

CT PROTOCOL MANAGEMENT

The UW ADVENTURE



DEPARTMENT OF
RADIOLOGY
University of Wisconsin
School of Medicine and Public Health

THE REALITY OF DOSE REDUCTION EFFORTS

Image Gently Campaign initiated in 2007

Others followed



Retrospective review of outside abdomen/pelvis CTs submitted to UW.

- 500 scans reviewed for:
 - The appropriateness of each phase on the basis of clinical indication and the ACR Appropriateness Criteria
 - Radiation effective dose per phase and total dose

Ionizing radiation in abdominal CT: unindicated multiphase scans are an important source of medically unnecessary exposure. Guite KM, Hinshaw JL, Ranallo FN, Lindstrom MJ, Lee FT Jr. J Am Coll Radiol. 2011 Nov;8(11):756-61.

Unindicated multiphase scans - a big source of medically unnecessary radiation exposure.

- 978 phases were performed in 500 patients
- 35.8% of phases (350 of 978) were unindicated
 - most commonly being delayed series
- Mean effective dose for unindicated phases 13.1 mSv
- Unindicated radiation was 33.3% of total effective dose
- Radiation effective dose >50 mSv in 21.2% of patients

Ionizing radiation in abdominal CT: unindicated multiphase scans are an important source of medically unnecessary exposure. Guite KM, Hinshaw JL, Ranallo FN, Lindstrom MJ, Lee FT Jr. J Am Coll Radiol. 2011 Nov;8(11):756-61.



Vendor Application Specialist Surveys (4)

- Circulated a questionnaire via an internet survey tool.
- 62 respondents
- Responses tabulated 4 months ago



What percentage of practices do you see that have made an attempt to lower dose?

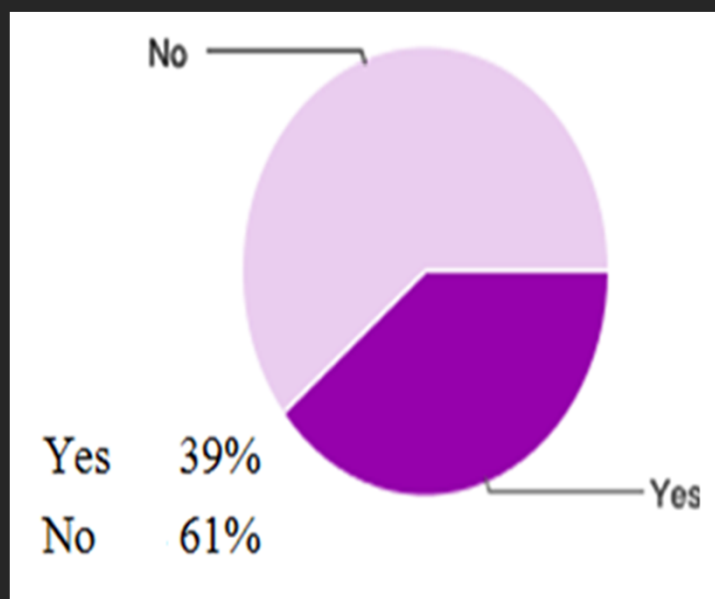
Over 75%

“However getting continuing physician engagement is tough.”

“They tend to set scan parameters at scanner turnover and never look at them again.”

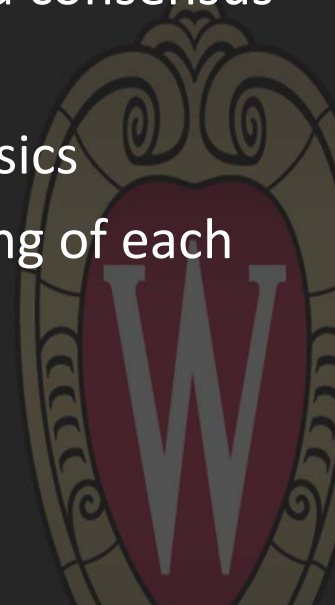


For centers that have Iterative Recon on their scanners, are they using it to full advantage?



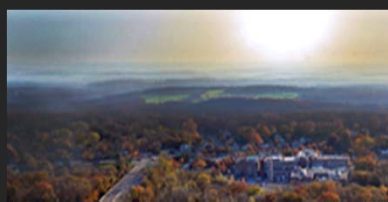
Why is the reality of dose reduction efforts disappointing?

- because it requires a champion and consensus
- it requires a lot of time and \$\$\$
- it requires a strong grasp of CT physics
- it requires a thorough understanding of each of your scanner's capabilities



The cost of protocol development is not trivial.

- Study at William W. Backus Hospital, Norwich, CT.

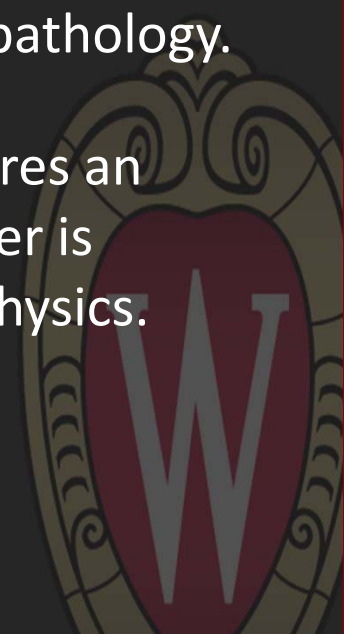


- The annual cost of reviewing and optimizing 30 protocols can exceed \$150,000
- Our own CT protocol process has now exceeded \$1,200,000

(1) Siegelman, Jenifer RQW, and Dustin A. Gress. "Radiology Stewardship and Quality Improvement: The Process and Costs of Implementing a CT Radiation Dose Optimization Committee in a Medium-Sized Community Hospital System." *J Am Coll Radiol.* 2013 Jun;10(6): 416-22.

The two sides of protocol development:

- Managing the **clinical** side requires an understanding of physiology and pathology.
- Managing the **technical** side requires an understanding of how each scanner is engineered and a mastery of CT physics.



There are options for anyone to get protocols

Organizations and Societies

The screenshot displays two web pages. The top page is from the American Association of Physicists in Medicine (AAPM), featuring a navigation menu with 'Purpose', 'FDA Award', 'Questions', 'Role of the QMP', and 'CT Dose-Cl'. Below the menu, it lists 'Available Protocols' and 'Adult Protocols' with several entries, including 'Lung Cancer Screening CT' and 'Routine Adult Chest-Abdomen-Pelvis CT'. The bottom page is from the Image Gently website, titled 'The Alliance for Radiation Safety in Pediatric Imaging'. It features a navigation bar with 'Home', 'What can I do as a...', 'Procedures', 'Current Events', 'Education', and 'FAQs & More'. The main content area is titled 'Computed Tomography' and includes a section for 'New Image Gently "Universal" CT Protocols are now available for Head, Thorax and Abdomen'. To the right, there is a 'Protocols for Imaging Gently' sidebar with a search bar and a list of categories: 'Steps for Radiation Safety in IR - Recommendations', 'Technologists', 'Medical Physicists', and 'Parents'. An image of a child running on a beach is also visible on the Image Gently page.

There are options for anyone to get protocols

Academic Centers

The collage features several overlapping screenshots from academic radiology department websites:

- Massachusetts General Hospital Imaging:** Shows a navigation menu with options like 'Imaging Home', 'The Patient Experience', 'Treatments & Services', and 'Research & Publications'. A prominent article titled 'Reducing Radiation Exposure' is visible, discussing the hospital's efforts since the mid-1990s to minimize radiation dose for adult and child patients, particularly from CT scans.
- Rhode Island Hospital:** Displays a navigation menu with 'Centers & Services' and 'Find A Doctor'. A sidebar lists various imaging services including Diagnostic Imaging (Radiology), General Radiology (X-ray, Fluoroscopy and IVF), Computed Tomography (CT or "CAT" Scan), Interventional Neuroradiology, Magnetic Resonance Imaging (MRI or MR), Nuclear Medicine, PET/CT, Positron Emission Tomography (PET), Ultrasound, and Vascular and Interventional Radiology (Angiography).
- University of Wisconsin Department of Radiology:** Shows a navigation menu with 'EDUCATION', 'RESEARCH', 'SECTIONS', and 'FOR REFERRING CLINICIANS'. A 'Sections' page is visible, featuring a 'Musculoskeletal Imaging and Intervention Home' and a 'Musculoskeletal Section' with a list of 'Imaging Protocols & Scanning Parameters'. The list includes items like 'shoulder', 'elbow', 'wrist', 'spine', 'bony pelvis', 'femoral anteversion', 'knee', 'ankle/foot', and 'reformats', each with a date (e.g., 5/31/11).
- CTisus:** A sidebar menu lists 'Protocols' by manufacturer (General Electric, Siemens, Philips, Toshiba) and 'SLICE COUNTS' (128 Slice, 64 Slice, 16 Slice, Single Detector). It also includes sections for 'PEDIATRIC PROTOCOLS' and 'ANATOMICAL REGIONS'.

Copy and Paste approach is OK but not necessarily the best for your particular scanner.

- Tube heat capacity
- Generator power
- Rotation time limits
- Detector efficiency and array
- Recon algorithms



At the University of Wisconsin, we are also sharing our protocols

...but with a different approach.

We have partnered with a vendor



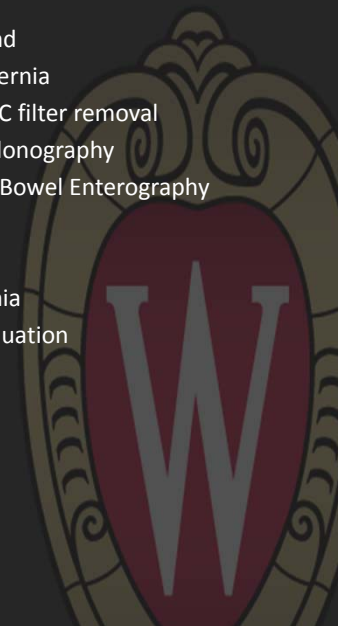
CTs ordered for known or highly suspect clinical conditions benefit from protocols fine-tuned to those issues.

- Patient positioning
- Type, timing, and volume of intravenous contrast
- Type, timing, and volume of oral contrast
- Scan range
- Delayed series
- Additional maneuvers
- Etc.



Abdominal Imaging Protocols - 22

- Neck/Chest/Abd and/or Pelvis
- Chest/Abd and/or Pelvis
- Abdomen and/or Pelvis
- Trauma – Chest/Abd and/or Pelvis
- Trauma – Chest
- Trauma – Abdomen/Pelvis
- Trauma – Penetrating Abdominal Trauma
- Trauma – CT Cystogram (Full Bladder Only)
- CT Cystogram Non-Trauma (Pre & Full Bladder)
- Liver – Biphasic
- Liver – Triphasic
- Liver – HCC
- Liver – Donor Work-up
- Liver – Cholangiocarcinoma
- Pancreas – Neoplasm/Screening
- Pancreas – Neoplasm Pre-Op CTA
- Pancreas – Transplant CTA
- Renal – Flank Pain
- Renal – CT Urography
- Renal – Kidney Tumor
- Renal – Donor
- Abdomen – Adrenal Gland
- Abdomen/Pelvis – R/O hernia
- Abdomen/Pelvis – Pre IVC filter removal
- Abdomen/Pelvis – CT Colonography
- Abdomen/Pelvis – Small Bowel Enterography
- CTA – Obscure GI Bleed
- CTA – Mesenteric Ischemia
- Portosystemic Shunt Evaluation



60 unique clinical protocols after including the other sub-sections

- Abdominal Imaging - 22
- Neuro Imaging - 19
- Pediatric – 10
- Musculoskeletal - 6
- Cardiovascular - 3
- Chest - 2



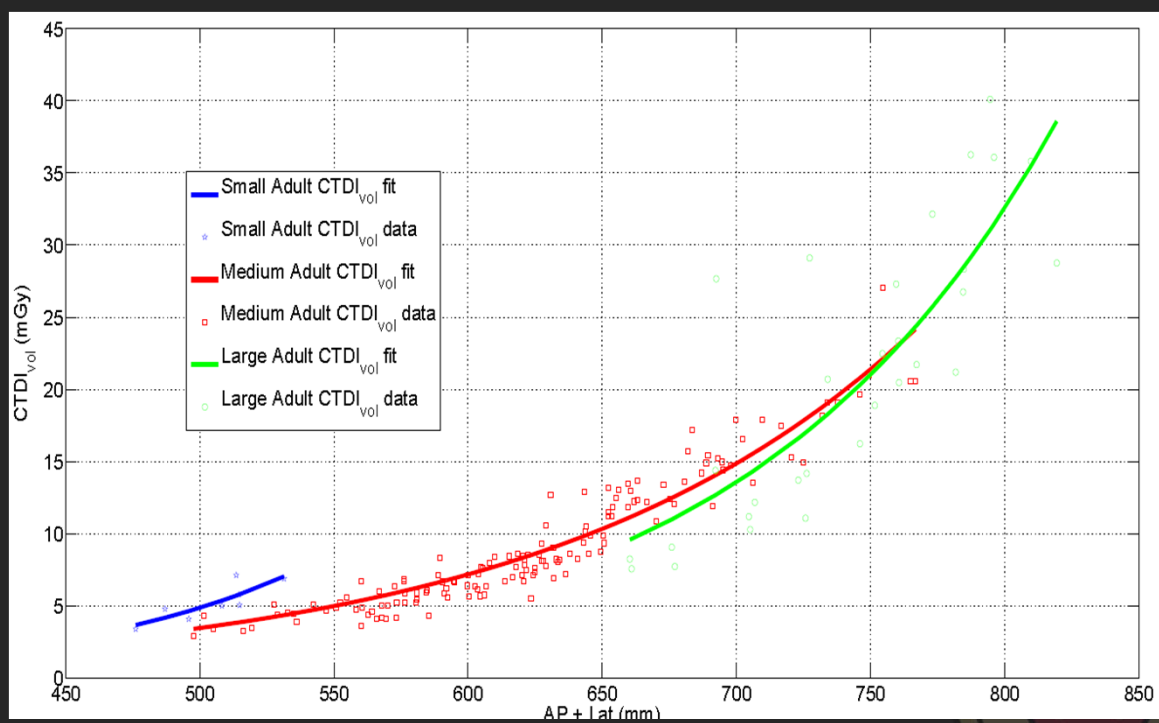
In addition to fine tuning for the clinical indication...

We have tuned the **technical** settings for the range of body habitus:

- Adult (small, medium & large)
- Pediatric (5 size gradations)



Dose curves – Small, Medium & Large



All protocols dealing with the torso are customized to three body sizes:

- Abdominal Imaging - 66
- Neuro Imaging - 27
- Cardiovascular - 6
- Chest - 6



UW CT protocol Optimization:

The image displays a collection of University of Wisconsin Hospital and Clinics CT scan protocols. The protocols are organized into several categories:

- Body Protocols:** Includes protocols for Abdomen/Pelvis, Chest, and various body parts like the head, neck, and spine.
- Chest Protocols:** Details protocols for chest CT scans, including standard and high-resolution techniques.
- CV Protocols:** Covers cardiac and vascular imaging protocols.
- MSK Protocols:** Lists protocols for musculoskeletal imaging, such as the spine, joints, and soft tissue.
- Pediatric Protocols:** Provides specific protocols for children, including Discovery HD 750.
- Neuro Protocols (Adult and Pediatric):** Details protocols for brain, spine, and neurovascular imaging.
- Discovery CT750 High-Resolution/GSI Protocols:** Lists protocols for the Discovery CT750 scanner, including protocols for various body parts and specific techniques like GSI (General Scan Image).

Each protocol document typically includes a title, a list of contents, and a detailed list of parameters such as scan type, contrast use, and technical specifications. A large red watermark 'W' is overlaid on the entire page.

Pediatric protocols - five body sizes

- Pediatric - 50

Musculoskeletal protocols are customized to those joints with metal or without

- Musculoskeletal - 14

Grand total of 219 protocols
Per scanner platform



Fully integrated approach to protocol development...

- UW protocol optimization involves:
 - Radiologists with Subspecialty CT Expertise
 - Manufacturing Engineers & Applications Specialists
 - Medical Physicists
 - UW CT Technologists
 - ISO Consultants

Szczykutowicz, Timothy P., et al. "Compliance with AAPM Practice Guideline 1. a: CT Protocol Management and Review— from the perspective of a university hospital." *Journal of Applied Clinical Medical Physics* 16.2 (2015).



As our vendor relationship evolved we were “introduced” to the ISO 9001 standard.

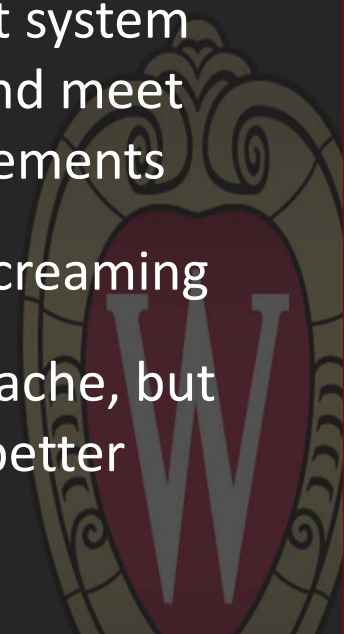


- If we wanted to provide protocols to a vendor, they would have to be validated to an industrial standard



ISO 9001

- Set of standards to help ensure a company's quality management system will meet customer demands and meet statutory and regulatory requirements
- We went into this kicking and screaming
- Lots of paperwork, lots of headache, but in the end these protocols are better

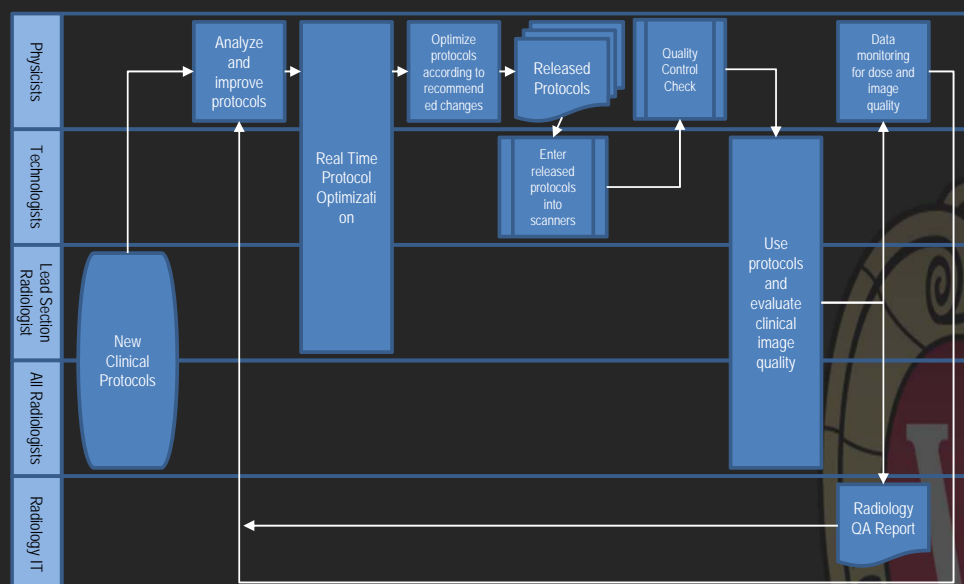


As a result ...

- We created a strict and well defined roadmap for protocol development and modification.
- We collect quality assurance data on EVERY patient exam
 - Most of this with automated IT tools

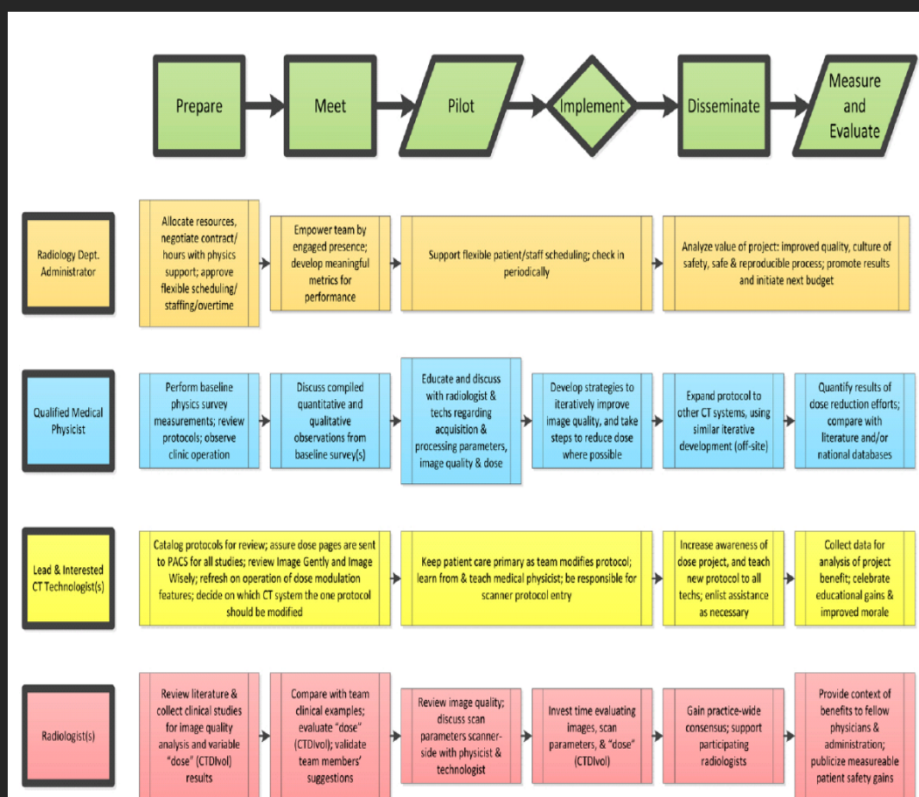
Szczykutowicz T, Ranallo F, Peppler W, Bruce R & Pozniak M 2013 MDCT protocol optimization using an automated it solution providing size specific patient doses, automatic tube current modulation information, and radiologist feedback. Presented at the 2013 RSNA Annual Meeting.

ISO UW Quality process map



Szczykutowicz, Timothy P., et al. "Compliance with AAPM Practice Guideline 1. a: CT Protocol Management and Review—from the perspective of a university hospital." *Journal of Applied Clinical Medical Physics* 16.2 (2015).

AAPM Practice guidelines

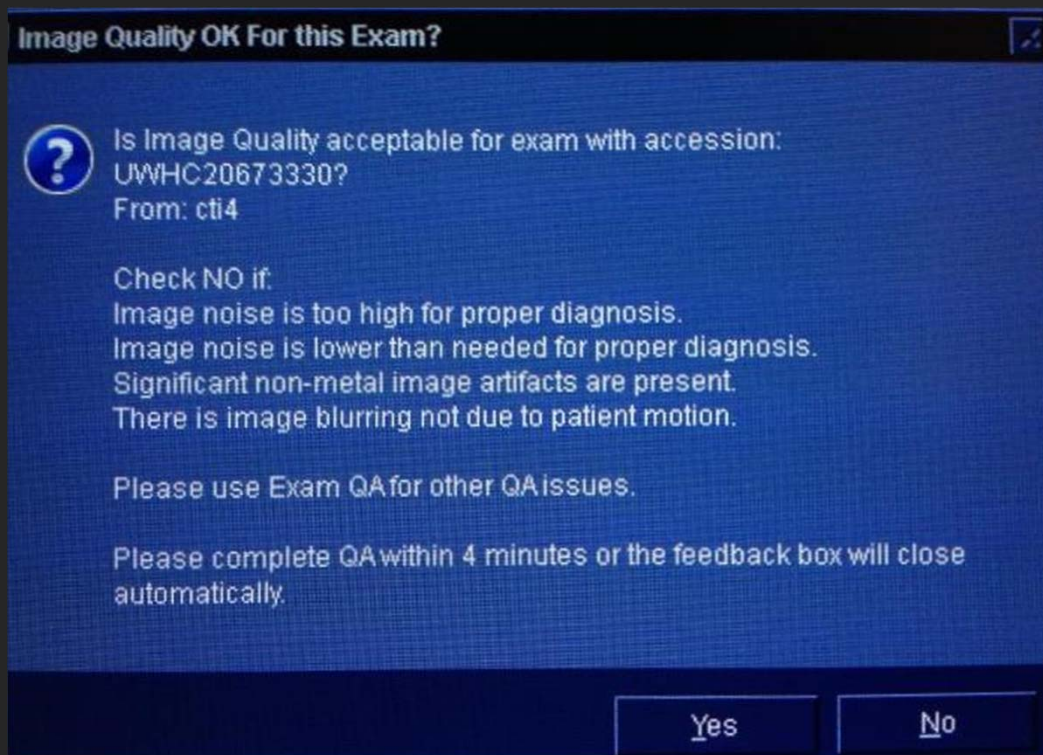


Our UW quality management system mandates:

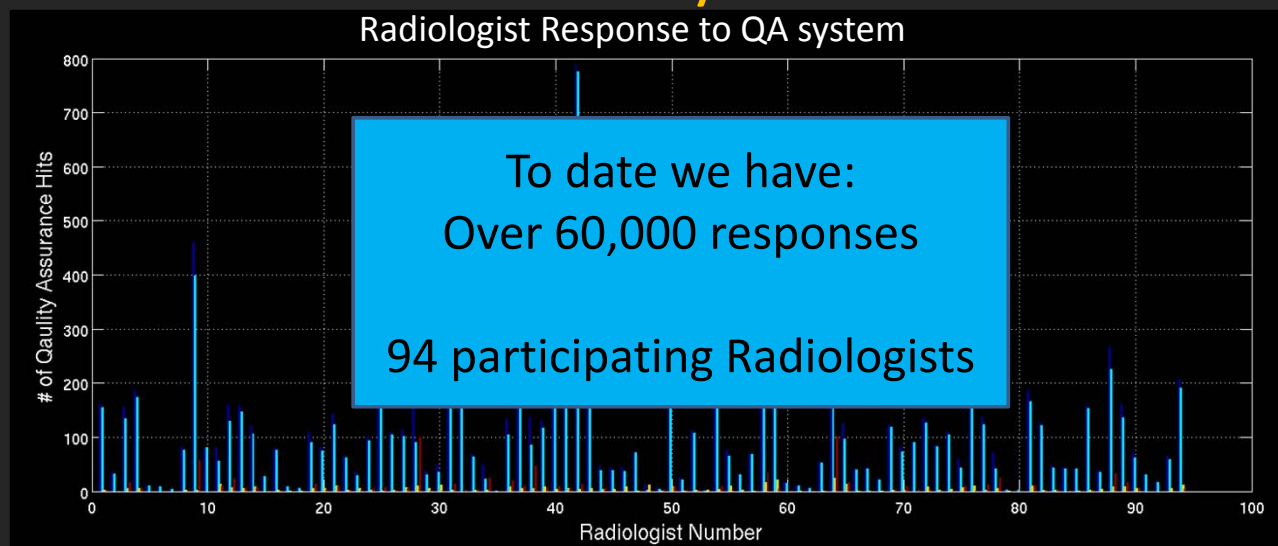
- Protocols are applied universally among all radiologists
- No arbitrary protocol modifications
- All protocol revisions are discussed and authorized by section leads, technologists, and physicists (protocolling by committee)



Our UW quality management system mandates:



IT tools: Radiologist quality assurance analysis



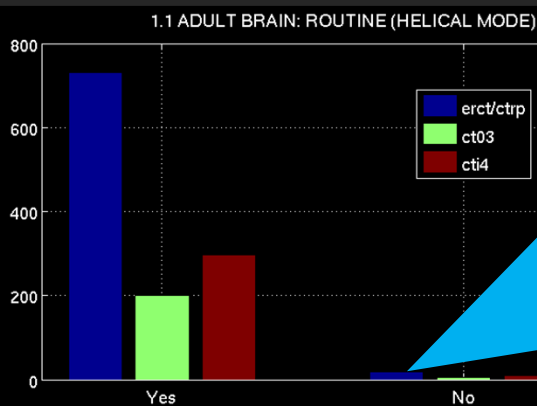
TP Szczykutowicz, F N Ranallo, W W Pepler, R J Bruce, and M A Pozniak "MDCT protocol optimization using an automated IT solution provided size specific patient doses, automatic tube current modulation information, and radiologist feed-back. RSNA 2013 S405AB-08

Our UW quality management system mandates:

- QA responses are actively monitored.
- That corrective actions be taken when a protocol receives excessive poor reviews



IT tools: Radiologist quality assurance analysis



For each “no” response, the physics team receives an email notification.

The CT section lead and the physicist then routinely perform “targeted” no response evaluations.



TP Szczykutowicz, F N Ranallo, W W Pepler, R J Bruce, and M A Pozniak “MDCT protocol optimization using an automated IT solution provided size specific patient doses, automatic tube current modulation information, and radiologist feed-back. RSNA 2013 S405AB-08

Where is this going?

- UW scanner specific protocols are now factory installed and shipping on one platform
- Delivered at no cost (on new scanners) to the end-user
- Removes the need for protocol entry with decrease in error rate.
- Protocols developed, validated and delivered on three other platforms




The Future

- Protocols will be maintained and constantly updated.
- We plan an annual upload



The Future

- Discussions in progress with the Joint Commission




The Joint Commission

• Issued January 9, 2015 •

Prepublication Requirements

The Joint Commission has approved the following revisions for prepublication. While revised requirements are published in the semiannual updates to the print manuals (as well as in the online E-dition®), accredited organizations and paid subscribers can also view them in the monthly periodical *The Joint Commission Perspectives*®. To begin your subscription, call 877-223-6866 or visit <http://www.jcinc.com>.



Revised Requirements for Diagnostic Imaging Services

APPLICABLE TO HOSPITALS AND CRITICAL ACCESS HOSPITALS

Effective July 1, 2015

Environment of Care (EC)

- the scanner room and the area that immediately precedes the entrance to the MRI scanner room.
- Making sure that these restricted areas are controlled by and under the direct supervision of staff trained in MRI safety.

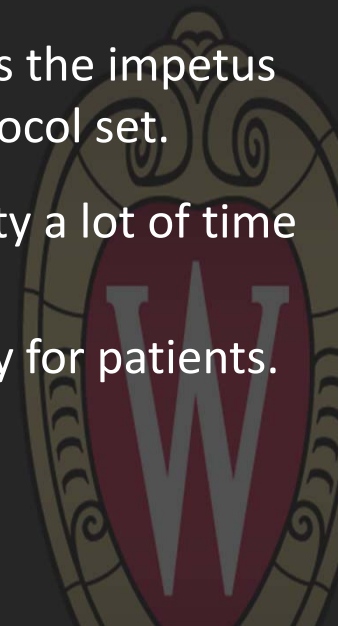
The Future

- Medical advisory board (Oct. 23, 2015)
- Physicist advisory board (2016)

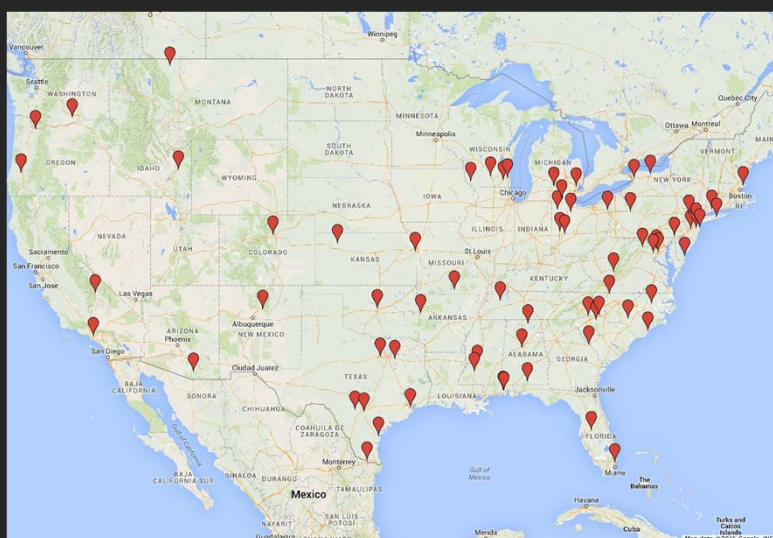


The UW Protocol Philosophy

- Image gently ... but image well
- Our hope is that these protocols will act as the impetus for development of a single universal protocol set.
- We hope this saves the imaging community a lot of time and \$\$\$
- Lower the dose and improve image quality for patients.



Sites with UW Protocols



78 scanners shipped with UW protocols as of March 2015