annually – and include an exposure analysis for patients and employees.
Protect the Patient	• Provide patients and families with information in this arena in a language and at a literacy level all can understand. • Develop a process to obtain informed consent from all patients before exposure to ionizing radiation. • Engage patients and family members in the development of the informed consent materials and process – solicit feedback on readability and comprehension. • Develop a platform to record/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/procedures that have been performed in your facility and in other facilities. • Complete a critical analysis of your screening processes.

Key Resources

- ACR Appropriateness Criteria: Radiation Dose Assessment Introductions. Retrieved at: http://www.acr.org/Quality-Safety/Appropriateness-Criteria
- ACR-AAPM-SIIM Practice Guideline for Digital Radiography. Retrieved at: http://www.acr.org/Quality-Safety/Standards-Guidelines/Practice-Guidelines-by-Modality/Radiography
- ACR/AAPM Practice Guideline for Diagnostic Reference Levels and Achievable Doses in Medical X-Ray Imaging. Retrieved at: http://www.acr.org/Quality-Safety/Standards-Guidelines/Practice-Guidelines-by-Modality/General-Diagnostic
- Federal Guide Report # 14: Radiation protection guidance for diagnostic and interventional radiology. Retrieved at: http://www.epa.gov/radiation/federal/fgr-14.html
- Choosing Wisely. Website: http://www.choosingwisely.org/
- Image Gently. Website: http://imagegently.dnnstaging.com/

REDUCING UNDUE RADIATION EXPOSURE DRIVER DIAGRAM

AIM: Reduce the incidence of unnecessary radiation exposure by 40%, by December 8, 2014

PRIMARY DRIVER	SECONDARY DRIVER	CHANGE IDEAS
Create Awareness	• Develop a toolkit with clinical educational materials on radiation safety for MDs throughout the learning continuum. Include information on the short- and long-term risks of radiation exposure.	• Educate ordering practitioners about the risks of ionizing radiation. • Provide ordering practitioners with resources which suggest 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 which includes test recommendations, test efficacy analyses, and risk/benefit analyses. • Periodically assess practitioner knowledge and competency in this arena, and provide opportunities for educational updates.
Ensure Proper Utilization	• Develop a program to guide diagnostic screening which uses ionizing radiation. • Disseminate guidelines and best practices for utilization of these procedures. • Link order sets to specific clinical indications, and, via hard stops, require documentation and justification for exceptions. • Use focused audits to monitor practice patterns and identify system failures.	• Identify subject matter experts within the organization to provide input and guidance. • Develop criteria for appropriate utilization of ionizing radiation. • Create – and make accessible – real-time reference tools for ordering practitioners. • Use alerts to prompt reconsideration and justification for choices. (Help providers "choose wisely.") www.choosingwisely.org • 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. • Reassess and modify standard orders, as necessary and appropriate. • Include physician radiation practice in Ongoing Professional Practice Evaluations (OPPE).
Avoid the "Don'ts"	• **Don't** order diagnostic studies that have no proven value, or will not impact the course of treatment. Examples may include: • Imaging for uncomplicated headache • Head CT for delirium • Head CT in the ER for a minor head injury • CT for possible appendicitis in children • Follow-up imaging for clinically inconsequential adnexal cysts • CT pulmonary angiography for suspected pulmonary embolism (PE) without pre-procedure indications of moderate or high probability (e.g. per D-dimer) • Daily chest X-rays (as a standing order)	• 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. **"Choosing wisely"** reminders. • Visit www.choosingwisely.org and review which specialty-specific exams have little proven value. • Develop and recommend alternate options to avoid frequent provider selection of procedures that trigger hard stops.

PRIMARY DRIVER	SECONDARY DRIVER	CHANGE IDEAS
Manage the Dose	• Develop and implement a process to collect, store, review, and analyze patient dosimetry data. • Participate in the National Dose Index Registry. • Consider the use of cloud-based technologies to aid your dose tracking processes. • Develop and implement an equipment performance evaluation process. Monitor and analyze personnel and patient exposure. • Encourage real-time learning from each failure or negative outcome, and revise procedures to prevent repetition.	• Review the key literature in radiation dosage, administration, and safety. • Launch a Radiation Safety Committee that meets on a regular basis to develop guidelines based on the literature/research. • Ask the Radiation Safety Committee to assess compliance with the standards and guidelines developed and implemented. • Use technology to notify key staff in real-time when alerts have been triggered. • Ask the Radiation Safety Committee to develop quality indicators (process, outcome, and balancing measures) for ongoing assessment. • Participate in a multi-center, standardized data collection and feedback program to establish national dose index benchmarks for designated examinations. • Complete a performance evaluation of equipment and personnel at least annually – and include an exposure analysis for patients and employees.
Protect the Patient	• Provide patient and family education about radiation risk in a language and at a literacy level all can understand. • Ask patients for specific informed consent before all such procedures. • Minimize the dose(s) of ionized radiation to a fetus. • Minimize the dose(s) of ionized radiation to a child. • Minimize the dose(s) of ionized radiation to an adult to the least amount necessary. • Provide patients with tools and records with which they can track their personal medical imaging history.	• Provide patients and families with information in this arena in a language and at a literacy level all can understand. • Develop a process to obtain informed consent from all patients before exposure to ionizing radiation. • Engage patients and family members in the development of the informed consent materials and process – solicit feedback on readability and comprehension. • Develop a platform to record/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/procedures that have been performed in your facility and in other facilities. • Complete a critical analysis of your screening processes. • Remember, one size does not fit all. Visit the websites **Image Gently** (http://imagegently.dnnstaging.com/) and Choosing Wisely (www.choosingwisely.org) to obtain more information on how to select appropriate exams and dose levels.

ELIMINATION OF UNDUE RADIATION EXPOSURE

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 too-high doses of radiation in diagnosis and treatment can result in well-documented side effects or negative outcomes. Even small radiation doses unfortunately may carry a risk of deleterious effects.[1]

The science of medicine has evolved from simple visual observation to the use of technology to help diagnose and monitor patients at levels invisible to the human eye. Radiation has become a common diagnostic and therapeutic tool in the fight to identify and eradicate disease.[2] Studies and procedures using ionizing radiation can provide practitioners with important clinical information. But, 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 followed up appropriately to identify if signs of radiation injury have developed.

The variety and complexity of human conditions make it difficult to predict with certainty a specific patient's response to treatment. However, recommendations from the research literature and evidence-based practice can suggest optimized and effective doses of radiation to successfully achieve 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.[3] 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; but, 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.

SUGGESTED AIMS

Reduce the incidence of unnecessary radiation exposure by 40% by December 8, 2014.

CREATE AWARENESS

Deficiencies in the awareness and understanding of radiation exposure risk by healthcare 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. Or, 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 mandatory. 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 as to the specific roles of each provider, and outline resources and tools available to support decision-making and to mitigate perceived challenges.

Secondary Driver: Develop a toolkit with clinical educational materials on radiation safety for MDs throughout the learning continuum. Include information on the short- and long-term risks of radiation exposure.

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 Useful Links.

Change Ideas

- Educate ordering practitioners about the risks of ionizing radiation.
- Provide ordering practitioners with resources which suggest 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 which includes test recommendations, test efficacy analyses, and risk/benefit analyses.
- Periodically assess practitioner knowledge and competency in this arena, and provide opportunities for educational updates.

Suggested Process Measures

- The percentage of exams (radiation therapy, nuclear medicine procedures, or radiation therapy) that do not have the dose of radiation documented.

"Hardwiring" Awareness in Improvement Plans

Regular assessments of performance are a key 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.

MANAGE THE DOSE

Professional organizations such as the American College of Radiology (ACR), the American Association of Physicists in Medicine (AAPM), and the NCRP, have endeavored to develop, with the support of the FDA, nationally established diagnostic reference levels (DRL) for many imaging procedures.[2] 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 and/or records/results. Without such information, physicians may re-order imaging procedures that had previously been performed, increasing patients' radiation exposure. It is therefore critical for healthcare 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.[4]

Secondary Driver: Participate in the National Dose Index Registry.

The National Dose Index Registry is a data registry that allows facilities to compare their CT dose indices with regional and national values. Information related to dose indices for all types of CT examinations is collected, de-identified, transmitted to the ACR, and stored in a database. Participating institutions can then be provided with periodic feedback reports which allow them to compare their local results to aggregate results by body part and exam type. Data collected from the registry is also used to establish national benchmarks for CT dose indices.[5]

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.[6]

Secondary Driver: Encourage real-time learning from each failure or negative outcome, and revise procedures to prevent repetition.

Monitoring rates of imaging orders can provide clues about trends and patterns in processes and systems. A "hard stop," i.e. one which requires documentation for repeat or high risk testing, spurs the ordering clinician to think twice about stepping outside the recommended guidelines and protocols. The justifications provided for ordering specific tests can be reviewed to revise and improve protocols, as well as to identify education and training needs. An override of a hard stop may be justified for a specific case, but patterns of overrides suggest possible system failures, such as inadequate order sets or insufficient provider training. Analysis of patterns may identify processes that require improvement or revision.

Secondary Driver: Consider using cloud-based technologies for data collection and analysis.

The Radiology Business Management Association (RBMA) and the American College of Radiology (ACR) have supported the concept of clinical decision support (CDS) in their Best Practice Guidelines on Radiology Benefit Management Programs. Cloud technology offers CDSs that allow 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.[7] (A list of sample products is provided in Appendix II).

Change Ideas

- Review the key literature in radiation dosage, administration, and safety.
- Launch a Radiation Safety Committee that meets on a regular basis to develop guidelines based on the literature/research.
- Ask the Radiation Safety Committee to assess compliance with the standards and guidelines developed and implemented.
- Use technology to notify key staff in real-time when alerts have been triggered.
- Ask the Radiation Safety Committee to develop quality indicators (process, outcome, and balancing measures) for ongoing assessment.
- Participate in a multi-center, standardized data collection and feedback program to establish national dose index benchmarks for designated examinations.
- Complete a performance evaluation of equipment and personnel at least annually – and include an exposure analysis for patients and employees.

Suggested Process Measures

- The percentage of patients receiving radiation therapy, nuclear medicine procedures, or radiation therapy that do not meet the designated criteria for appropriate ordering.

"Hardwiring" Dose Management in Improvement Plans

By offering real-time decision-making tools that are accessible and user-friendly, the organization can promote compliance with recommendations for limiting radiation exposure.

PROPER UTILIZATION

The Radiation Safety Committee 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 in the 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 3 to 4 times less likely to develop cancer from radiation exposure. 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.

To promote effective guideline development, performance management, and quality improvement, the Radiation Safety Committee should be multi-disciplinary. Members should be drawn from a breadth of relevant fields, including medicine, nursing, radiology, medical physics, and quality improvement.

Secondary Driver: Disseminate best practices and guidelines that are supported by evidence.

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

Secondary Driver: "Hard stop" specific order sets to require documentation of clinical indications.

Documentations of clinical indications and justifications for certain radiologic procedures can be monitored and evaluated to assess for appropriate ordering. This QI analysis should include a "close the loop" feature through which necessary revisions to guidelines can be made and needed education and training can be implemented

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

- Identify subject matter experts within the organization to provide input and guidance.
- Develop criteria for appropriate utilization of ionizing radiation.
- Create – and make accessible – real-time reference tools for ordering practitioners.
- Use alerts to prompt reconsideration and justification for choices. (Help providers "choose wisely.")
- 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.
- Reassess and modify standard orders, as necessary and appropriate.
- Include physician radiation practice in Ongoing Professional Practice Evaluations (OPPE).

Suggested Process Measures

- The percentage of patients who had a high-risk radiologic examination performed without documented clinical justification.

"Hardwiring" Proper Utilization into Improvement Plans

Many of the interventions above are not only implementation strategies but also hardwiring strategies. Hardwiring for proper utilization not only requires action and public support by the RSC, but hospital senior leadership as well. Both the RSC and the senior leadership can educate the providers and other hospital staff about the benefits of reducing ionizing radiation exposure in patient safety.

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 Radiation Safety Committee. Ordering physicians may be unaware of the recommended criteria for test ordering 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.[8]

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 Measures

- The percentage of Emergency Room patients who had CT scans of the thorax to R/O pulmonary embolism without appropriate justification.

"Hardwiring" the "Don'ts" into Improvement Plans

Each hospital's RSC needs to identify a key list of radiologic procedures that comprise the organization's "Don't" list. Involving local clinicians in the development of these lists and processes will enhance the providers' understanding of the rationale behind these improvement changes, and will increase the buy-in for the processes, thereby promoting their implementation.

PROTECT THE PATIENT

Patient protection must remain at the forefront of all quality improvement efforts. When ordering any exam/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 diagnostic radiology, nuclear medicine, and radiation therapy exams/procedures.

A recent survey found that approximately 25% of all written complaints involved poor communication between providers and patients. Research evidence has demonstrated that patients wish to be more engaged in their healthcare and involved in decision-making with their providers. Patient- and family-centered healthcare in an environment of respect and cultural competency has resulted in improved patient outcomes.

Secondary Driver: Provide patient and family education about radiation risks in a language and at a literacy level all can understand.

There is little evidence which 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.

Secondary Driver: Minimize the dose.

One size does not fit all.[10] ALARA is an acronym for "As Low As (is) Reasonably Achievable," i.e. making every reasonable effort to maintain exposures to ionizing radiation as far below the dose limits as practical.[9] 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

- Provide patients and families with information in this arena in a language and at a literacy level all can understand.
- Develop a process to obtain informed consent from all patients before exposure to ionizing radiation.
- Engage patients and family members in the development of the informed consent materials and process – solicit feedback on readability and comprehension.
- Develop a platform to record/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/procedures that have been performed in your facility and in other facilities.
- Complete a critical analysis of your screening processes.

Suggested Process Measures

- The percentage of patients who signed a radiation-specific informed consent.
- The percentage of patients who received a patient medical imaging card.

"Hardwiring" Patient Safety into Improvement Plans

Communicate, communicate, communicate. Practitioners cannot communicate too much or too often with their patients and their families. Patients' thoughts and perceptions about radiation exposure should be solicited. By enhancing communication with patients, providers can promote patient engagement and help to hardwire patient safety into the healthcare process.

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 physician 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 they 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 protocols on quality of care and patient outcomes, and including physicians in the protocol development process, can be reassuring.

Useful Links

- ACR's Appropriateness Criteria® are available at http://www.acr.org/Quality-Safety/Appropriateness-Criteria
- ACC's Appropriate Use Criteria (AUC) are available at http://www.cardiosource.org/Science-And-Quality/Practice-Guidelines-and-Quality-Standards.aspx?type=KkmZefu5Ikel7rdhS3uegw,Appropriate+Use+Criteria&search=1
- Choosing Wisely Website: http://www.choosingwisely.org/
- Image Gently Website: http://imagegently.dnnstaging.com/

Undue Radiation Exposure Top Ten Checklist

TOP TEN EVIDENCE BASED INTERVENTIONS				
PROCESS CHANGE	**IN PLACE**	**NOT DONE**	**WILL ADOPT**	**NOTES (RESPONSIBLE AND BY WHEN?)**
Develop a process to collect, store, and analyze **patient** dosimetry data.	☐	☐	☐	
Create and implement a "Don't" list of exams that have little proven value or do not change the course of treatment.	☐	☐	☐	
Participate in the National Dose Index Registry.	☐	☐	☐	
Require informed consents specific to ionizing radiation examinations.	☐	☐	☐	
Eliminate routine ionizing radiation orders (e.g. a daily chest x-ray).	☐	☐	☐	
Provide patients with tools to track their personal medical imaging history.	☐	☐	☐	
Assess staff/practitioner knowledge about the risks/benefits of ionizing radiation.	☐	☐	☐	
Develop a toolkit with educational materials about radiation safety for ordering practitioners.	☐	☐	☐	
Analyze data/information from EMR alerts and redesign and improve standardized processes.	☐	☐	☐	
One size does not fit all: Develop specific criteria for the use of ionizing radiation in special cases, e.g. for infants, small children, and pregnant women.	☐	☐	☐	

Additional resources, such as the driver diagram and change package, can be found at www.HRET-HEN.org

Appendix II: Examples of Radiology Decision-Support Systems

1. Radiation Passport (iOS – Cost) http://www.tidalpool.ca/radiationpassport/
2. iCat Medical Software (iOS – Cost) http://www.icatsoftware.co.uk/
3. Radiology Toolbox (iOS – Free) http://itunes.apple.com/us/app/radiology-toolbox/id415176373?mt=8
4. RadX Mobile (iOS –Cost) http://itunes.apple.com/us/app/radx-mobile/id375114750?mt=8
5. NucRx (iOS – Cost) http://itunes.apple.com/us/app/nucrx/id360970146?mt=8
6. Radiographic Calculator (iOS – Cost) http://itunes.apple.com/us/app/radiographic-calculator/id427543626?mt=8
7. Appropriate Use Criteria (AUC) for Cardiac Radionuclide Imaging (iOS – Free) http://itunes.apple.com/us/app/appropriate-use-criteria-auc/id391068250?mt=8
8. RadSnap (iOS, Android, PC – Free) http://www.RadSnap.com

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