Protocol Management and Review Strategies: The Mayo Experience

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Rochester, Minnesota

Overview

- Brief look back at CT protocols at Mayo
- Goals of a protocol "system"
- Mayo's current protocol system
  - The Team
  - The System
  - Elements of a protocol
  - Lessons learned

Why this is so important to Mayo

- 500+ scans per day
- Nearly 150,000 CT scans per year

EVERY scan starts with a protocol!

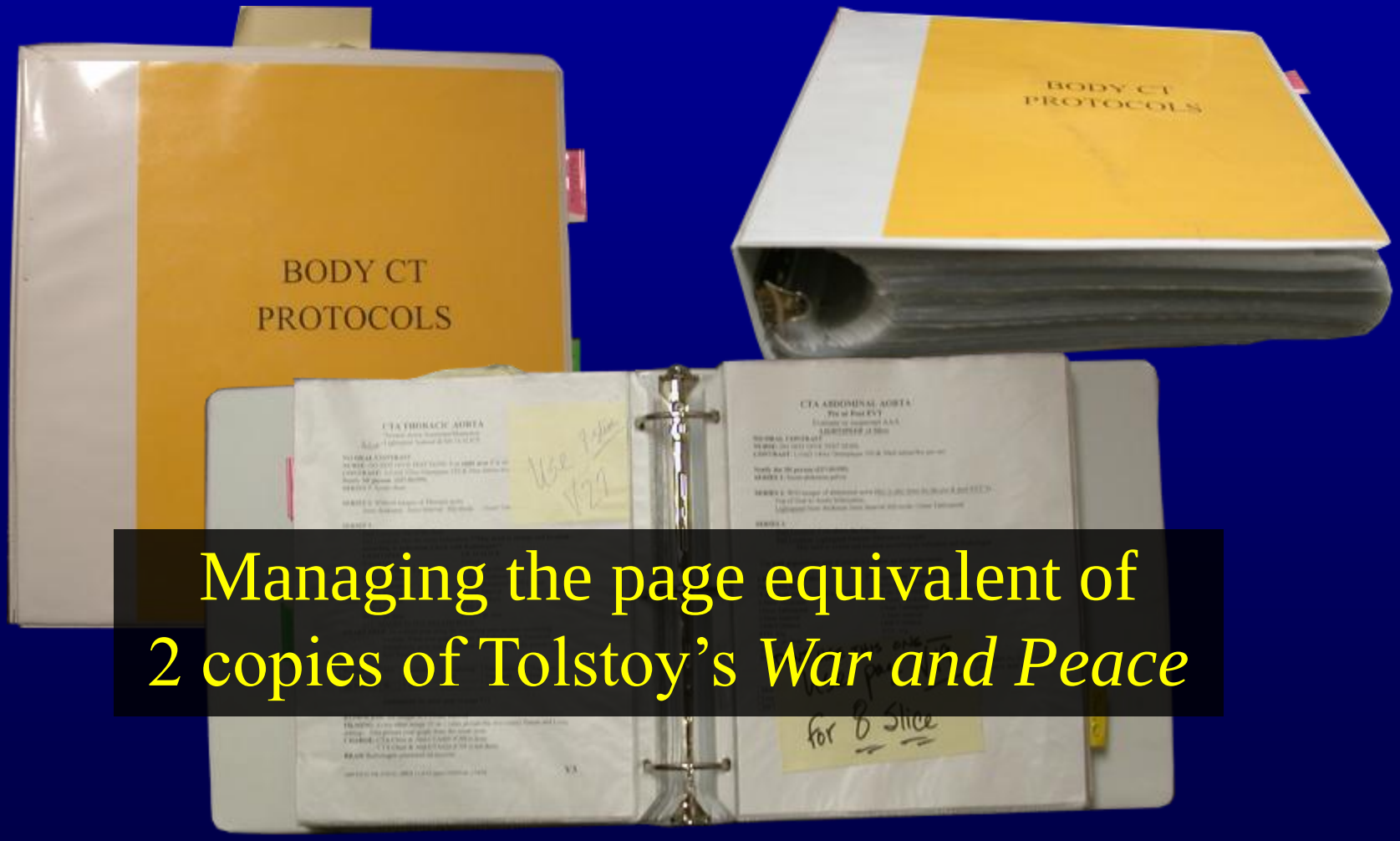
In the beginning (~2002)

- 16 scanners
  - 3 different buildings
  - 4 different models (1 manufacturer)
- 450+ protocol files
  - Different folders
  - Duplicates, different versions, outdated
  - Radiologist-specific versions
- Printed, stuffed into plastic sleeves, in binders

In the beginning (~2002)

- Protocol changes needed
  - 1-5 requests per week typical
  - Usually some urgency
- Managed by 6 Lead Technologists
  - Worked independently (no point person)
  - Many other responsibilities, including scanning

In the beginning (~2002)



Managing the page equivalent of
2 copies of Tolstoy's *War and Peace*

In the beginning (~2002)

- Inefficient
- Drain on resources
- Error-prone
  - Inconsistencies
- General sense of “brink of losing control”

Initial Actions

- FIRST: Buy-in from leadership
- Protocol Review Group
  - Input from…
    - CT Leads and technologists
    - Radiologists
    - Physicists
    - CT leadership
    - Nursing staff
- Determined goals of new system

Goals

- Manageable file system
- Critiqued and optimized protocols
- Clear, consistent, and concise instructions
- Content for ALL interested parties
- Fast turn-around time (quickly updated)
- Always available at the scanner

Goal 1. Manageable File System

- Reduce number of files
  - Consolidate models into single protocol
  - Eliminate radiologist-specific protocols
- File-naming convention, directory structure
- Limit access to “master” files
- Database, custom software?
  - Several prototypes built and evaluated
  - Too many problems, limitations

Goal 2. Critiqued & Optimized Protocols

- Reviewed by a cross-section of individuals
  - Physicist, radiologist, technologist (nurse, others…)
  - Approval for major changes
- Scan Parameters
  - Start with what works
    - Similar exams, published scans, colleagues, etc.
  - Look for improvements
  - Match noise for other models
    (using best parameters, including scanner features)

Goal 3. Clear and Concise Instructions

- Minimize possibility of misinterpretation
- Consistent and concise phrasing
- Consistent structure
- Consistent formatting & color-coding
- Consistent naming convention
  - In protocols and scanners

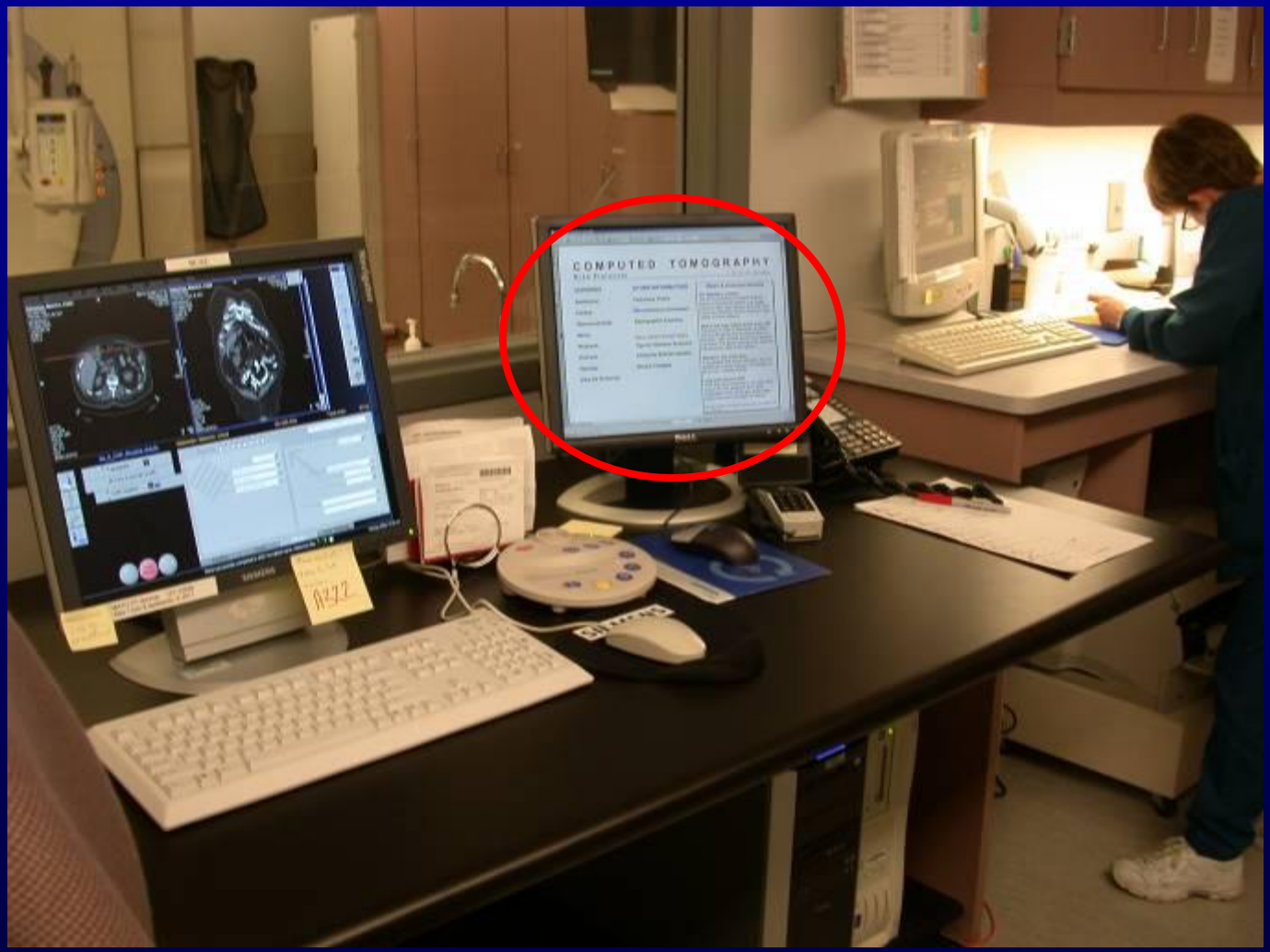
Goal 4. Content for ALL parties

- Technologists
  - Patient positioning, scan parameters, filming, networking, billing, etc.
- Nurses
  - Contrast information and instructions
- Radiologists and Physicists
  - Dose information, min. retro recon, det. configs.

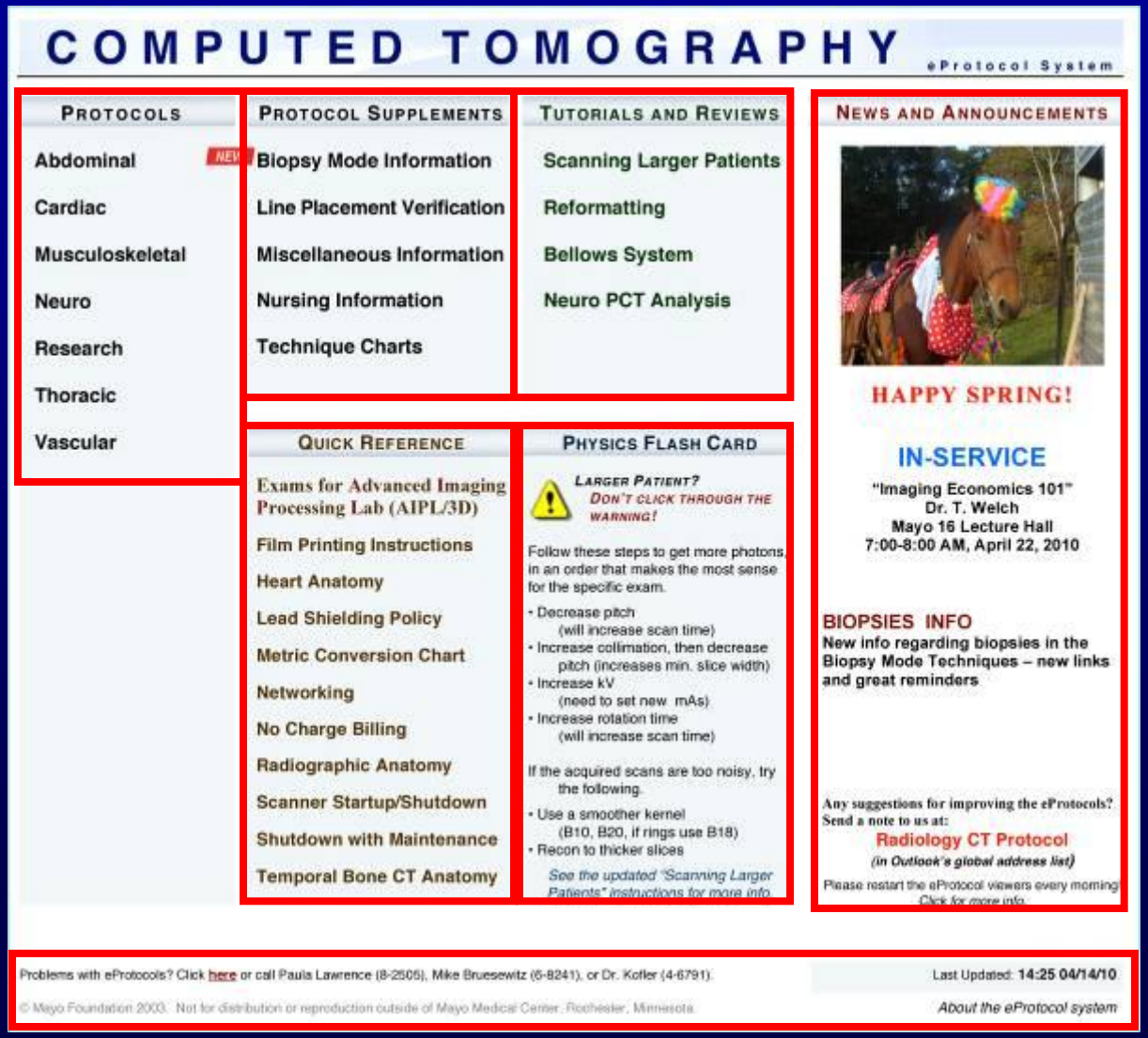
Goals 5, 6. Quickly updated, at scanner

- Dedicated limited systems
  - Access only to protocols
  - All hyperlinks (no keyboard)
  - Automatic updates
  - Files stored locally
- Web
  - Access to other clinical systems
  - Had anyway
  - Familiar

eProtocol Systems



"Home" Page


COMPUTED TOMOGRAPHY
eProtocol System
PROTOCOLS
Abdominal
Cardiac
Musculoskeletal
Neuro
Research
Thoracic
Vascular
PROTOCOL SUPPLEMENTS
Biopsy Mode Information
Line Placement Verification
Miscellaneous Information
Nursing Information
Technique Charts
TUTORIALS AND REVIEWS
Scanning Larger Patients
Reformatting
Bellows System
Neuro PCT Analysis
QUICK REFERENCE
Exams for Advanced Imaging Processing Lab (AIPL/3D)
Film Printing Instructions
Heart Anatomy
Lead Shielding Policy
Metric Conversion Chart
Networking
No Charge Billing
Radiographic Anatomy
Scanner Startup/Shutdown
Shutdown with Maintenance
Temporal Bone CT Anatomy
PHYSICS FLASH CARD
LARGER PATIENT?
DON'T CLICK THROUGH THE WARNING!
Follow these steps to get more photons in an order that makes the most sense for the specific exam.
• Decrease pitch (will increase scan time)
• Increase collimation, then decrease pitch (increases min. slice width)
• Increase kV (need to set new mAs)
• Increase rotation time (will increase scan time)
If the acquired scans are too noisy, try the following.
• Use a smoother kernel (B10, B20, if rings use B18)
• Recon to thicker slices
See the updated "Scanning Larger Patients" instructions for more info
NEWS AND ANNOUNCEMENTS
HAPPY SPRING!
IN-SERVICE
"Imaging Economics 101"
Dr. T. Welch
Mayo 16 Lecture Hall
7:00-8:00 AM, April 22, 2010
BIOPSIES INFO
New info regarding biopsies in the Biopsy Mode Techniques – new links and great reminders
Any suggestions for improving the eProtocols? Send a note to us at:
Radiology CT Protocol
(in Outlook's global address list)
Please restart the eProtocol viewers every morning
Click for more info
Problems with eProtocols? Click here or call Paula Lawrence (8-2505), Mike Bruesewitz (6-8241), or Dr. Kofler (4-6791).
Last Updated: 14:25 04/14/10
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About the eProtocol system

"Home" Page

COMPUTED TOMOGRAPHY

eProtocol System

PROTOCOLS

- Abdominal
- Cardiac
- Musculoskeletal
- Neuro
- Research
- Thoracic
- Vascular

PROTOCOL SUPPLEMENTS

- NEW Biopsy Mode Information
- Line Placement Verification
- Miscellaneous Information
- Nursing Information
- Technique Charts

TUTORIALS AND REVIEWS

- Scanning Larger Patients
- Reformatting
- Bellows System
- Neuro PCT Analysis

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QUICK REFERENCE

- Exams for Advanced Imaging Processing Lab (AIPL/3D)
- Film Printing Instructions
- Heart Anatomy
- Lead Shielding Policy
- Metric Conversion Chart
- Networking
- No Charge Billing
- Radiographic Anatomy
- Scanner Startup/Shutdown
- Shutdown with Maintenance
- Temporal Bone CT Anatomy

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About the eProtocol system

Division Page

(Home) COMPUTED TOMOGRAPHY eProtocol System

NEURO PROTOCOLS

CTA

Carotid – CTA
Circle of Willis / Carotid – CTA
Circle of Willis – CTA
Head – Dynamic Perfusion
Head – Dynamic Multi 4D perfusion Shuttle Mode
Head – Subtraction CTA
Head – Subtraction Venogram
Intracranial Venogram
Occiput – C2 Neurovascular Morphology CTA
Spine – CTA

CRANIAL

Electrode Placement
Head – 3D
Head – Routine (Sequential/ Axial)
Head – Routine (Spiral)
Head – Trauma
Head – Stroke Thrombolysis Candidate
Parenchymal Hemorrhage
Skull Base
Skull Base – RC
Stereotactic, Head
Stereotactic, Head – Deep Brain Stimulator
Stereotactic, Head – Frameless
Stereotactic, Head – Gamma Knife
Stereotactic, Head – Gamma Knife IAC
Stereotactic, Head – Pallidotomy, Thalamotomy

HEAD and NECK

Carina/Neck
Cisternogram
Face
Face – Reconstructed Coronals (RC)
Head & Neck
Lacrimal Gland
Larynx
Nasal Septum
Neck 4D Parathyroid
Neck and Chest Routine (Neuro)
Orbit
Orbit – Reconstructed Coronals (RC)
Sella
Sella – Reconstructed Coronals (RC) (GE)
Sinus
Sinus – Brain Lab
Sinus – Instatrak
Sinus – Instatrak Skull Base
Sinus – Reconstructed Coronals(GE)
Sinus – Presurgical
Sinus – Tumor
Subglottic – Stenosis
Temporal Bone
Temporal Bone – Long Axis
TMJ

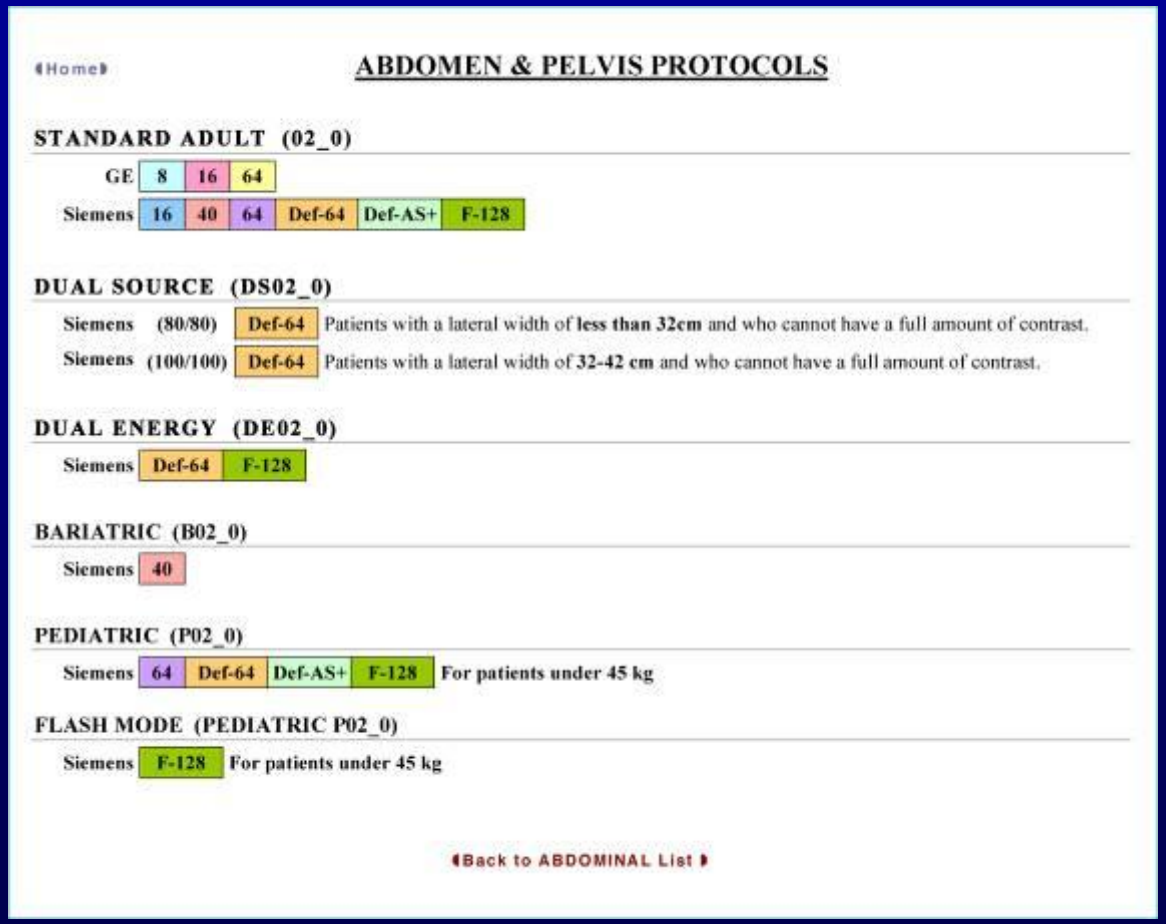
SPINE

Spine, C1-C2 Transarticular Fixation
Spine, Cervical – Myelogram
Spine, Cervical – Nerve Root Avulsion
Spine, Cervical – Rotation
Spine, Cervical – Routine
Spine, Complete – Cervical, Thoracic, & Lumbar
Spine, Discogram
Spine, Dynamic Myelogram
Spine, Ultrafast Dynamic Myelogram-prone
Spine, Lumbar – Routine
Spine, Lumbar – Myelogram
Spine, Thoracic – Routine
Spine, Thoracic – Myelogram

DENTAL/ORTHODONTICS

Orthodontics
Medical Modeling
Prosthodontics – Mandible
Prosthodontics – Maxillary
Prosthodontics – Mandible & Maxillary

Scanner Index



Home

ABDOMEN & PELVIS PROTOCOLS

STANDARD ADULT (02_0)

GE: 8 | 16 | 64

Siemens: 16 | 40 | 64 | Def-64 | Def-AS+ | F-128

DUAL SOURCE (DS02_0)

Siemens (80/80): Def-64 — Patients with a lateral width of **less than 32cm** and who cannot have a full amount of contrast.

Siemens (100/100): Def-64 — Patients with a lateral width of **32-42 cm** and who cannot have a full amount of contrast.

DUAL ENERGY (DE02_0)

Siemens: Def-64 | F-128

BARIATRIC (B02_0)

Siemens: 40

PEDIATRIC (P02_0)

Siemens: 64 | Def-64 | Def-AS+ | F-128 — For patients under 45 kg

FLASH MODE (PEDIATRIC P02_0)

Siemens: F-128 — For patients under 45 kg

Back to ABDOMINAL List

Protocol

PROTOCOL 02_0 — **SIEMENS 16 40 64 Def_64 Def-AS+ F-128** — 04/06/10

Home / LIST

CHEST – ROUTINE

GENERAL: For patients equal to or less than 45 kgs. and under, use the **Pediatric technique**.
Patient supine, arms above head on pillow.
NOTES: Recon 2 is a volumetric high resolution chest CT.
An optional recon for nodule thin cuts per radiologist request is available (Recon 3) and the position of these should be directed by the radiologist.
Low dose techniques should be used if additional expiratory and/or prone high resolution images are requested.
The full dose imaging should only be done at the specific request of the radiologist.

This protocol includes the parameters needed for all 3D reconstructions of the chest including **Virtual Bronchoscopy, Super Dimension Bronchus and Breast Implant Evaluation. Recon 2, HiRes Chest needs to be networked to the 3D lab.** The additional images performed by the 3D lab requires a 3D charge, but the acquisition and reconstruction protocols are the same as a routine chest CT.

CONTRAST: **Oral.** None.
IV. Use 80cc at 3.0 cc/s of Omnipaque 300 (all scanners) if indicated by radiologist.

TOPOGRAM: PA, 512; **STOP SCAN** when through lungs.

CHEST SCAN: Scan from top of lungs through the bottom of lungs. Scan through the adrenals if the indication is lung cancer or if requested by the radiologist. Instruct patient to hold breath at inspiration during entire scan.

SIEMENS	Sens-16	Sens-40	Sens-64	Def-64	Def-AS+	F-128
Scan Type	Spiral	Spiral	Spiral	Spiral	Spiral	Spiral
Rotation Time (s)	0.5	0.5	0.33	0.33	0.33	0.28
Collimation	16 x 0.75	40 x 0.6	64 x 0.6	64 x 0.6	128 x 0.6	128 x 0.6
Pitch	1.1	1.15	0.9	0.9	0.9	0.9
Feed (mm/rot)	*13.2*	*13.2*	*17.8*	*17.8*	*34.6*	*34.6*
kVp	120	120	120	120	120	120
Quality ref. mAs	180	140	180	180	180	180
CARE Dose4D	ON	ON	ON	ON	ON	ON
API	Inspiration	Inspiration	Inspiration	Inspiration	Inspiration	Inspiration
Prep Delay (s)	20	20	20	20	24	24
Min. Retro (mm)	*0.75*	*0.6*	*0.6*	*0.6*	*0.6*	*0.6*
CTDI (mGy)	*14.04*	*15.02*	*14*	*12.98*	*12.13*	*12.16*
Base Protocol	*ThoraxRoutine*	*ThoraxRoutine*	*ThoraxRoutine*	*ThoraxRoutine*	*ThoraxRoutine*	*ThoraxRoutine*

	RECON 1	RECON 2	RECON 3	RECON 4 (optional)*
Series description	Chest Routine	HiRes Chest	MIP Chest	Thin Nodule
Type	Axial	Axial	SPO-MIP Thins	Axial
Start	Top of Lungs	Top of Lungs	Top of Lungs	Above Nodule
End	Bottom of Lungs	Bottom of Lungs	Bottom of Lungs	Below Nodule
Angle	None	None	None	None
Image Order	Craniocaudal	Craniocaudal	Craniocaudal	Craniocaudal
Kernel	B40	B46	B50	B40
Slice (mm)	5	1.5	20	2
Increment (mm)	5	1.5	10	1
FOV (mm)	Patient	Patient	Patient	150
:-Q/-D	---	---	---	---
Network	IAU and Rad	IAU and Rad A3D3 if 3D needed	IAU and Rad	IAU and Rad
FILMING				
Format	20:1	20:1	---	20:1
WW, WC	400/40 & 1500/-600	1500/-600	1500/-600	400/40 & 1500/-600
Images	ALL	Every 10th image	---	ALL

*** To be done upon request by radiologist.**
For Virtual Bronchoscopy and Breast Implant Evaluation, call 3D Lab (4-1424).

CHARGE	# Charges	# Sequences	w/o contrast	with contrast	w & w/o contrast	with 3D recons requiring independent workstation
Lungs only: Chest	1	1	71250	71260	71270	--
Chest Lmtd (approx. < 10 cm scan length)	1	1	07213	NA	NA	--
Virtual Bronchoscopy	1	1	71250B	--	--	--
Breast Implantation Evaluation	2	1	71250	--	--	CT3D02
Lungs + adrenals: Chest with Lmtd Abd	1	1	CT510	CT511	CT512	--

Images read by radiologist scheduled on the scanner. The radiologist notes that additional 3D was performed, if applicable.

Title, Page Number, Scanners, Date

PROTOCOL 02_0

SIEMENS 16 40 64 Def_64 Def-AS+ F-128

04/06/10

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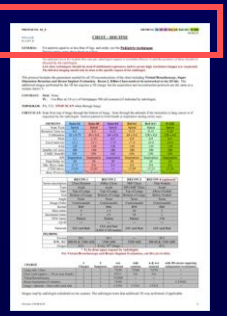
LIST

CHEST – ROUTINE

GENERAL: For patients equal to or less than 45 kgs and under, use the Pediatric technique



General Info

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CONTRAST: **Oral** None

Nursing

Routine chest CT.

CONTRAST: **Oral.** None.
IV. Use 80cc at 3.0 cc/s of Omnipaque 300 (all scanners) if indicated by radiologist.

TOPOGRAM: PA 512; STOP SCAN when through lungs

Another example (bi-phase enterography)

CONTRAST: **Oral.** Nurse will give the following oral contrast to the patient.

Routine Patient	ER Patient
450mL Volumen, 60 min prior to CT 450mL Volumen, 45 min prior to CT 450mL Volumen, 30 min prior to CT 500 mL or 2 glasses of water, 15 min prior to CT	1.8-2.0 liters of water over 30min. Scan the patient 75min after the start of drinking water.

IV. Use weight-based chart. Standard is 150ml Omnipaque 300 at 4cc/sec.
Needle must be in place BEFORE the patient is given oral contrast.
For large patients consult with radiologist regarding increasing contrast dosage.
Consult with radiologist regarding use of Reglan.
Good coordination is critical for this timed study.

TOPOGRAM: PA 512; STOP SCAN when through pelvis

Parameter Grid

IV. Use 80cc at 3.0 cc/s of Omnipaque 300 (all scanners) if indicated by radiologist.

TOPOGRAM: PA, 512; **STOP SCAN** when through lungs.

CHEST SCAN: Scan from top of lungs through the bottom of lungs. Scan through the adrenals if the indication is lung cancer or if requested by the radiologist. Instruct patient to hold breath at inspiration during entire scan.

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Pitch	1.1	1.15	0.9	0.9	0.9	0.9
Feed (mm/rot)	*13.2*	*13.2*	*17.8*	*17.8*	*34.6*	*34.6*
kVp	120	120	120	120	120	120
Quality ref. mAs	180	140	180	180	180	180
CARE Dose4D	ON	ON	ON	ON	ON	ON
API	Inspiration	Inspiration	Inspiration	Inspiration	Inspiration	Inspiration
Prep Delay (s)	20	20	20	20	24	24
Min. Retro (mm)	*0.75*	*0.6*	*0.6*	*0.6*	*0.6*	*0.6*
CTDI (mGy)	*14.04*	*15.02*	*14*	*12.98*	*12.13*	*12.16*
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	RECON 1	RECON 2	RECON 3	RECON 4 (optional)*

Recons, Reformats, Network, Filming

	RECON 1	RECON 2	RECON 3	RECON 4 (optional)*
Series description	Chest Routine	HiRes Chest	MIP Chest	Thin Nodule
Type	Axial	Axial	SPO-MIP Thins	Axial
Start	Top of Lungs	Top of Lungs	Top of Lungs	Above Nodule
End	Bottom of Lungs	Bottom of Lungs	Bottom of Lungs	Below Nodule
Angle	None	None	None	None
Image Order	Craniocaudal	Craniocaudal	Craniocaudal	Craniocaudal
Kernel	B40	B46	B50	B40
Slice (mm)	5	1.5	20	2
Increment (mm)	5	1.5	10	1
FOV (mm)	Patient	Patient	Patient	150
:-Q/-D	---	---	---	---
Network	IAU and Rad	IAU and Rad A3D3 if 3D needed	IAU and Rad	IAU and Rad
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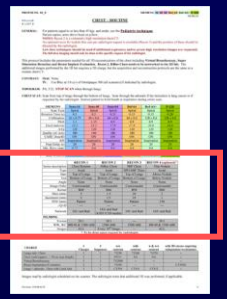

Charges

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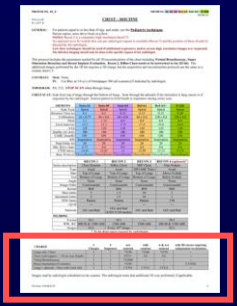
Division: THORACIC

1



Protocol

PROTOCOL 02_0 — **SIEMENS 16 40 64 Def_64 Def-AS+ F-128** — 04/06/10

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Kernel	B40	B46	B50	B40
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Increment (mm)	5	1.5	10	1
FOV (mm)	Patient	Patient	Patient	150
:-Q/-D	---	---	---	---
Network	IAU and Rad	IAU and Rad A3D3 if 3D needed	IAU and Rad	IAU and Rad
FILMING				
Format	20:1	20:1	---	20:1
WW, WC	400/40 & 1500/-600	1500/-600	1500/-600	400/40 & 1500/-600
Images	ALL	Every 10th image	---	ALL

*** To be done upon request by radiologist.**
For Virtual Bronchoscopy and Breast Implant Evaluation, call 3D Lab (4-1424).

CHARGE	# Charges	# Sequences	w/o contrast	with contrast	w & w/o contrast	with 3D recons requiring independent workstation
Lungs only: Chest	1	1	71250	71260	71270	--
Chest Lmtd (approx. < 10 cm scan length)	1	1	07213	NA	NA	--
Virtual Bronchoscopy	1	1	71250B	--	--	--
Breast Implantation Evaluation	2	1	71250	--	--	CT3D02
Lungs + adrenals: Chest with Lmtd Abd	1	1	CT510	CT511	CT512	--

Images read by radiologist scheduled on the scanner. The radiologist notes that additional 3D was performed, if applicable.

Additional Information

- CT Leads assigned to Divisions
- Leads (ONLY) update scanners
- 1 Lead assigned to triaging requests
- Protocols created in MS Word, converted to PDF
  - Neither program without quirks

Other Lessons Learned

- Maintain protocol histories
- Enforce structure
  - File-naming, formatting, processes, etc.
- Keep focused on goals
- Communicate major changes
- General “team” advice
- Meet regularly

Conclusions

- Must have support from leadership
- Team is essential
- Approval process critical
- Defined protocol process
  - From request to publication
- On-going process