



University of Wisconsin Develops and Validates Dose Optimized CT Protocols



At the University of Wisconsin - Madison School of Medicine and Public Health, the medical physics and radiology departments have been collaborating with the hospital staff to refine CT imaging protocols in an effort to reduce dose, enable the acquisition of more clinically useful images, and reduce the frequency of repeat scans. According to Myron A. Pozniak, MD, Professor of Radiology and Chief of the Section of Abdominal CT at the University of Wisconsin, the UW protocols have been constantly evolving.

"We have the privilege of working with one of the largest medical physics departments in the world," Dr. Pozniak says. "With their help, we have taken our protocols and modified them so we image gently, but also we image well."

The project has been so successful that the UW is partnering with GE Healthcare to develop these protocols for the benefit of GE CT users. This has the potential to save time and resources for many CT users. A study at the William W. Backus hospital presented at the 2011 annual meeting of the RSNA, revealed that the estimated annual cost of reviewing and optimizing 30 protocols can exceed \$150,000.¹

This release of UW protocols will cover nearly all clinical indications for CT imaging including neuro, MSK, chest, body, vascular, and pediatric. By adjusting the type, amount, and timing of oral and intravenous contrast, as well as modifying patient positioning, and scan and reconstruction parameters, each protocol is optimized to enhance potential for accurate diagnosis of a suspect clinical condition.



Interaction between departments

Over the years as CT scanner complexity increased, Frank Ranallo, PhD, Associate Professor of Medical Physics and Radiology at the University of Wisconsin, became closely involved in protocol development. “I realized there was a great opportunity for improving image quality and also lowering radiation dose.” He has interacted extensively with the radiologists and evaluated numerous parameters for CT image acquisition and reconstruction.

“In most protocols, there are over 30 different technical parameters that can be adjusted and we consider all of them to be fair game for modification,” says Dr. Ranallo. “We start by optimizing the image quality for a particular dose level and then, in collaboration with the radiology faculty, lower the dose to the minimum required for CT imaging that is consistently diagnostic.”

What is truly unique about the UW protocol optimization project is that for each clinical protocol, there are multiple protocol sub-sets tuned-in to patient size: adult (3 sets) and pediatric (5 sets). “With larger patients, image quality can really suffer, and if you try to improve it you quickly get very high radiation doses,” explains Dr. Ranallo. This is the key issue—how to generate diagnostic quality images at a reasonable dose for all size patients.

At many institutions, there is a single set of technical scan parameters per clinical protocol. They then rely on automatic exposure control (AEC), to produce the needed dose modification as patient size varies. That’s a good start. But AEC only varies the mA. UW tweaked multiple settings: kV, mA, rotation time, pitch, slice thickness, viewing window width and level, iterative reconstruction methods, etc., so the end result was maximum dose reduction for specific scanners across the spectrum of body sizes.

“Typically when an institution acquires a new CT scanner they simply take the set of protocols that they’ve been using on their old scanner, copy it over, and start scanning. Some modifications may happen but it really takes time and an understanding of the new scanner’s capabilities to fine-tune those protocols so they can take full advantage of it,” explains Dr. Pozniak. “We are trying to provide those protocols with that scanner. They are optimized, validated and take full advantage of that new scanner, right out of the box.”

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University of Wisconsin Provides Dose Optimized Protocols to GE for Dissemination to CT Users

A first-of-its-kind agreement between the University of Wisconsin School of Medicine and Public Health and GE Healthcare will provide physicians with robust Computed Tomography (CT) protocols. These protocols are designed to reduce radiation dose, acquire clinically useful images, and reduce the rate of repeat scans. Radiologists and physicists at the University of Wisconsin, a recognized leader in imaging, have developed and validated the protocols, and are making them available to GE CT systems users.

"We are excited to share our protocols with current and future GE Healthcare CT centers," said Dr. Myron Pozniak, Professor of Radiology and Chief of the Section of Abdominal CT, UW-Madison. "At the University of Wisconsin, we've built a rigorous process for protocol development and quality control, and these protocols are the result of that process."

"We see this agreement as providing a more comprehensive, robust set of clinically developed and validated protocols to our customers," said Steve Gray, President and CEO of MICT & AW for GE Healthcare. "Knowing that these robust protocols are being developed by a top-notch CT imaging program, and that our CT users can expect protocol updates as the University of Wisconsin continuously improves them, we think is a big advantage and time saver for our customers."

Industry validation

Before the protocols can be turned over to GE, UW Radiology had to become ISO compliant (an industry standard for quality). "For an academic institution to go through this exercise is unusual and I won't deny; it was painful," says Dr. Pozniak. "We hired an ISO specialist to generate formal documentation of our protocol management and optimization framework that we developed organically since our early days of CT." "When the AAPM Medical Physics Practice Guidelines came out for CT protocol management this year,² we were glad to see we were meeting or exceeding all of the AAPM recommendations" says Dr. Timothy Szczykutowicz, PhD, Clinical Medical Physicist.

To ensure that patient exams are accepted internally at the UW Madison, a robust quality assurance procedure had to be set-up. Every exam read by UW radiologists from CT scanners participating in the protocol project is QA'd for image quality. The radiologists leave feedback in the form of "good" or "bad" responses, and if bad provide details as to why the image was not adequate for their needs. To date, over 10,000 unique image quality reviews have been received. "We are able to analyze the performance of our protocols across each of our scanners, for each of our patient sizes", says Dr. Szczykutowicz who is spearheading the compilation and analysis of the QA data.

This QA data lets us take an aggregate view of our protocol performance, and often spurs changes or consultations between the physicists and clinical staff. "That's something that would be hard to do without a robust QA system as our protocol set contains hundreds of protocols, each tuned slightly differently depending on which CT scanner the protocol was written for" says Dr. Szczykutowicz.

An efficient workflow

With so many various protocols, one might think there would be a negative impact on workflow. "Not so," says Dr. Ranallo. "It has actually improved our workflow."



Myron Pozniak, MD, FACR, is Professor of Radiology at the University of Wisconsin Madison. He has been the Chief of Body CT for almost 30 years. He was also Chief of the Body Imaging section. He and the medical physics team have been driving protocol development at the UW for many years.

Dr. Pozniak explains, "The first major advantage is that we tailor the protocol to the particular clinical indication. These are often straightforward (such as a known cancer follow-up) and we only employ a single scan sequence." This eliminates those multiple sequence studies that are not needed for diagnosis. The more sequences performed the more dose the patient gets, and the longer the study takes, he adds.³

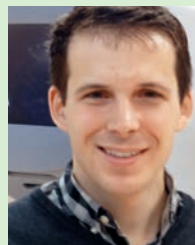
At many centers, the radiologic technologist is left to arbitrarily modify the protocol based on patient weight or BMI. The quality of the scan and dose are then highly dependent on their knowledge and expertise. "That's a big responsibility. We take the guess work out of it," states Dr. Pozniak. "The scanner user interface presents the operator with the different clinical protocols. Once selected and the scout image obtained, the technologist selects the body size-specific protocol based on patient measurements and runs with it. No time is wasted experimenting with the settings and they are done right."

Additionally, with timely advanced radiologist protocoling (motivated by insurance pre-approval process), the technologists know exactly how long the patient preparation and the CT scan will take. This benefits patient scheduling and enables the procedure to be completed more quickly.

At the end of the day, it's all about making a confident diagnosis with an appropriately low dose. "Just a few years ago the primary focus in CT, was on increasing the number of slices and getting better resolution," says Dr. Pozniak. "Now we realize it's time to pull back from the over-pursuit of detail. We want to make the diagnosis accurately, quickly, and do it at an appropriate dose. ■



Frank Ranallo, PhD, is an Associate Professor of Medical Physics and Radiology and has worked as a clinical physicist, teacher, and researcher at the University of Wisconsin – Madison School of Medicine and Public Health for the last 35 years. In the last several years his clinical and research efforts have centered on improving image quality and patient dose in Computed Tomography including the optimization of CT protocols. He directs the UW Radiology Resident's Physics Course and has presented invited talks at the annual AAPM meetings on optimization of CT protocols.



Timothy Szczykutowicz, PhD, is a researcher and clinical imaging physicist at the University of Wisconsin—Madison. His research interests include CT imaging dose modulation techniques. Dr. Szczykutowicz works closely with Dr. Ranallo to optimize the CT protocols

and educate clinicians on features of the CT scanners. Dr. Szczykutowicz also completed an ISO internal auditor course and is responsible for maintaining the ISO compliance and CT protocol QA system.

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