GE Healthcare

Dose Management

University of Washington Medical Center Combines Technique and Technology to Reduce Radiation Dose
Background

The University of Washington (UW) Medical Center is a nationally renowned academic hospital located in Seattle. In 2013, it rated in the top 10 hospitals in the United States for rehabilitation, cancer, diabetes and endocrinology specialties. Its mission is to improve the health of the public by advancing medical knowledge, providing outstanding primary and specialty care to the community, and preparing tomorrow’s physicians, scientists and other health professionals.

One way the physicians and staff at UW Medical Center are bringing the mission to life is through an unsurpassed dedication and focus on reducing patient radiation dose. Championing the effort within radiology are William P. Shuman, MD, FACR, who serves as Vice Chair and Medical Director, and Kalpana Kanal, PhD, DABR, Director of Diagnostic Physics and Associate Professor at the university. Together, Shuman and Kanal have catapulted the UW Medical Center to the forefront of dose management. They are well-respected advocates for low dose who share their message with other medical professionals through lectures, articles and Dr. Shuman’s Blog on low radiation dose CT (www.lowradiationdosect.net).

Why the focus on dose?

The past decade has witnessed a substantial increase in public awareness around patient radiation exposure, as well as a flurry of activity. Professional societies created and enthusiastically promoted the Image Gently and Image Wisely campaigns. Several states passed legislation requiring tracking of CT dose and recently the Joint Commission released new requirements for monitoring and recording patient exposure.

Still, decreasing and optimizing patient dose isn’t yet a mandatory universal requirement. It takes time, resources and perseverance. There may be significant technical and cultural challenges to surmount. So why does the University of Washington make it a priority? Dr. Shuman points out that “Dose reduction is good for the patient, good for the practice and good for business.” Patients receive the benefit of the exam with lower radiation risk; physicians are confident they’re following best practices; and hospitals with lower radiation dose (and quality diagnostic images) can benefit from marketing their success.

Challenges

A successful dose management program faces a number of hurdles. First, staff need to be onboard with the initiative. It’s not simply another project pushed by technologists, physicists, or physicians. It’s a change in the organizational mindset, “a cultural change driven by leadership,” according to Dr. Shuman. “Cultural change requires department leadership, with leadership in alignment and backed by education.” Participants need to understand the clinical relevance of dose management, grasp the underlying physical principles, and feel confident presenting ideas or raising alerts to each other. Imagine the scenario of a co-pilot reluctant to speak with the pilot about a warning indicator because previous concerns were dismissed out of hand. It’s a scenario to avoid in the air, as well as in the radiology department. Technologists, radiologists and physicists need an environment where they are comfortable raising questions, soliciting feedback from each other and sharing expertise.

Technology, expertise and time are additional challenges that can impact dose management. Dr. Kanal notes that when high exposure accidents have occurred at other facilities, it isn’t due to malevolence, but a combination of ignorance, lack of monitoring, or not using imaging devices appropriately. Providers need technology to help them identify “red flags” early, with informatics systems minimizing the data collection and analysis effort and reporting results to the right people at the right time. Until recently, Dr. Kanal’s team struggled collecting data that was often not easily accessible or required manually intensive processes. Technologists typed study dose indices into the Radiology Information System (RIS) and the department leveraged Dose Check® to help prevent over exposures. Collating and reporting data was a lengthy process, even with a team of four diagnostic physicists. As Dr. Kanal expressed, “If academia has issues, what about non-academic sites?”

Approaches for Success

Speaking from experience, Drs. Shuman and Kanal are upfront that dose management may appear daunting. But it can be a phased process.

Low Hanging Fruit

Controlling acquisition technique is an important and relatively low-cost initial step. “Our first focus was on the easy stuff,” explained Dr. Shuman. “We spent a great deal of time and effort educating technologists on the proper protocols for controlling the z-axis scan length, minimizing the number of phases, applying external body shields and centering patients.” Dr. Kanal also encourages participation in the American College of Radiology’s (ACR) dose index registry, adding “if you do nothing else, invest the money (to join the National Radiology Data Registry) and see where you stand.” Benchmarking your performance allows you to know what changes need to take place. The ACR dose registry allows similar institutions to compare their use of radiation in CT imaging.
Build the Culture

Find or recruit dose champions at leadership levels. At the University of Washington, the chair of radiology is vocal about patient radiation concerns. This impacts the culture of radiology, influences other medical departments and affects decision-making on imaging device purchases. Radiologists are especially important advocates as they can bridge dose discussions with the emergency department, cardiology and referring physicians. Use a combination of logic, reason and data when persuading others to adopt lower dose techniques.

Promote Education

Technologists, physicians and physicists all need continuing education on dose, as well as education on any new technology implementation. Train all appropriate staff (not just technologists) on the latest “bells and whistles” available on installed imaging systems. Dr. Kanal notes, “Techs and radiologists always come to the physicists, who are often the least trained on the software and systems. That’s a big problem for education.” Dr. Shuman added that when working with staff outside radiology, remember to keep the education focused on helping personnel. Provide examples, approaches and things to be aware of. Most importantly, keep the material “digestible”.

Leverage Technology

University of Washington takes pride in being an early technology adopter, noting that it’s a key differentiator between them and their competitors. So, when sub-milliSievert CT imaging became a possibility through the use of Veo, they invested in the capability and have used it extensively. In 2011 they were also the first adopter in the Northwest of a new informatics system called DoseWatch, which provides near real-time collection, evaluation and alerting of patient radiation exposure. Coupling state of the art dose reduction technology with efficient data collection and reporting tools was synergistic, resulting in dose optimization for the patient, timely identification of outliers and reduced staff effort.

Continual Improvement

Dose management isn’t a one time event. It’s a process that must be integrated into the workflow – and it takes time. You won’t be able to optimize all modalities or all protocols at once. But gradually improvements will happen. Focus initially on the devices you can collect data from and then expand.

Dr. Shuman says his team feels compelled to see how low they can reduce radiation exposure to their patients while keeping the exams clinically useful. New imaging equipment has helped drop dose significantly, while DoseWatch has facilitated dose optimization efforts within and outside of radiology.

Actions & Results

Through education, leadership and diligence, Dr. Shuman and Dr. Kanal have initiated changes resulting in dose reduction not only in the radiology department, but throughout the Medical Center. When GE Healthcare introduced DoseWatch in 2011, Dr. Shuman and Dr. Kanal were quick to see the potential value of having a web-based dose monitoring solution that captured, tracked and reported radiation dose statistics across the enterprise. However their intent was not to just measure performance, but to improve it.

DoseWatch implementation is ongoing and so far 22 radiation emitting devices throughout the Medical Center, including CT, interventional systems, mammography and digital radiography have been connected. In addition to DoseWatch, GE Healthcare implemented Veo, a model-based iterative reconstruction product that delivers high-quality CT images with ultra-low dose. ASiR, an image noise-reduction technology, was already widely used at the hospital.

The addition of Veo to the hospital’s low dose strategy is particularly noteworthy, especially as it relates to the Emergency Department (ED). CT is used in the ED to rapidly diagnose and triage patients; but it has been an area of focus in recent years partly due to concerns around overuse. Forty-eight Veo CTE protocols were developed for patients under the age of 45 and communicated to physicians throughout the facility. ED physicians were particularly interested in the technology because it allowed them to be more confident in their choice of imaging modality - knowing their patients could benefit from a CT exam with significantly less patient exposure. Data from DoseWatch supported the case, indicating a greater than 60 percent reduction in some cases. Dr. Shuman observed, “The immediate information DoseWatch provides helps us know if the changes we make are actually improving our dose performance. After all, that’s what is really most important.” Now, ED physicians commonly include specific instructions for the use of Veo on the orders they write for CT exams.

Dr. Kanal credits DoseWatch with markedly improving her ability to analyze dose data by automatically collecting it from devices throughout the Center and presenting the information in a consistent, easy-to-use format that she can quickly review and present to UW’s Radiation Safety Committee. Armed with better information, the team can iteratively lower dose and more easily track and compare data over time. She also points to DoseWatch’s automated alerting feature as a key element in their continuous improvement efforts. She uses the alerts, which are specific to a patient exam, to discuss variances with technologists when they occur. “This immediate feedback has heightened awareness of dose overall and greatly enhances our efforts by enabling us to make quicker changes in protocols or documentation, even outside the radiology department.”
University of Washington experienced an average dose reduction of 40% with ASiR and 64% with Veo across protocols and patients.

VCT DLP of 798 mGy·cm (left) versus HD750 DLP of 378 mGy·cm using ASiR (right). Slightly better image quality on the VCT, but is twice the dose justified?

DoseWatch data provides comparison of CTDI_{vol} for standard protocols and Veo on abdomen/pelvis examinations

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This boxplot shows the CTDI_{vol} (mGy) for various abdomen CT protocols for 2013, quarters 1 and 2. Of specific interest is the comparison of the non-Veo KUB protocol with the Veo-KUB protocol, showing a 50% decrease in the median study CTDI_{vol} (10 mGy to 5 mGy in Q2) as a result of using Veo.
Interventional

The dose management initiative at UW has been all-encompassing, including radiation emitting devices and procedures throughout the Center. The immediate access to dose information provided by DoseWatch has enabled the team to establish a pro-active follow-up process for angiographic patients. This process ensures patient dose levels are monitored and the appropriate workflow is implemented if a 5 Gy threshold is exceeded.

Dose Follow-Up Process for Angiographic Patients

1. Prepare a patient information sheet on skin reactions
2. Establish a dose trigger level for follow-up
3. During case, notify physicians of AK values
4. Review dose & tissue reaction thresholds & combine with LUT with physicians
5. If estimated entrance skin dose of 5Gy is exceeded, physics section notifies the physician in charge of the case and this triggers the follow-up protocol
6. Follow-up involves calling the patient to discuss if any potential skin reaction observed

ACR Dose Registry

UW’s successful dose management is also due in part to the Center’s participation in the American College of Radiology’s (ACR) dose index registry. Dr. Kanal and her team provide the registry with the Center’s dose data, which is stored in a database with data provided by other participating institutions. ACR provides periodic feedback reports comparing UW’s results by body part and exam type to aggregate results. These reports allow them to track their performance and compare their CT dose indices to regional and national values. Dr. Kanal explained that UW has participated in the registry since its inception. She touts the benefits of receiving such valuable information, and believes it helps them make better decisions.

Dr. Shuman and Dr. Kanal have developed a vigorous program using both technique and technology to lower CT dose on many exams by 40-70 percent over the past three years. They are energized about the future of dose informatics and imaging technology, viewing them as essential tools to help physicians make good choices and improve patient outcome and safety.

About Dose Management

A comprehensive dose management program requires a combination of a well-designed low dose strategy, low dose devices and technologies, and the collaborative efforts of the entire imaging team, from the referring physician and technologists operating the equipment to the radiologists reading the scan and medical physicists evaluating protocols. GE Healthcare provides an integrated program of evidence-based best practices that help facilities capture, track, report and monitor radiation dose at the patient level, across the enterprise and integrated with current PACS and RIS. GE’s Dose Management solutions can help collect comprehensive data across facilities and devices; manage risk in hospitals; achieve better value from technology through advanced analytics; and create one ecosystem within the hospital network.

For more information on GE Healthcare’s Dose Management solutions, visit www.doseoptimization.gehealthcare.com

William P. Shuman, MD, FACR  
Vice Chair and Medical Director,  
Department of Radiology  
Professor of Radiology  
University of Washington Medical Center  

Dr. Shuman received his medical degree from the State University of New York in Syracuse, New York. After completing a residency in Diagnostic Radiology at Mary Fletcher Hospital of the University of Vermont in Burlington in 1979, Dr. Shuman went on to complete a two year fellowship in Ultrasound and Computed Tomography at the University of Washington in 1981. Dr. Shuman continued at the University of Washington serving as a Professor in the departments of Radiology, Oncology and Radiation Oncology until 1990. While at the University of Washington, Dr. Shuman then served as the Director of CT (1982 – 1990) and MR (1983 – 1990). Subsequently, he was director of Computed Tomography, U/S and MR at the University of Vermont (1992 – 1995) and continued to hold Clinical positions at the University of Washington and Seattle University. In 1995, Dr. Shuman became the Director of CT/MR/US at Evergreen Hospital Medical Center in Kirkland, WA. In 1997, he was promoted to Medical Director of Evergreen’s Diagnostic Imaging Department and CEO of Radiation Imaging. In 2003, Dr. Shuman returned to the University of Washington to become Professor, Medical Director of Radiology at UW Medical Center, and Vice Chair of the Department of Radiology. His clinical activity is in Body CT and MR and his research interests center around cardiac and dual energy CT. Outside the University of Washington, he is the incoming President of the Society of Computed Body Tomography/ MR and serves on the Radiology Education Alliance of the ACR.

Specialty Certifications -

- Verified Level 3 Experience in Cardiac CT, Society of Cardiovascular Computed Tomography (SCCT)
- Cardiac CT Board Certified, Certification Board of Cardiovascular Computed Tomography (CB CCT)
- Areas of Interest - Body CT/MR

Kalpana Kanal, Ph.D., D.A.B.R.  
Director of Diagnostic Physics,  
Associate Professor  
University of Washington Medical Center  

Kalpana M. Kanal came to the United States to pursue an MS degree in Physics in 1989 and received her MS degree from UT Arlington, Arlington, TX in 1991. She received her PhD in Radiological Sciences from the UT Health Science Center, San Antonio, TX in 1996. After completing the Medical Physics Residency Program at Mayo Clinic, she joined the Department of Radiology at University of Minnesota, in 1998. In 1999, Dr. Kanal was certified by the American Board of Radiology in Diagnostic Radiological Physics. She has been working in the Department of Radiology at the University of Washington since 2000 and is currently Director of Diagnostic Physics and Associate Professor. Dr. Kanal is also chair of the Radiation Safety Committee at University of Washington. She served as Vice-Chair of the AAPM Imaging Physics Curricula Subcommittee before becoming Chair in 2011. She has been course director for CME courses at the AAPM annual meeting and often serves as an Associate Editor of the journal, Medical Physics. Dr. Kanal is currently the chair of the ABR physics core exam and is active professionally in the ABR and ACR. She has published over 30 papers in peer-reviewed journals and has made several scientific presentations throughout her career. She has also been recognized as a fellow by the AAPM, ACR and SCBTMR.
About GE Healthcare
GE Healthcare provides transformational medical technologies and services that are shaping a new age of patient care. Our broad expertise in medical imaging and information technologies, medical diagnostics, patient monitoring systems, drug discovery, biopharmaceutical manufacturing technologies, performance improvement and performance solutions services help our customers to deliver better care to more people around the world at a lower cost. In addition, we partner with healthcare leaders, striving to leverage the global policy change necessary to implement a successful shift to sustainable healthcare systems. Our "healthymagination" vision for the future invites the world to join us on our journey as we continuously develop innovations focused on reducing costs, increasing access and improving quality around the world. Headquartered in the United Kingdom, GE Healthcare is a unit of General Electric Company (NYSE: GE). Worldwide, GE Healthcare employees are committed to serving healthcare professionals and their patients in more than 100 countries. For more information about GE Healthcare, visit our website at www.gehealthcare.com.

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