CT Protocol Management: Pearls and Pitfalls

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Disclosures

- OSU Radiology has research agreements with Siemens Healthineers and Qaelum.
- Our department has worked with a vendor, Qaelum, on a protocol manager prototype. No funding was provided.
- OSU protocols are managed, but the process is time-consuming.

What is a protocol?

- Starting point to achieve **consistent, high-quality** images with **reasonable** radiation and iodine contrast **doses**

Same patient
4 months later
Different scanner model

What is a protocol?

- Clinical indications for the exam and clinical parameters

CT Routine Abdomen	
Indication	Abdominal pain, most other general indications
Oral Contrast	PO Omnipaque with 30, 45, or 60 minute prep time
IV Contrast	Weight based Iodine injection protocol
Delay	80 Second
Respiration	Inspiration

80 Second venous - Scan from diaphragm to aortic bifurcation

What is a protocol?

- Technical parameters (Siemens)

FOV	Cone in to anatomy, not to exclude any muscle
Scan range	See ranges below
Special Instructions	Adjust CkV slide bar to 3 if without contrast
Typical CTDI Range (mGy): 8-31	
Scanner Protocol Name	ABDOMEN_WITHOUT or ABDOMEN_WITH

	AS+ 128	AS+20	Flash	AS+ 64	Edge	Force	go.TOP
80 Second venous - Scan from diaphragm to aortic bifurcation							
Scan mode	Spiral	Spiral	Spiral	Spiral	Spiral	Spiral	Spiral
Rotation time	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Detector Rows	128	20	128	64	128	192	64
Collimation	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Pitch	0.8	0.8	0.8	0.8	0.8	0.8	0.8
kVp	120	120	120	120	120	120	120
Reference mAs	175(Safire=140)	175(Safire=140)	175(Safire=140)	175(Safire=140)	175(Safire=140)	175(Safire=140)	110
Dose Modulation	CD4D/CkV-7	CD4D/CkV-7	CD4D/CkV-7	CD4D/CkV-7	CD4D/CkV-7	CD4D/CkV-7	FULL- Non Con/ST C+

What is a protocol?

- Technical parameters (GE)

FOV	Cone in to anatomy, not to exclude any muscle
Scan range	See ranges below
Special Instructions	Without contrast change kV assist to C-

	GE Brightspeed	GE HD750
80 Second venous - Scan from diaphragm to aortic bifurcation		
Scan mode	Helical	Helical
Rotation time	0.8	0.5
Detector Rows	16	64
Collimation	0.625	0.625
Pitch/Speed	1.375/13.75	1.375/55
kVp	120	120
NI	16	16
Min-Max mA	100-440	100-650
Dose Modulation	Smart/Auto	Smart/Auto/kVA.C+ 100-140

What is a protocol?

- Reconstruction parameters (Siemens)

	AS+ 128	AS+20	Flash	AS+ 64	Edge	Force	go.TOP
Recon 1 - Axial							Recon 1 - Axial
Slice thickness	2	2	2	2	2	2	2
Slice increment	3	3	3	3	3	3	3
Kernel/Iterative	B40(Safire=I40, 2)	B40(Safire=I40, 2)	B40(Safire=I40, 2)	B40(Safire=I40, 2)	B40(Safire=I40, 2)	Br40, 2	Br40, 3
Window	Abdomen	Abdomen	Abdomen	Abdomen	Abdomen	Abdomen	Abdomen
Send destination	PACS	PACS	PACS	PACS	PACS	PACS	PACS
Recon 2 - Coronal MPR							Recon 2 - Coronal
Slice thickness	2	2	2	2	2	2	2
Slice increment	2	2	2	2	2	2	2
Kernel/Iterative	B40(Safire=I40, 2)	B40(Safire=I40, 2)	B40(Safire=I40, 2)	B40(Safire=I40, 2)	B40(Safire=I40, 2)	Br40, 2	Br40, 3
Window	Abdomen	Abdomen	Abdomen	Abdomen	Abdomen	Abdomen	Abdomen
Send destination	PACS	PACS	PACS	PACS	PACS	PACS	PACS
Recon 3 - Axial thin							Recon 3- Fixed Axial thins
Slice thickness	1.5	1.5	1.5	1.5	1.5	0.75	1.5
Slice increment	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Kernel/Iterative	B30(Safire=I30, 1)	B30(Safire=I30, 1)	B30(Safire=I30, 1)	B30(Safire=I30, 1)	B30(Safire=I30, 1)	Br40, 2	Br40, 3
Window	Abdomen	Abdomen	Abdomen	Abdomen	Abdomen	Abdomen	Abdomen
Send destination	3D Lab	3D Lab	3D Lab	3D Lab	3D Lab/Syngo	3D Lab/Syngo	3D Lab

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Protocol review requirements

- Regulatory (varies from state to state)
  - Ohio Dept. of Health: A hospital's radiation dose review committee for CT "shall determine and review written protocols to improve image quality and minimize patient dose. The review shall include acquisition and reconstruction protocols, image quality, and radiation dose." ORC 3701:1-66-04
  - Team includes RSO, physicist, physician, and technologist
  - Annual review requirement for adult & pediatric head & abdomen, adult chest, and brain perfusion.

Protocol review requirements

- Accreditation – The Joint Commission
  - Protocols are reviewed and kept current with input from an interpreting physician, medical physicist, and lead imaging technologist.
  - Time frame for review is specified by the hospital.

Protocol review requirements

- Accreditation - ACR
  - CT Protocol and Management Team that includes the supervising radiologist, qualified medical physicist, and lead technologist "design[s] and review[s] all new or modified CT protocol settings to ensure that both image quality and radiation dose are appropriate."
  - Review all protocols periodically, no less than 24 months, with common protocols reviewed annually.

Protocol review

- OSU Radiology's diagnostic CT fleet:
  - 17 systems
  - 9 geographically separate locations
  - 10 models from 2 manufacturers
- Master protocols are maintained as an Excel spreadsheet on SharePoint
- Organized by body section, then by Adult/Peds, then by manufacturer

| Abdomen Siemens | Abdomen GE | Pediatric Abdomen Siemens | Pediatric Abdomen GE |

Protocol review

- Protocols are reviewed with each body section (abdomen, neuro, cardiac (including cardiology), MSK, thoracic, vascular)
- Goal: One section every two months and all sections each year
- Protocol changes are made based on image quality and/or dose feedback radiologists, physicists, and technologists
  - Often changes are made mid-year, before the annual review
  - Changes are usually piloted on limited studies before changing the master protocol

Protocol maintenance

- Parameters must be changed at the scanner to make sure the protocol on the scanner matches the master protocol
- It was extremely time-consuming initially to make sure all protocols matched the master protocols
- It is very time-consuming to make individual protocol updates that are decided at each review
- It can take two technologists over an hour per scanner to make the updates & check the existing protocols for one body section (dual energy scanners take considerably longer)

Protocol maintenance

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- Sometimes important protocol settings are not obvious

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Potential Solutions

- Homegrown solutions
- Export protocol as a CSV, XML, or other semi-readable format at each scanner
- Use a script to read in protocol parameters for display and review.
- While this can save time after the initial time investment, there is no guarantee that a vendor software update won't change the protocol export format.
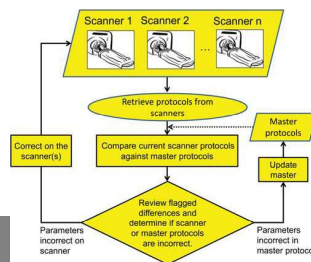- Each unit still needs to be accessed individually to export protocols.

Potential Solutions

Implementation and evaluation of a protocol management system for automated review of CT protocols

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Potential Solutions

A Wiki-Based Solution to Managing Your Institution's Imaging Protocols

Timothy P. Szczykutowicz, PhD, Nicholas Rubert, PhD, Daryn Belden, BS, Amanda Ciano, BS, Andrew Duplissis, Ashley Hermanns, Stephen Monette, BS, Elliott Janssen Saldivar

Reduces the number of "free" parameters by having most protocols reference parameters in a "master" protocol for a given body section and contrast phase.
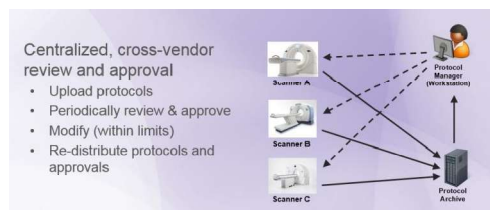

Potential Solutions

- Manufacturer's offer solutions with their analytics tools:
  - Siemens teamplay Protocols
  - GE Imaging Protocol Manager
  - Philips Incisive CT
  - Canon Vitality XT CT Applications
- Most can view protocol parameters on their vendor's scanners
- Depending on the software, the ability to "push" to scanners may be limited
- None (that I know of) can manage protocols for other vendors

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Potential Solutions

- 3rd Party Dose Monitoring Software
  - Imalogix
  - Qaelum Dose
  - Radimetrics
- Range of functionalities from "fancy spreadsheet" to store your master protocol to automated solutions that detect deviations from master protocols

Potential Solutions

- Management of Acquisition Protocols (MAP) IHE profile would allow for vendor-neutral protocol management

Centralized, cross-vendor review and approval
- Upload protocols
- Periodically review & approve
- Modify (within limits)
- Re-distribute protocols and approvals

https://wiki.ihe.net/index.php/Management_of_Acquisition_Protocols

Conclusions

- CT protocol management includes thousands of scan and reconstruction parameters.
- Access to make protocol changes should be restricted to a small team.
- When done manually, protocol updates can be time consuming.
- Tools are beginning to become available from vendors that allow viewing and (in some cases) editing of protocols remotely.
- Bug your vendor to support the Management of Acquisition Protocols (MAP) IHE profile for vendor-neutral protocol management