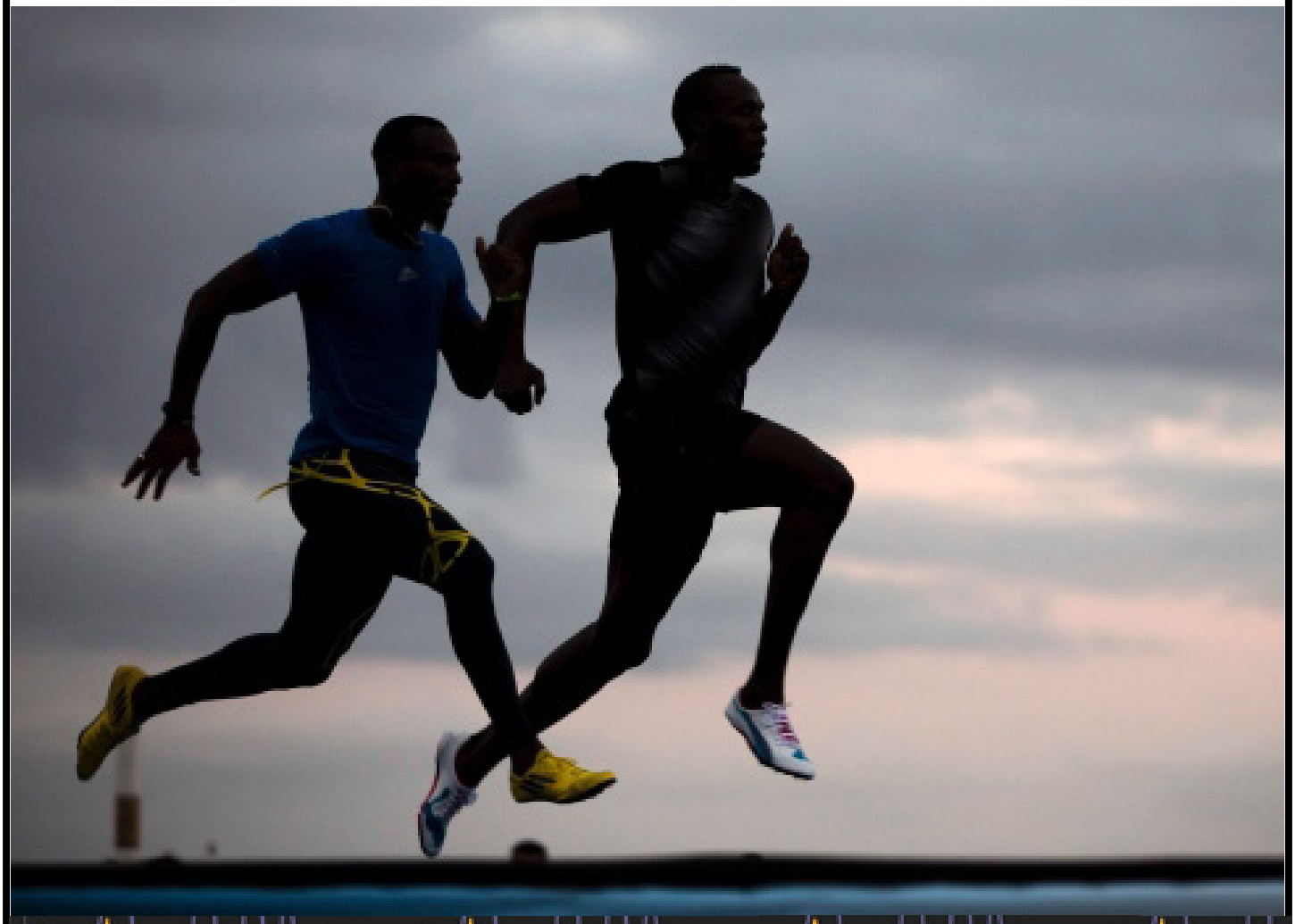
Radiation Dose

Track - Monitor & Lower



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When it comes to CT Radiation Dose there are three questions you should be asking....

1) Are you prepared for mandatory CT Dose Tracking?

2) Do you have the ability to lower the dose on your existing CT Scanners to ALARA Standards?

3) What if you could take your CT dose below ALARA Standards while maintaining superior image quality? Would you?

If you answer Yes to all three questions then you are ahead of the game as they say. If not read on.....

Table of Contents

1. Radiation Dose
2. Tracking Radiation
3. A system for tracking & monitoring
4. Are you prepared for mandatory CT dose tracking?
5. Role of iterative reconstruction technique for low dose CT
6. Trends: Managing and Reducing CT Radiation Doses
7. Q & A: How one practice achieved extreme low dose
8. A successful dose management strategy takes teamwork
9. SafeCT an iterative reconstruction solution
10. Costs & Solutions for tracking & lowering with a 16 slice CT Scanner

Radiation Dose

Most people have taken the steps to lower their dose according to the CAPABILITIES of their existing CT Scanners. This includes lowering mAs, kVp, reducing scan length, center positioning the patient, throwing out the non-contrast studies etc.

The truth is: ALARA STANDARDS ARE NOT ALL THAT HARD TO ACHIEVE FOR MOST CT's. It is only by adding an iterative image reconstruction (IR) algorithm that you can achieve really low dose and maintain the quality of your images.

There are over 80,000,000 CT Scans performed in the United States every year, that is the equivalent of 1 scan for every four people.

There is a 1 in 1,000 chance of developing cancer from radiation exposure associated with a CT Scan.

This is in the NEWS:

HARVARD MEDICAL SCHOOL

James H Thrall MD Radiologist-in-Chief. Mass. General Hospital
Juan M Taveras Professor of Radiology Harvard Medical School

MGH 1811 MASSACHUSETTS GENERAL HOSPITAL

Concerns about radiation risk on the part of the public, physicians, regulators and legislators represent the number one non-fiscal challenge to the future of radiology.

Tracking Radiation

Now is the time to implement a radiation dose tracking, monitoring and recording solution in your medical facility. Recently mandated laws, along with heightened patient demand for reducing the risk of radiation overexposure, has pushed this topic into news headlines. The Joint Commission's recent issue of a "Sentinel Alert" stating that there is reason for concern regarding heightened use of medical radiation exposure has further raise awareness. It is not a question of 'if' a radiation dose tracking system should be installed, it is a matter of 'when'.

The time is approaching when hospitals nationwide will be required to track hospital radiation. California, Texas and Connecticut are three of the first states to implement this mandate. It is important to know that the process of implementing radiation dosage tracking systems can be very involved and expensive. Now is time to explore what alternatives are available.

Radiation monitoring involves tracking and recording the amounts of radiation a patient is exposed to through medical examinations. Systematically tracking and recording your patient's radiation exposure levels will inform you when a patient is at risk for overexposure.

The prevention of radiation overdose before it occurs can protect against patient liability issues. A radiation dose tracking system can tell when overexposure becomes a possibility, allowing the doctor or physician to act accordingly.

Dose tracking, monitoring, and reporting are more complex than one might think. Procedures that expose patients to radiation include basic radiographic x-ray film and digital radiography, CT Scan, cardiac catherization, angiography studies and fluoroscopy. Many older analog machines do not report dose and some newer machines make obtaining dose information sort of like reading Egyptian hieroglyphics. Anytime a program that encompasses so many varied procedures and crosses departments is implemented, there are enormous institutional implementation issues.

Several mainstream dose tracking, monitoring and reporting programs are very expensive and intrusive to already existing IT structures.

What to do? Look at at "SafeCT Dose" Reporting program that overcomes many of these roadblocks.

Are you prepared for mandatory CT dose tracking?

Dose Monitoring & Reporting Capability of SafeCT

SafeCT® Dose Reporting is an extension of SafeCT iterative image reconstruction product line.
It is the industry's first and only product to provide dose monitoring/reporting along with low-dose CT image enhancement in one solution.

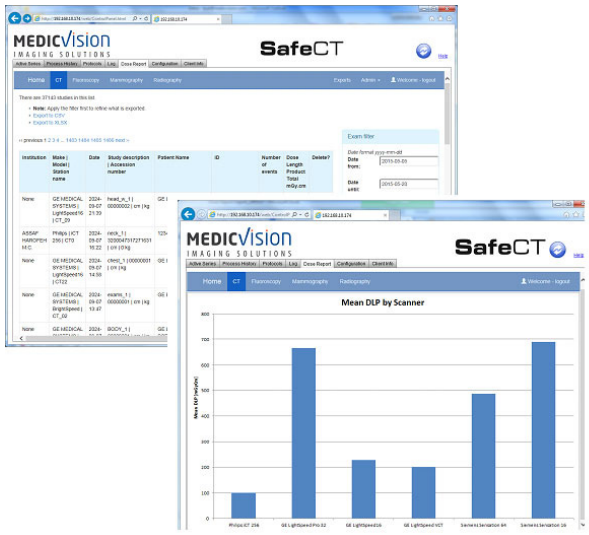
SafeCT Dose Reporting is a single software platform that enables compliance with the CT dose monitoring and reporting standards as required by The Joint Commission by July 1, 2015.
It continuously captures dose information directly from the CT scanner and saves it to a database for easy retrieval and analysis. Reports can be generated by as needed – per patient, per day, per procedure.

Main features:

- Compliance with The Joint Commission Dose Reporting requirements
- Automatic collection of radiation data from all CT scanners
- Generates RDSRs (radiation dose structured reports) that can be sent to ACR DIR
- Supports CT scanners of all vendors and models
- Generates and exports reports based on user-defined filters (e.g. dates, site, scanner, patient)
- Graphical display and analytics of dose data
- Alerts in case of overdose

SafeCT Dose Reporting has already been implemented by healthcare facilities in the U.S. Available to both existing and new Medic Vision customers; SafeCT Dose Reporting is an enhancement to the existing SafeCT product. It can be used in conjunction with the Safe CT low-dose CT image enhancement solution, or as a stand-alone dose reporting system.

SafeCT Dose Reporting is distributed by local USA distributors.



Role of Iterative Reconstruction Technique for Low-dose CT

Case Study: Role of image-based iterative reconstruction technique for low radiation dose chest CT examination

Sarvenaz Pourjabbar, MD; Ranish Deedar Ali Khawaja, MD; Sarabjeet Singh,MD; Atul Padole, MD; Diego Lira, MD; Mannudeep Kalra, MD

Summary

A 50-year-old male weighing 80 kg (body mass index: 22 kg/m2) underwent follow up chest CT for further evaluation of indeterminate focal ground glass opacity in the right lower lobe. The patient had symptoms of shortness of breath, fatigue, chest pain and pressure with exertion that were unrelated to coronary artery disease. In addition, the patient had history of progressive muscular weakness and difficulty in walking, for which a skeletal muscle biopsy was performed and revealed chronic neuropathic myopathy. The patient was suspected to have paraneoplastic syndrome and for which he underwent the initial chest and abdominal CT.

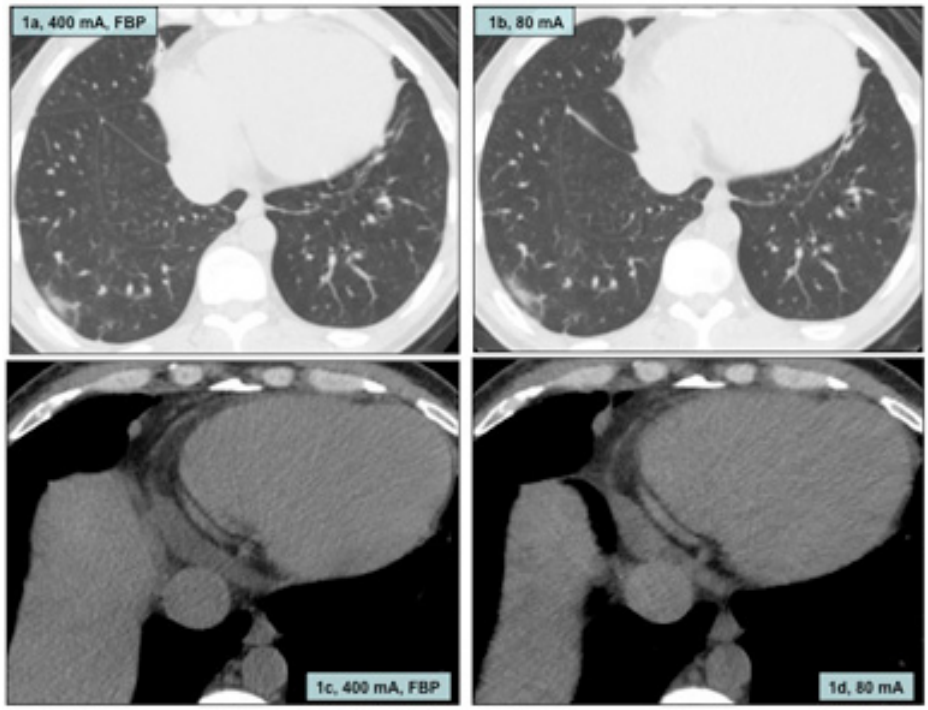
Diagnosis

Pneumonia or aspiration. Given resolution of the focal opacity in the right lower lobe, the finding likely represented a small focus of pneumonia or aspiration.

Findings

At the time of follow up chest CT, written informed consent was obtained from the patient for acquiring a low dose CT image series in addition to the standard of care chest CT. Standard of care chest CT was acquired on a 64-section multidetector-row CT scanner (Discovery 750HD, GE Healthcare) at 400 mA. Immediately after the standard, we acquired low dose CT images over a 10 cm scan length in the mid chest and reduced tube current of 80 mA. Other scan parameters were held identical to the standard of care CT at 120 kV, pitch of 0.984:1, table speed 40 mm per rotation, 64*0.625 mm detector configuration, and 0.5 second gantry rotation time. All standard of care and research images were reconstructed at 2.5 mm section thickness and 2.5 mm section increment using detail reconstruction algorithm using conventional filtered back projection technique. The volume CT dose index (CTDIvol) for standard of care and research low dose CT series was 15 mGy and 3.4 mGy, respectively, resulting in 75% radiation dose reduction. The research images were then processed with SafeCT algorithm (MedicVision Inc., Israel) in order to improve the image quality.

SafeCT processed low dose CT images (Figure 1) at 75% lower radiation dose were then compared with the standard of care CT images. Both the processed low dose and unprocessed standard of care CT images demonstrated patchy ground glass opacity in the superior segment of the right lower lobe. No significant mediastinal or hilar lymphadenopathy was noted on either set of images. Diagnostic confidence and image quality on both sets of images were identical. Subsequent follow up chest CT showed interval resolution of the ground glass opacity in the right lower lobe.



Discussion

Several studies have evaluated strategies to reduce radiation dose from CT such with reduction of tube potential and tube current, and with improvement in image quality of low radiation dose images with image noise reduction filters and iterative reconstruction techniques [1-4]. Iterative reconstruction algorithms reduce image noise while maintaining or improving other image attributes (such as sharpness and contrast) in the low dose CT images [5-9]. The Food and Drug Administration (FDA) approved three-dimensional (3D) image-based iterative reconstruction algorithm, SafeCT (MedicVision, Israel) used in our study segments CT images into 3D patches to estimate the noise statistics and signal. Then, images are processed in an iterative loop to reach an acceptable quality [10]. Since this process takes place entirely in DICOM image domain, it can process images from any CT vendor and takes few seconds to process a routine CT examination. Generally, SafeCT image processing server lies between the CT scanner and the PACS so that images are processed with SafeCT when they arrive to the interpretation workstations in an automatic manner [10].

The example presented in this article demonstrates significant potential of image based iterative reconstruction techniques such as SafeCT for dose reduction while retaining the image quality and diagnostic information.

Conclusion

Radiation dose reduction for chest CT is important and feasible with use of iterative reconstruction techniques, which help improve image quality of low dose CT images.

Figure legend

Figure 1: Follow up chest CT examination was performed at standard (400 mA, fig 1a and 1c) and low dose (80 mA, fig 1b and 1d) and the low dose images were processed with image based iterative reconstruction technique. Lung window shows ground glass opacity in right lower lobe in transverse chest CT images at both dose levels as well as the pericardium in the mediastinal window settings.

Trends: Managing and Reducing CT Radiation

It is well known that CT procedures provide valuable and irreplaceable diagnostic information for patients. CT volumes are on the rise— with more than 62 million scans performed each year. However, with this increase in utilization, there is a growing concern about the cumulative radiation dose to the general population.

A recent article in the "Journal of the America College of Radiology/Vol. 9 11 November 2012 by John O. Johnson, MD and Jon M. Robins, MD" provided a thorough examination of the risks of CT Radiation Doses and the strategies that are being incorporated to combat that risk. While it's impossible to provide you with all of the valuable information in the article, here are some of the highlights. However, any CT provider should review the article in its entirety. It's a great resource to help you prepare for 2014 and beyond.

Increased scan volumes equate to increased radiation exposure to the general patient population and healthcare professional team. Unfortunately, that also theoretically equates to increased cancer risks to those receiving CT scans. In fact, 0.7%-2.0% of future cancers may be attributable to CT scans. This risk increases for children, since they are more radiation sensitive and have longer post radiation life spans. With four million CT scans being performed on children each year, concerns about radiation exposure are warranted. For every 1,000 patients that receive a 10-mSv exposure, one excess cancer can be predicted.

As a result, radiation specialists have recognized the need to minimize radiation dose exposure during CT scans. They are quickly adopting new strategies to reduce patient dose while maintaining diagnostic image quality. The good news is that these new strategies can be simple, reproducible and inexpensive to implement.

New radiation dose reduction strategies include:

- Redesigning CT acquisition protocols
- Adjusting CT doses based on each patient's Body Mass Index (BMI)
- Limiting the length of CT scan coverage
- Revisiting how we administer multi-phase examinations
- Implementing iterative reconstruction hardware/software

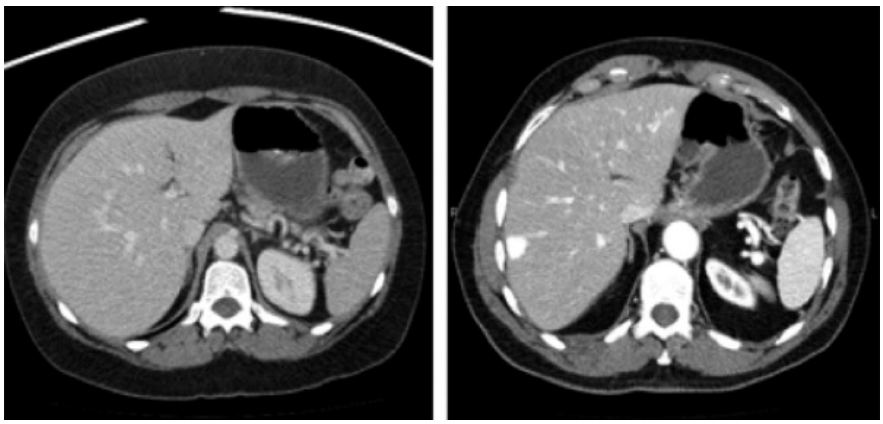


Fig 1. *Peak kilovoltage, 120 kVp vs 100 kVp. The image on left was obtained at standard 120 kVp. The axial image on the right was obtained at 100 kVp. Note comparable image quality with expected increased image contrast at reduced peak kilovoltage.*

Let's take a look at some specifics outlined in this informative article.

Decreased Peak Kilovoltage is very valuable tool, but can be tricky because changing kilovoltage (kVp) has a non-linear effect on radiation dose reduction. For example, while "normal" kVp for an adult is 120, we also know that adults vary in size. However, by using a patient's Body Mass Index (BMI) to determine the patient size, you can accurately adjust and optimize kVp to maximize dose reduction.

Automatic Dose Modulation: Most all-modern CT scanners have the ability to automatically adjust x-ray tube current (mA) on the basis of each patient's size and shape (auto-mA). It's important to have an understanding of the amount of noise allowed for defining auto-mA parameters, depending on the vendors and types of CTs you use. As noise allowance is increased, the mA and dose are decreased. Having an understanding of the relationship between allowed system noise and how it effects auto-mA and dose will allow you to increase the amount of noise used for auto-mA and to decrease mA and patient dose—all while maintaining diagnostic image quality. Just remember, the noise values may be different on each type of scanner you use, plus each scanner must be "tuned" to achieve the required dose reduction goals.

Decreased Length of Scan Coverage: The length of CT acquisition is directly proportional to CT dose. Because of this, it is important to limit the length of each scan (z-axis) and the number of phases (arterial, venous, delayed) so that only the anatomy of clinical interest is included in the scan.

Pitch: It's important to evaluate pitch adjustments. The faster the pitch, the lower the amount of radiation dose delivered. Pitch optimization should be discussed with the manufacturer's CT Applications Specialist. Ideally, pitch should be greater than 1.

Create Limitations on Double Scans and Multi-Phase Studies: Whenever possible, eliminate studies without contrast because no-contrast scans often provide little additional diagnostic information and actually increase patient dose and overall exam cost. You should also consider eliminating no-contrast scans in multi-phase examinations for the same reasons.

Iterative Reconstruction Hardware & Software / SafeCT: Iterative Reconstruction (IR) is the newest method of CT image reconstruction. It's a highly effective method of reducing image noise and also has the ability to routinely reduce patient dose by 40% to 50%. SafeCT is a major component in an overall CT dose management solution. SafeCT Iterative Image Reconstruction should be employed with "Smart CT Protocols" such as kVp changes, automatic dose modulation (auto-mA), limited scan coverage and multi-phase considerations etc. in order to optimize dose savings. Adding an IR solution like SafeCT is the biggest single step a CT provider can take to effectively achieve their greatest dose savings.

Comprehensive CT Dose Management Implementation requires:

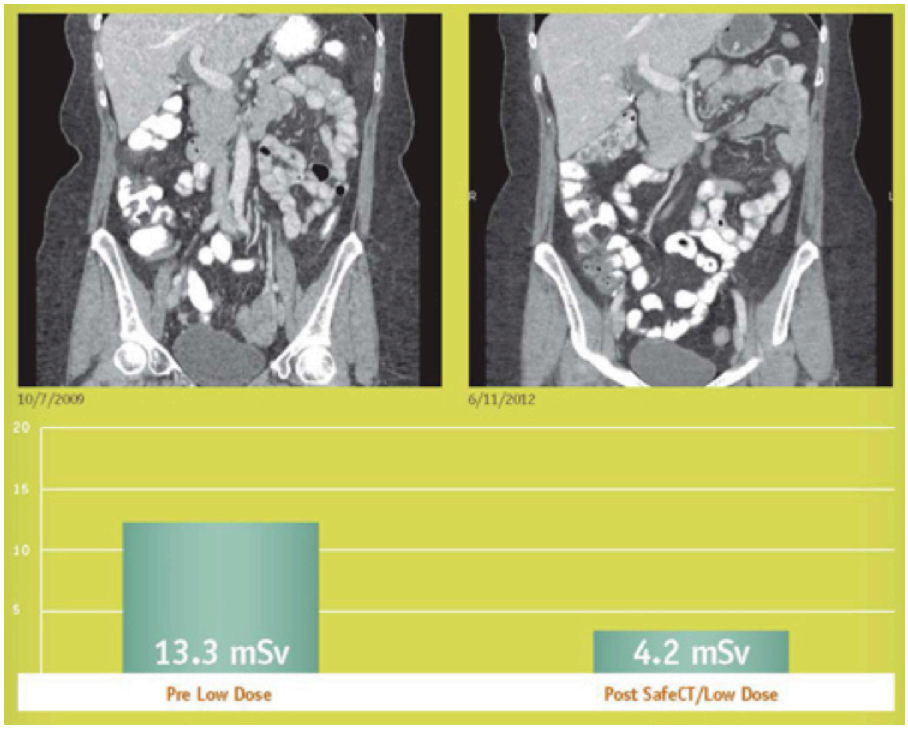
- Dedicated, committed and focused leadership
- All members of the organization need to agree that CT dose reduction is a major goal.
- All CT acquisition protocols must be examined and revised to focus on radiation reduction.
- The process requires a team consisting of a lead CT Radiologist, lead CT Technologist, a Physicist / Radiation Safety Officer, a Champion at the Administrative level and vendor CT Application Specialists
- A continuous feedback loop and processes must be in place to educate staff members and to audit each CT scanner's compliance.

A unified commitment to a cohesive strategy is the first and most important step in reducing radiation doses.

Q & A: How One Practice Achieved Extreme Low Dose

by Whitney L.J. Howell

Since August, **Imaging Healthcare Specialists (IHS)** in San Diego has achieved what they say is one of the lowest dose levels for CT scans nationwide, in some cases reducing exposure by 90 percent. IHS chief executive officer Jon Robins, MD, credits the practice's long-standing tradition of being an early adopter of technology with this success. Last fall, the practice paired iterative reconstruction software with industry dose guidelines. Now, an abdominal CT scan with and without IV contrast, for example, now averages a dose of 3.5 to 5 mSv, compared with 11 to 13 mSv, Robins said. Diagnostic Imaging spoke with Robins about how they did it and the impact on the practice.



Why did IHS pursue such a low-dose business model?

After the series of accidental and exceptionally high over-exposures that gained national attention, we, and all other responsible radiology practices re-examined our methods and asked ourselves piercing questions. Why do we use the levels we do, and are those levels necessary? Would there be ways to do what we do without significant technical changes and still reduce dose? We evaluated all the premises behind what we do, and we realized that, using all the same equipment, that there were many things we could do to preserve image quality and value while reducing dose.

This became a national goal through the American College of Radiology's Image Gently and Image Wisely campaign, but we did it earlier and in a way that resulted in significantly reducing dose without any sense at all of compromising what we do.

How has this impacted how your practice lowers doses?

Iterative reconstruction is actually a new capability that makes it possible to diminish dose and still end up with the same quality exam. Our dilemma was whether to purchase new scanners that had this ability or to use add-on software that would allow us to avoid the three- to five-year phase-in period that many practices have when faced with acquiring new technology. We found a product called Safe CT, and we put it in a central location so all our CT scanners could link to it. The ACR put their Dose Index Registry in place, and we just received our first six month report. We are at the absolutely lowest end of dose in the country.

From a practice management perspective, how have these changes affected your staff, workflow, and patient relations?

Internally, this hasn't, in any meaningful way, negatively impacted our business model or the services we provide to patients. It hasn't raised our costs, and our overhead has remained the same except for the expenditure to acquire the add-on technology. We haven't added additional staff; there's been no lengthening of exams; patients don't have to be prepped differently. It's been seamless and invisible in the background.

How would you advise other practices that are looking to follow what IHS has done?

IHS has a history of being an aggressive early adopter of the technology that we believe in. But the mindset of many people is that the new technology is what they want, but they'll buy it when they need a new scanner. Everyone wants to lower dose, but they have to decide for themselves the timing and how quickly their economic standing will allow them to move. There's no message about the best way to do this. It takes people a while to figure out how and when to make technology changes. Each individual practice has to look at how they would make changes, how they could adopt the available technology, and what they could gain from doing so.

This article was originally from Diagnostic Images Vol No. March 7, 2012

A Successful Dose Management Strategy Takes Teamwork

The utilization of diagnostic radiation is a key part to proper healthcare diagnosis and as such can help save lives. However, the over utilization of ionizing radiation has detrimental and sometimes disastrous effects. In an effort to find the most effective balance, hospitals and imaging centers are considering strategies to design and implement integrated dose reduction across modalities. They have, however, encountered many internal issues. Read on to learn more about the initial steps to take in order to implement a comprehensive CT dose reduction strategy for your hospital or imaging center.

The main issues that must be addressed when implementing a dose reduction strategy tend to be:

- Equipment technology vendor mix
- Different/disparate technologies that use radiation for diagnoses or treatment (radiology is not the only place where radiation is used)
- Standardizing the different interdepartmental policies and protocols that exist throughout an organization
- Education and ongoing training of users across departments with varying levels of knowledge and experience in their jobs

Patients also present their own issues, with their broad mix of diseases and varying levels of "knowledge" regarding the use of radiation. Events presented in the media and misinformation from their non-healthcare peers can create questions and concerns about radiation risk that may or may not be unfounded, but certainly need to be addressed.

Getting Started

The first step is to take an inventory of where your institution is today. What policies and procedures exist with relation to an overall dose management/reduction solution? Define the leadership within the organization that will champion the cause. Then, seek out areas of opportunity on your existing equipment that can be improved and make the easy changes first. This exercise will help you to implement "best practices" with the technology you have today that you may not be taking full advantage of. Specific to CT, do you have the ability to modulate the tube current? Are we scanning according to the patients BMI? Have we optimized the parameters of each type of scan? Evaluate your current technology and determine what can be adapted to meet the current needs. Finally, put in place an educational program that will train new and experienced personnel, as well as an educational program that can address the needs of your patients.

After you've taken these 5 steps, you should be able to answer the following questions: Have you done everything you can with what you have? Are your solutions implemented and consistent across all departments and facilities including radiology, radiation oncology, women's health, outpatient imaging services, the cancer center etc.? Does your training program address the current and forecasted needs of your employees and of your patients?

And finally, are you tracking your progress from today forward on all fronts in dose management and reduction? From the types of exams you perform, to the techniques you use, to the monitoring, recording and tracking of patient dose etc. Have you created a starting point after which you can measure your progress moving forward?

SafeCT®

The Safe Solution

SafeCT is an iterative image reconstruction solution that provides unsurpassed image quality on CT images acquired over a wide range of exposure parameters. It works with all vendor's CTs 4 slices or greater. Some of SafeCT's other benefits include:

- Vendor neutral design, communicate with any PACS or RIS system
- Centralized IT managed solution across all CT scanners / departments / geographic locations
- Fast installation, no downtime, no revenue loss, immediate results
- No departmental change in workflow for radiologist or technologists
- Cost: a fraction of OEM solution iterative reconstruction solutions like ASIR, SAFIRE, AIDR, or iDose
- No need to replace existing CT Scanners

SafeCT Description

Medic Vision's FDA-approved SafeCT is a universal iterative image reconstruction solution that substantially enhances the Signal-to-Noise Ratio (SNR) of CT images acquired over a wide range of exposure parameters on CT scanners of all vendors.

Using proprietary, patented, iterative, volumetric image reconstruction algorithms, SafeCT delivers diagnostic image quality to studies acquired with low-dose protocols on CT scanners of all brands and models. Over 100,000 patients have been scanned so far with low-dose protocols, using SafeCT to improve image quality to diagnostic levels while increasing patient safety.

SafeCT is a centralized network-based add-on system that supports any number of CT scanners, thus offering image enhancement functionality for the entire radiology department in hospitals and private imaging centers or throughout Integrated Delivery Networks(IDNs).

SafeCT is seamlessly integrated into the CT department network. It protects existing CT scanners against obsolescence, eliminating the need for newer and more expensive CT scanners capable of similar functionality.

SafeCT has been clinically validated at leading medical centers such as University of Pittsburgh Medical Center (UPMC, Pittsburgh, PA), Massachusetts General Hospital (MGH, Boston, MA) and Rambam Medical Center (Haifa, Israel). Clinical results have been presented in professional conferences, such as RSNA and ASNR. US FDA clearance and European CE approval were received in 2011. As of May 2013, over 100,000 low-dose CT studies were processed by SafeCT.

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Product Reviews and Publications

In the November 2012 **Journal of the American College of Radiology (JACR)**, Drs. John Johnson and Jon Robins of Imaging Healthcare Specialists (IHS) in San Diego stated: "…SafeCT has been successfully deployed at IHS, with a dramatic reduction in radiation dose while maintaining diagnostic image quality… we have concluded that the combination of smart CT protocols and SafeCT iterative reconstruction is a superior method of dose reduction… dose savings of up to 90% have been achieved in select patients."

In their August 2012 publication of **Health Devices, ECRI** stated: **"SafeCT may offer a more affordable option for facilities looking to provide Iterative Reconstruction (IR)** for a large number of CT scanners, compared to upgrading individual scanners. We highly recommend considering this system for new and existing CT systems that do not already have iterative reconstruction."

"After six months of using SafeCT, we are at the low end of dose in the country without replacing or upgrading a single one of our 11 CT scanners. We have avoided spending hundreds of thousands of dollars on new equipment while delivering the safest and highest quality diagnostic services to our patients. The implementation of the SafeCT technology has been seamless across our practice with rapid acceptance by our technical staff and our referring community."

Jon Robins, MD, Chairman and CEO of Imaging Healthcare Specialists, San Diego, CA., Daily News Update, Advance for Imaging & Radiation Oncology, April 14, 2012.

"SafeCT images were consistently preferred over ASiR-50% (GE Healthcare) reconstructed images of CT examinations obtained at half dose…each of the 4 (experienced radiologists reviewing images from the 83 patient chest study conducted at the center) consistently rated SafeCT reconstructed images as equal or better for appearance of lung parenchyma, artifacts, overall diagnostic acceptability, diagnostic confidence… and general image preference."

Christopher R. Deible, MD, PhD, University of Pittsburgh Medical Center, Pittsburgh, PA., Comparison of Reconstruction Approaches for Improving Low Dose CT images, RSNA Annual Meeting, November 25, 2012.

"When I was introduced to SafeCT, it seemed too good to be true in some respects. It was a relatively affordable product that can go with multiple platforms without affecting my flow of work… Installation was seamless and within a matter of weeks we feel we are now on the cutting edge of low dose technique in our community…We are using it in our musculoskeletal CT practice…CT angiograms as well as virtual colonoscopy."

Michael Shapiro, MD, Medical Arts Radiology, Long Island, NY, Video Recording, February 2013.

To watch the video go to:
http://info.atlantisworldwide.com/blog/bid/272725/SafeCT-Dr-Shapiro-s-Take-on-SafeCT

What does SafeCT cost?

SafeCT licenses are sold on a volume basis. SafeCT pricing is offered as a function of the number of licenses a customer purchases. A SafeCT license for a single scanner starts at less than $70,000.00 and depending on how many licenses a customer purchases, the price per license can quickly become less than $50,000.00 per license.

SafeCT is now offered through the following Group Purchasing Organizations: Premier, the Greater New York Hospital Association (GNYHA), and HealthTrust Purchasing Group (HPG).

Next Steps

Please contact Jeff Weiss for more information. 212-366-9100 x 170 or email jeffweiss@atlantisworldwide.com

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