CT PROTOCOL MANAGEMENT
The UW ADVENTURE
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

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

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?

- Yes: 39%
- No: 61%
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

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
There are options for anyone to get protocols

Academic Centers
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
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

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

AAPM Practice guidelines

- **Prepare**
  - Allocate resources, negotiate contracts, meet with physics, support, approve, refine scheduling, staffing, inventory

- **Meet**
  - Empower team by engaging partners, develop meaningful metrics for performance

- **Pilot**
  - Support flexible patient/staff scheduling, check in periodically

- **Implement**
  - Launch value of project, implement local, culture of safety, valuing, understandable process, promote results and refine next budget

- **Disseminate**
  - Educate and discuss with radiologist, medical physicists regarding acquisition & processing parameters, image quality & time

- **Measure and Evaluate**
  - Develop strategy to iteratively improve image quality, take steps to reduce dose when possible

**Administrative**
- Perform baseline physics survey measurements, review protocols, observe clinical operations
- Discuss completed qualitative and quantitative observations from baseline survey(s)
- Develop strategies to iteratively improve image quality, and take steps to reduce dose when possible
- Present protocols to other CT users, using similar timeline development (pilot site)
- Quantify results of dose reduction efforts, compare with literature and/or national databases

**Qualified Medical Physicist**
- Follow quality assurance protocol [QAP], review image quality surveys, attend meetings, monitor, decide on which CT scanner the new protocol should be modified
- Keep patient case primary as team leader (protocol), form team & teach medical physicists; be responsible for scanner protocol entry
- Increase awareness of dose project, one teach on new protocol in clinics, ensure attendance as necessary
- Collect data for analysis of project benefits, collaborate with clinical staff, educational goals, & improved outcomes

**Radiographers**
- Review literature & collect clinical studies for image quality analyses and workloads [QAP], refine [QAP]
- Compare with team clinical examples, modular “how” [QAP], validate [QAP] suggestions
- Review image quality, discuss scan parameters concern, with physicist & technologist
- Assess time evaluating images, scan parameters, “how” (QAP)
- Can practice-wise reinforce, support, participating radiographers
- Provide context of benefits to fellow physicists, administrators, public or measurable patient safety gains
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:

- Every single scan is checked for acceptable diagnostic quality.
- All radiologists receive training on the QA system.
- Their participation is monitored (frequency and accuracy).

Our UW quality management system mandates:
To date we have:

- Over 60,000 responses
- 94 participating Radiologists

TP Szczykutowicz, F N Ranallo, W W Peppler, 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 S405A8-08
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 Peppler, 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 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