How to Create a World Class Dose Reduction Program

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EXECUTIVE SUMMARY

- Effective dose reduction is best accomplished using a multifaceted approach. Protocol optimization, proper use of scanner features, patient dose tracking and analysis, and staff training are among the many important elements that should be addressed.
- A dose reduction committee should be composed of the radiology administrator or center manager, the chief or supervising radiologist, the diagnostic medical physicist, and the chief technologist for each x-ray based modality.
- Once responsibilities have been assigned and a timeline set, start with CT and establish baseline doses, make sure existing hardware and software is being used properly, optimize protocols, evaluate new hardware and software needs, and then track and analyze patient doses to measure progress.
- Once the dose reduction program is up and running, ensure that key stakeholders are educated about it and that its existence, purpose and results are communicated to patients and the surrounding community.

Maintaining the lowest possible radiation dose while still achieving high quality diagnostic images has become a top priority in the field of radiology. Federal and state regulatory agencies have recently implemented new regulations in the area of patient dose and more appear to be on the way.[1–4] Accreditation bodies such as The Joint Commission are ramping up their expectations in this arena[5] and both the American College of Radiology (ACR) and the Intersocietal Accreditation Commission (IAC) already have substantial patient dose accreditation standards in place.[5–7] Finally, the news media, members of the public, and referring physicians are asking more questions and showing more concern about dose. So what is a hospital radiology department or outpatient center to do? Where does one start and what must be done to meet current and upcoming regulations, maintain accreditations, and do the right thing for patients? How does one create a truly "world class" radiation dose reduction program?

Due to the numerous elements that affect dose and image quality, optimizing radiation dose in the clinical setting is *not* a simple task. Facilities are being presented with all different types of solutions: machine hardware upgrades, machine software upgrades, dose tracking software packages, operations consulting, etc. It seems like almost every major radiology vendor is offering some type of solution to help reduce dose, but what many radiology professionals are finding is that there is no one purchase that they can make that is going to address all of their needs in this area.

Effective dose optimization is best accomplished using a multifaceted approach. All of the following are important aspects of a successful dose optimization strategy and it is important to not leave any of these items out of a dose reduction effort:

- Optimization of clinical exam protocols
- Ensuring proper operation of equipment dose reduction features
- Verification of scanner dose readings
- Tracking of doses to patients
- Setting of dose action limits and thresholds
- Consideration of alternate modalities, such as ultrasound and MRI
- Reducing the number of repeated and unnecessary exams
- Training of technologists, radiologists, and physicists in dose reduction
- Augmentation of site policies and procedures
- Investigation of new hardware and software options and equipment

- Feedback to continually improve and refine the practice.

Responsible facility radiology personnel should take some time to educate themselves about the expectations and standards for a successful dose reduction program. Joint Commission Sentinel Event Alert 47 (available on The Joint Commission website) is a particularly excellent resource to start with and the ACR, Image Gently, and Image Wisely websites also have excellent materials to get started. If all this information begins to feel overwhelming, spread out the burden by taking this first important step: establish a dose reduction committee. This committee should be composed of (at a minimum) the radiology administrator or center manager, the chief or supervising radiologist, the diagnostic medical physicist, and the chief technologist for each x-ray based modality. Keep in mind that good diagnostic medical physicists, whether in-house or consulting, should be fully apprised of all dose related regulations in the state as well as any accreditation body requirements and guidelines that apply to the facility. They should also be specifically trained on dose optimization for all modalities, but a specific inquiry about this should be made and if they have not had dose optimization training sponsored by the American Association of Physicists in Medicine (AAPM), they should get it as soon as possible. Medical physicists go to school for years to learn about radiation dose; as such, they are an important resource and should take a leading role in the dose reduction effort.

Once the dose reduction committee has been formed, the next step is to assign responsibilities and set a timeline. Establishing a healthy dose reduction program at most facilities is about a one year project, with some larger or more complex facilities taking up to two years. With respect to assigning responsibilities, if there is an in-house diagnostic medical physicist (not a therapy medical physicist, as therapy physicists typically are not trained for imaging equipment dose measurement or imaging protocol optimization), then this person should take the lead on the technical aspects of this effort. The supervising radiologist must be involved to approve protocol changes as well as needed changes to policies and procedures, and the technologist must also be involved in important procedural and clinical practice changes. However, the medical physicist is typically the most equipped by education and experience to recommend the specific protocol changes, set dose action limits, verify indicated scanner doses, train other staff on radiation dose, etc.

If, like most facilities, a consulting diagnostic medical physicist is used for periodic equipment testing, that person *may* be equipped to provide this type of sophisticated consultative service. Ask them whether they have helped design dose reduction programs for other clients. If so, speak to those clients to see how it went. Ask the physicist if he has attended an AAPM sponsored dose optimization course. Has he optimized CT protocols before? Does he have example policies and procedures for dose reduction topics (this can save many hours of development time)? Does he have dose reduction training materials to train technologists and radiologists? It should be evident in a short conversation whether the physicist is highly experienced at this type of effort or not. If not, contact an individual or firm with these capabilities, as this type of project is probably not a good time for on-the-job training by a less experienced physicist.

Once responsibilities have been assigned and a timeline set, then what? First, start by quantifying the patient doses by exam type before any actions are taken (ie, "baselining"). The degree of progress made won't be known if this is not done at the outset. The medical physicist should be able to measure and document the doses currently being put into various sized patients, including pediatric patients. Second, if the facility has CT, start with CT. And then move onto fluoroscopy and radiography at the appropriate time. CT is where most facilities generate the highest aggregate dose to their patients and it is a modality where there is the greatest amount of reference material and information to reduce doses.[8] It is also the most technically challenging, but the upside to that is that at least once CT is addressed successfully, the other modalities will seem much easier by comparison. If the facility does not have CT, address fluoroscopy first. Third, before spending thousands, tens of thousands, or hundreds of thousands of dollars on new hardware and/or software, make sure existing hardware and software is being used optimally. Many facilities do not properly use all of the dose reduction features built into their equipment. This may be caused by technologists who did not get applications training, or by a misunderstanding of the features and when they should be used. Also, before jumping straight to capital investments in new technology, go after the low hanging fruit first. Get protocols optimized, analyze and reduce repeat exams, and provide feedback and training to referring physicians to prescribe imaging exams appropriately. The dose savings these steps produce can be amazing. Fourth, if new hardware or software is purchased to further lower (or track) doses, consider consulting an objective third party expert during the selection process to help validate the options from a technical standpoint. Consulting physicists have typically worked with many hardware and software platforms and may have some opinions on what systems may be best for a facility's particular needs. Fifth, and lastly, if patient dose tracking software is purchased, please be aware that it won't run itself. This software can be amazing and produce reams of fantastic information to help improve the dose reduction program, but someone is going to need to be analyzing all of that data and determining how to use it to iteratively improve the radiation dose reduction program. If there is an in-house physicist, that person will need substantial time to do this analysis and decide how to use the information it produces. If there is a consulting physicist,

discuss with that person the additional services to take on that role at the facility. Facilities sometimes assign this role to a technologist or radiologist, but those individuals in many cases have neither the time nor the desire to delve into the data analysis that this role requires.

Once the dose reduction program is up and running, its results can be maximized by ensuring that two other important steps are taken: 1) Educating key stakeholders about the program; and 2) Communicating the existence, purpose and results of the program to patients and the surrounding community. For the purposes of this article, "key stakeholders" includes healthcare industry personnel internal and external to the facility who can affect, or be affected by, the dose reduction program. This group includes technologists, radiologists, emergency department physicians and referring physicians (ie, all of those professionals who prescribe, execute, or interpret x-ray based diagnostic imaging). This group also includes senior facility management who need to understand the basic function and impact of the program to patient safety to help them make informed high level decisions that may impact the program.

A variety of options exist to train these various stakeholders, and the form and content of that training will be necessarily different depending on the person's job function. Technologists, for example, will need to understand the operational details of the program including additional actions or steps that they need to take to ensure correct protocols are used, new protocols are properly reviewed, dose reduction features are used properly, patients are positioned optimally, patient doses are recorded, etc. Radiologists need to understand their roles in the program and potentially help create training materials, feedback, or guidance for referring physicians that are prescribing exams at the facility. These referring physicians can have an enormous impact on the success of the dose reduction effort and need to be brought in to the process and their roles carefully considered. Should materials or guides be created to help advise them on proper imaging exam prescription? Should they receive training on ACR appropriateness criteria? Is there a standing method for them to contact a facility radiologist if they would like assistance with prescribing the correct exam or if they have concerns about their patients receiving too many x-ray based imaging exams? The facility will need to address these types of questions to ensure that the gains achieved through enhancing hardware, software, protocols, positioning, etc are not undone by poor prescribing behavior.

Communicating the existence, purpose and results of the program to patients and the surrounding community is also a valuable undertaking. Not only will this show these individuals that the facility cares about its patients and is doing something to protect them; it will also give them peace of mind that they, and their families, are not being overexposed, potentially reducing the anxiety that many patients demonstrate. This communication can take many forms, from brochures about the program given to radiology patients, to facility signage, website information, and even television and radio advertisements. In all of these avenues, once the program has operated for a sufficient amount of time and has solid data to draw from, the facility's diagnostic medical physicist should be able to provide accurate numbers for achieved dose reductions. These results can be presented in a variety of ways, from simple to complex, for all modalities or one. The main consideration is to ensure that the data are accurate and that the technical wording is precise but also easy to understand.

In the end, for a dose reduction program to be considered truly world class, it needs to reduce patient doses to the maximum extent possible, while still ensuring that image quality is maintained at a level that permits reliable clinical diagnoses. It needs to include all those stakeholders who can impact dose to patients and the surrounding community needs to be informed about these efforts. For all of this to happen, patient radiation safety must be prioritized in the facility such that adequate staffing, operations, and fiscal support are provided to the program to allow it to succeed. Of course, even when this commitment is made, the actual process of creating a world class dose reduction program is a challenging and complex endeavor. However, by assembling the right personnel, becoming educated on the essential elements of a strong program, and working diligently towards the goal in a structured and logical manner, just such a program can be created.

References

[1]H.R.4302—Protecting Access to Medicare Act of 2014, enacted April 1, 2014.

[2]California Senate Bill 1237, enacted September 29, 2010. http://www.westphysics.com/category/regulatory-updates/

[3]Texas Regulatory Changes to 25 TAC 289.227, effective May 1, 2013. http://www.westphysics.com/category/regulatory-updates/

[4]Connecticut Bill 6423, proposed January, 2013. http://www.cga.ct.gov/2013/TOB/H/2013HB-06423-R00-HB.htm

[5]Joint Commission Diagnostic Imaging Services Pre-Publication Standards, released December 23, 2013.

[6]American College of Radiology Accreditation Standards (CT), updated 2013; www.acr.org/Quality-Safety/Accreditation/CT

[7]Intersocietal Accreditation Commission Accreditation Standards (CT), updated July 2013; www.intersocietal.org/ct/

[8]National Council on Radiation Protection and Measurements. Ionizing radiation exposure of the population of the United States (NCRP Report No 160). Bethesda, Md: National Council on Radiation Protection and Measurements; 2009.

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