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POWERFUL PARTNERSHIPS ADVANCING IMAGING AND THERAPY

CT Protocol Review: Practical tips for the Imaging Physicist

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President, Upstate Medical Physics –
A LANDAUER Medical Physics Partner

Objectives

- How to
  - Come up to speed on a wide range of scanner types
  - Leverage your experience from one site to others
  - Build relationships that encourages your client to seek your input on protocols
  - Address protocol problems once you find them, particularly if the site isn't willing to pay for support
  - Utilize AAPM support tools

Outline

- What is a consultant?
- Scope of the project
- Benefits and Challenges for the Consultant
  - Technical
  - Operational
  - Professional
- Recommendations (Advice)
- AAPM WG CTNP and TG 225 Practice Guidelines

Who is a consultant?

- 33 year old pregnant (18 weeks) female presents with severe headaches and labored breathing
- ER physician orders CT scans
  - Head
  - Chest (r/o PE)
- OB/GYN consult
- Neurologist consult
- Radiologist consult
- Medical Physics consult

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Who is a consultant?

- **Main Entry: con·sul·tant**
- **Pronunciation: \kən-ˈsəl-tənt**
- **Function: *noun***
- **Date: 1697**
- **1 :** one who **consults** another
  2 : one who gives professional advice or services **:** expert

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http://www.merriam-webster.com/dictionary/consultant

Who is a consultant?

- According to traditional medical use of the term, "consultant" is not the patient's primary care provider but has expertise that contributes to patient care
- According to dictionary, we are all consultants
- All medical physicists are "consultants"
- Issues for FTE hospital staff medical physicists may be somewhat different
- FTE Staff Medical Physicists share much in common with "consultants"

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Technical Benefits, Challenges

- Diversity of manufacturers and models
  - Use same process as when starting ACR CT support
  - Start with one or two sites and CT scanners
  - Allow extra time to refine the process
    - Consider reduced or no-charge at first
  - Choose receptive site (management, personnel, schedule)
  - Form and lead the **CT Protocol Review Committee**
  - Build your own scanner-specific protocol table
    - Use AAPM "CT Protocols" resources
  - Pilot the project and identify success milestones

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Scope of Protocol Review project

- Obtain grassroots support – find an on-site ***Champion***
- Present the case to decision makers
- Lock down all protocols, subject to approval
- Form **"CT Protocol Review Committee"**
  - Radiologist, CT Technologist, Medical Physicist
- Use AAPM TG 225 for support
  - Start by reviewing this document with the leadership

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Scope of Protocol Review project

- Start with highest dose impact/volume studies Perfusion and Pediatrics
- Review clinical considerations, dose, protocol details
- Minimize number of protocols
- Educate members about patient dose vs. CTDI
- Agree on CTDI ranges for key exams
  - And what to do if they are exceeded
- Generate recommendations (trial solutions)
- Meet regularly and re-evaluate
- Evaluate more protocols
- Document process and results

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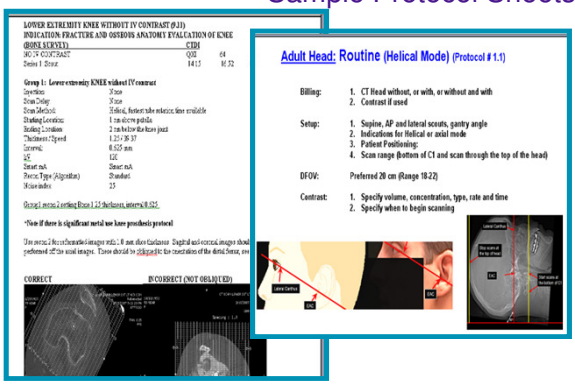
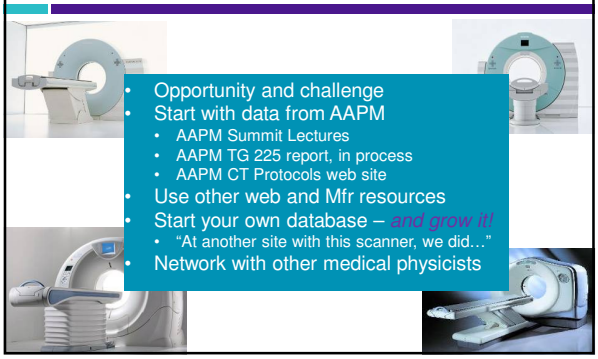
Sample Protocol Sheets



Diversity of Manufacturers – Models



- Opportunity and challenge
- Start with data from AAPM
  - AAPM Summit Lectures
  - AAPM TG 225 report, in process
  - AAPM CT Protocols web site
- Use other web and Mfr resources
- Start your own database – *and grow it!*
  - "At another site with this scanner, we did…"
- Network with other medical physicists

Create a list of "rules of thumb"

- kV
  - 120 kVp for average adults
  - 100 kVp for small adults
  - 80 – 100 kVp for peds
  - 140 kVp for very large adults
- Change kVp to maintain noise
  - If increase from 120 – 140 kVp, reduce mAs by 40%
  - Reduces patient dose by about 20%
  - Increasing 120 – 140 kVp to reduce streaking artifacts (shoulders and hips)

Adapted from Frank Ranallo, PhD

Create a list of "rules of thumb"

- ImageThickness
  - Thinner slices produce better axial resolution with less partial volume effect
  - Thinner slices require more mAs for equivalent noise
- Image Recon Incrementation
  - For axial, slice incrementation = slice thickness
  - For helical, best z-axis resolution may be achieved at recon interval = ½ thickness

Adapted from Frank Ranallo, PhD

Create a list of "rules of thumb"

- Pitch
  - Pitch <1 improves image quality, less helical artifact
  - Pitch >1 gives faster anatomical coverage (less motion)
  - Motion is important for breath hold, peristalsis, etc.
  - On newer scanners in manual mode, consider
    - lower pitch,
    - adjust rotation time needed for coverage/motion,
    - adjust mA for proper dose
  - Automatic mode, adjust noise index (reference mAs)
    - Increase pitch to reduce scan time
    - Check maximum mA

Adapted from Frank Ranallo, PhD

How do we prepare?

- Study each manufacturer's features, terms, quirks
  - We engaged an experienced CT physicist to consult with us in January 2010
  - You have the benefit of many recent AAPM activities
- Improve your understanding of clinical needs
  - We engaged an experienced CT radiologist to consult with us in March 2010
  - Developed close relationships with CT focused radiologists at two client sites
  - Review specific cases remotely, at their request

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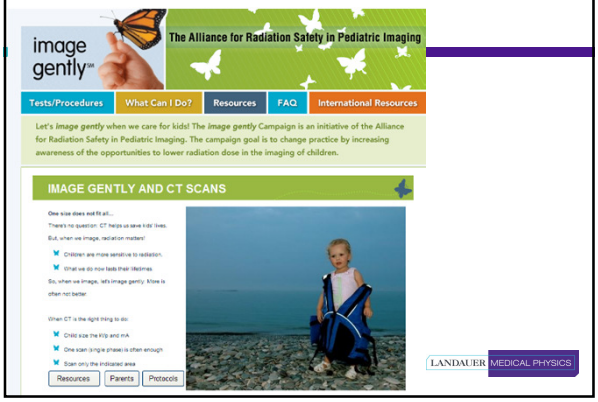
http://www.pedrad.org/associations/5364/ig/index.cfm?page=614



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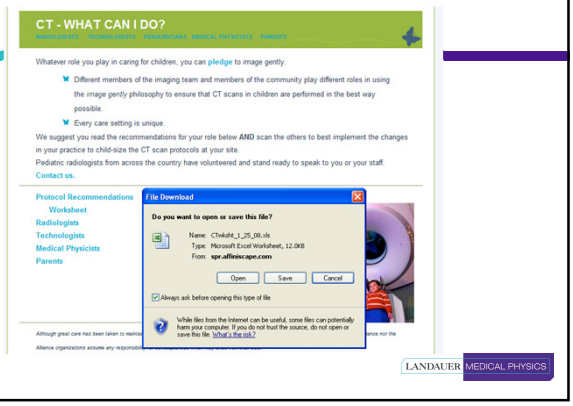
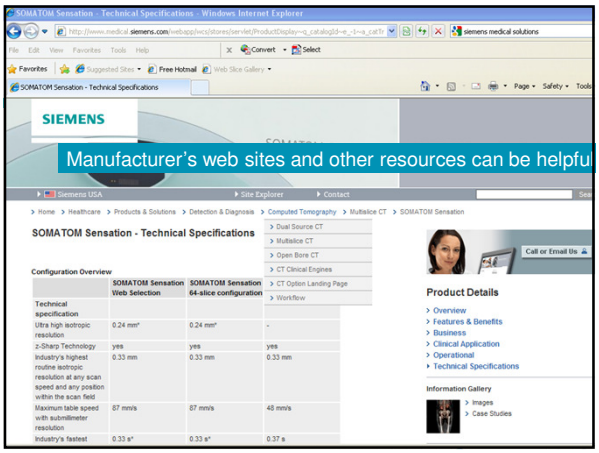
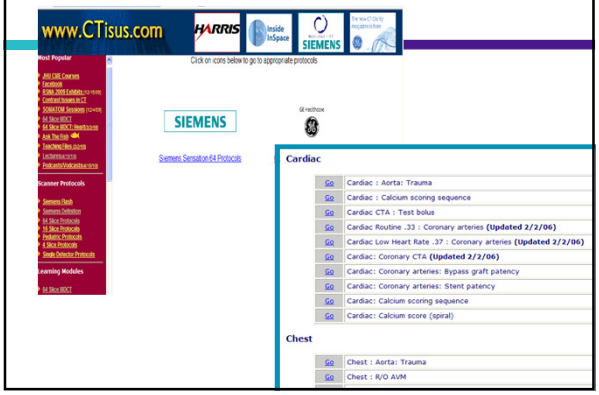


Image Gently – mAs Reduction Factors for Peds

Abdomen Baseline:	kVp	mA	Time (sec)	Pitch Abdomen	Pitch Thorax
	120	200	0.5	1	1
		Abdomen		Thorax	
PA Thickness (cm)	Approx Age	mAs Reduction Factor (RF)	Estimated mAs = BL x RF	mAs Reduction Factor (RF)	Estimated mAs = BL x RF
9	newborn	0.31	31	0.29	29
12	1 yr	0.36	36	0.34	34
14	5 yr	0.61	61	0.57	57
16	10 yr	0.71	71	0.63	63
19	15 yr	0.77	77	0.69	69
22	small adult	0.91	91	0.84	84
25	med adult	1.0	100	0.93	93
31	large adult	1.33	133	1.21	121



http://www.ctisus.com



Operational Benefits, Challenges

- Daunting size of this project
- Requires
  - Significant institutional will
  - Significant resources
  - Significant cooperation
- Could potentially be largest patient benefit
  - From Image quality, Dose and ALARA perspectives
- Process/results useful for
  - Professional development
  - Marketing in a competitive environment (sites and MP)

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Do the math – How many protocols are there?

Hospital	Small	Med	Large
	16	16	64
– Head	16	16	18
– Ear	5	4	8
– Soft Tissue	1	4	8
– Spine	2	9	10
– Ortho (Extrem)	2	2	31
– CTA	3	11	15
– Cardiac	0	0	6
– Chest	7	17	12
– Abdomen	13	23	15
– Pelvis	2	2	6
Total	44	88	131

Obstacles

- "There is no $ in the (dept operating) budget"
- "CT schedule is full all the time"
- "We will irritate referring MD's"
- "No radiologist is willing to spend the time"
- "All radiologists will never agree to standardization"
- "Technologists are too busy"
- "All protocols are fine" (set by manufacturer)
  - (Ignorance is bliss)
- "No regulatory requirement"

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Benefits to the medical physicist

- Make a difference
- Professional development
  - Expand our technical and clinical understanding
  - ABR MOC
- Become "essential" and not easily replaced by others without this understanding
- Build relationships with RT's and Radiologists
- Increased visibility
  - to staff, radiologists, management, administrators
- Create and refine a new MP service "product"

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Costs to the medical physicist

- Time, travel (labor intensive project)
  - On-site monthly meetings
  - On-going project
  - Documentation of recommendations
  - Telephone calls as project progresses
- $ (hard to receive optimal comp)
  - Consider as a partial "loss leader"
    - Professional growth
    - Future new service offering (growth)
- Do we have the staff?
  - Consider residents, physics assistants for data collection (R&F, CR, etc.)
  - Use senior CT experienced physicists and residents for this project

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Building Relationships

- Need to sell the concept of CT protocol review –
  - Need an internal, powerful *Champion*
- Natural progression from ESE and ESER (R&F)
- RSO or Supervising Radiologist (TJC) is responsible for patient doses
- State regulations may soon specify CT Dose Review
- Medical physicist must commit to, and truly be
  - Available for consultation
  - Knowledgeable (technically, clinically) or willing to learn
  - Willing to participate as a team member
  - Invest the ongoing effort to make this work
  - Step beyond the "testing" comfort zone and truly "consult"
- Recall experience with mammo technique charts

Motivations for Radiologist

- Patient Care (General)
- Useful when answering questions (specific patient)
  - "We have reviewed all of our protocols …."
- ABR MOC
- Risk Management
- Communication with referring physicians
  - Marketing: "We are doing this new project…"
- TJC Sentinel Alert

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TJC Sentinel Alert

The Joint Commission
Sentinel Event Alert

A complimentary publication of The Joint Commission

Issue 47, August 24, 2011

Published for Joint Commission accredited organizations and interested health care professionals, *Sentinel Event Alert* identifies specific types of sentinel events, describes their common underlying causes, and suggests steps to prevent occurrences in the future.

Accredited organizations should consider information in an Alert when designing or

Radiation risks of diagnostic imaging

Diagnostic radiation is an effective tool that can save lives. The higher the dose of radiation delivered at any one time, however, the greater the risk for long-term damage. If a patient receives repeated doses, harm can also occur as the cumulative effect of those multiple doses over time.[1,2,3] Conversely, using insufficient radiation may increase the risk of misdiagnosis, delayed treatment, or, if the initial test is inadequate, repeat testing with the attendant exposure to even more radiation.[4] The risks associated with the use of ionizing radiation in diagnostic imaging include cancer, burns and other injuries.[1,5,6,7] X-rays are officially classified as a carcinogen by the World Health Organization's International Agency for Research on Cancer, the Agency for Toxic Substances and Disease Registry of the Centers for Disease Control and Prevention, and the National Institute of Environmental Health Sciences.[1]

"Right Dose"

- 6. Radiologists should assure that the proper dosing (sic) protocol is in place for the patient being treated.
- 7. Institute a process for the review of all dosing (sic) protocols either annually or every two years to ensure that protocols adhere to the latest evidence.

ABR AMERICAN BOARD OF RADIOLOGY

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Policies
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LOG IN TO YOUR PDB
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MOC: Maintenance of Certification

MOC > Diagnostic Radiology

DR Diagnostic Radiology

The ABR believes in the value of maintenance of certification. All ABR Trustees participate in ABR-MOC.

Our maintenance of certification process (ABR-MOC) is designed to facilitate and document the professional development of each diplomate through its focus on the essential elements of quality care.

MOC focuses on the essential elements of quality care.

The American Board of Medical Specialties (ABMS) and the American Board of Radiology (ABR), as a member board, have initiated this process. Over the next ten years, ABR-MOC will continue to develop into a comprehensive vehicle through which all diplomates can ensure the public and the radiologic community that they are incorporating new information into their practices, thereby delivering excellence in care.

With this in mind, we recommend that all diplomates participate in the ABR-MOC program.

Those with time-limited certificates are automatically enrolled in the process, though they must initiate their activity. Those with lifetime certificates should consider ABR-MOC as an investment that will ensure continuing education, instill confidence, and promote the best interests of the patient.

www.theabr.org

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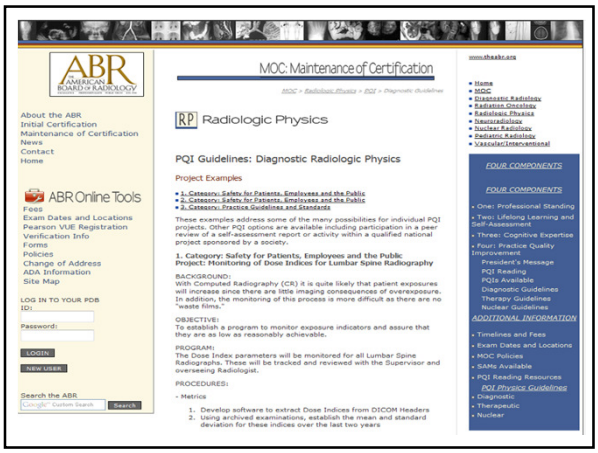
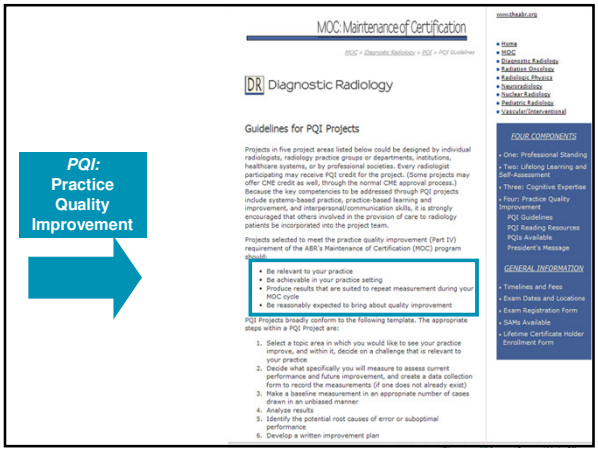
FOUR COMPONENTS

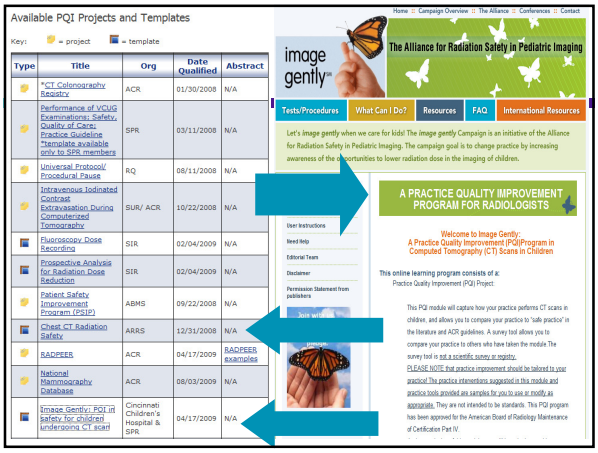
- One: Professional Standing
- Two: Lifelong Learning and Self-Assessment
- Three: Cognitive Expertise
- Four: Practice Quality Improvement

GENERAL INFORMATION

- Timelines and Fees
- Exam Dates and Locations
- Exam Registration Form
- Study Guides
- SAMs Available
- Lifetime Certificate Holder Enrollment Form
- MOC Fee FAQ


MOC: Maintenance of Certification
Radiologic Physics
PQI Guidelines: Diagnostic Radiologic Physics
Project Examples
1. Category: Safety for Patients, Employees and the Public
2. Category: Safety for Patients, Employees and the Public
3. Category: Practice Guidelines and Standards
1. Category: Safety for Patients, Employees and the Public
Project: Monitoring of Dose Indices for Lumbar Spine Radiography
BACKGROUND:
With Computed Radiography (CR) it is quite likely that patient exposures will increase since there are little imaging consequences of overexposure. In addition, the monitoring of this process is more difficult as there are no "waste films."
OBJECTIVE:
To establish a program to monitor exposure indicators and assure that they are as low as reasonably achievable.
PROGRAM:
The Dose Index parameters will be monitored for all Lumbar Spine Radiographs. These will be tracked and reviewed with the Supervisor and overseeing Radiologist.
PROCEDURES:
- Metrics
1. Develop software to extract Dose Indices from DICOM Headers
2. Using archived examinations, establish the mean and standard deviation for these indices over the last two years
FOUR COMPONENTS
ADDITIONAL INFORMATION
POI Physics Guidelines


PQI:
Practice
Quality
Improvement
MOC: Maintenance of Certification
Diagnostic Radiology
Guidelines for PQI Projects
Be relevant to your practice
Be achievable in your practice setting
Produce results that are suited to repeat measurement during your MOC cycle
Be reasonably expected to bring about quality improvement
1. Select a topic area in which you would like to see your practice improve, and within it, decide on a challenge that is relevant to your practice
2. Decide what specifically you will measure to assess current performance and future improvement, and create a data collection form to record the measurements (if one does not already exist)
3. Make a baseline measurement in an appropriate number of cases drawn in an unbiased manner
4. Analyze results
5. Identify the potential root causes of error or suboptimal performance
6. Develop a written improvement plan
FOUR COMPONENTS
GENERAL INFORMATION


Available PQI Projects and Templates
Key: = project = template
Type
Title
Org
Date Qualified
Abstract
*CT Colonography Registry
ACR
01/30/2008
N/A
Performance of VCUG Examinations: Safety, Quality of Care: Practice Guideline *Template available only to SPR members
SPR
03/11/2008
N/A
Universal Protocol/ Procedural Pause
RQ
08/11/2008
N/A
Intravenous Iodinated Contrast Extravasation During Computerized Tomography
SUR/ ACR
10/22/2008
N/A
Fluoroscopy Dose Recording
SIR
02/04/2009
N/A
Prospective Analysis for Radiation Dose Reduction
SIR
02/04/2009
N/A
Patient Safety Improvement Program (PSIP)
ABMS
09/22/2008
N/A
Chest CT Radiation Safety
ARRS
12/31/2008
N/A
RADPEER
ACR
04/17/2009
RADPEER examples
National Mammography Database
ACR
08/03/2009
N/A
Image Gently: PQI in safety for children undergoing CT scan
Cincinnati Children's Hospital & SPR
04/17/2009
N/A
image gently
The Alliance for Radiation Safety in Pediatric Imaging
Tests/Procedures
What Can I Do?
Resources
FAQ
International Resources
A PRACTICE QUALITY IMPROVEMENT PROGRAM FOR RADIOLOGISTS
Welcome to Image Gently:
A Practice Quality Improvement (PQI)Program in Computed Tomography (CT) Scans in Children
This online learning program consists of a:
Practice Quality Improvement (PQI) Project.

No one wants to be Front-Page Headlines

Building relationships

- Build on past successes
  - ACR CT Accreditation (3 protocols, then 4)
  - Image Gently
  - ESE analysis
  - CR Exposure index (s-number, LgN, EI, etc.)
- Start with CT technologist and Radiologist
- Remind others of Congressional hearings
  - Statements from AAPM, ACR, etc.
- FDA position April 20, 2010

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Initiative to Reduce Unnecessary Radiation Exposure from Medical Imaging

FDA is launching a collaborative *Initiative to Reduce Unnecessary Radiation Exposure from Medical Imaging*, with a focus on the types of imaging procedures that are associated with the highest radiation doses: CT, fluoroscopy, and nuclear medicine.

U.S. Food and Drug Administration

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- …two principles of radiation protection: appropriate *justification* for ordering and performing each procedure, and careful optimization of the radiation dose used during each procedure.
- These types of imaging exams should be conducted only when medically justified.
- When such exams are conducted, patients should be exposed to an optimal radiation dose – no more or less than what is necessary to produce a high-quality image.
- In other words, each patient should get the right imaging exam, at the right time, with the right radiation dose.

Salesmanship 101

- Why should facilities engage in protocol review
  - Quality Patient Care
  - Risk Management
  - Patients are asking "What is my dose from CT"
    - Would be helpful to respond "We are engaged in an ongoing review process to assure ALARA?"
  - Potentially emerging (or new interpretations of) **regulations** and **accreditation requirements**
  - MP Consider "no charge" first client while you are learning
  - Reference this success to other clients

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Salesmanship 101 – **Decision makers**

- Radiology Manager
- RSO
- Radiation Safety Committee
- Hospital Administrators
- Risk Management
- Hospital Board of Directors

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Salesmanship 101

- Why should facilities engage in protocol review
- Quality Patient Care
- Risk Management
- Patients are already asking "What is the dose from CT"
- Would be helpful to respond "We are engaged in an ongoing review process to assure ALARA"
- Potentially emerging regulations, accreditation requirements or interpretations

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The Joint Commission
Sentinel Event Alert
Issue 47, August 24, 2011

Addressing contributing factors to eliminate avoidable radiation dosing (sic)
There are actions that organizations can take to eliminate avoidable radiation. First, staff should be aware of the contributing factors to, and activities that can help eliminate, avoidable radiation doses, which include: …….

- Knowledge regarding typical doses.
- Clear protocols that identify the maximum dose for each type of study.
- Consulting with a qualified medical physicist when designing or altering scan protocols.
- Communication among clinicians, medical physicists, technologists and staff.

"Right Dose"

6. Radiologists should assure that the proper dosing (sic) protocol is in place for the patient being treated.

7. Institute a process for the review of all dosing (sic) protocols either annually or every two years to ensure that protocols adhere to the latest evidence.

8. Investigate patterns outside the range of appropriate doses. Track radiation doses from exams repeated due to insufficient image quality or lack of availability of previous studies to identify the causes. Address and resolve these problems through education and other measures.

Personnel to Support Project…

	Concerns	Authority Time	$$$	Staff	MDs
CT RT (Spvsr)	Pt care, standardization	✓	?	✓	?
Radiology Mgr	+ operating budget	✓	✓	✓	?
Radiologist	Pt care, standardization, Referring MDs, legal	✓	?	?	✓

Essential Personnel to Support Project…

	Concerns	Authority Time	$$$	Staff	MDs
CT RT (Spvsr)	Pt care, standardization	✓	?	✓	?
Radiology Mgr	+ operating budget	✓	✓	✓	?
Radiologist	Pt care, standardization, Referring MDs, legal	✓	?	?	✓
RSC - RSO	Avoid incidents; compliance	?	?	?	✓
Admin	Avoid incidents;	✓	✓	✓	?
Risk Mgmt	Publicity; Legal	✓	✓	✓	?
Brd of Directors	Publicity, personal legal risk	✓	✓	✓	?

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A few  of advice…

- Teaching technologists is win-win
  - How their scanner works
  - Meaning of CTDI and DLP displays
  - Set trigger levels
- Carefully document process and recommendations

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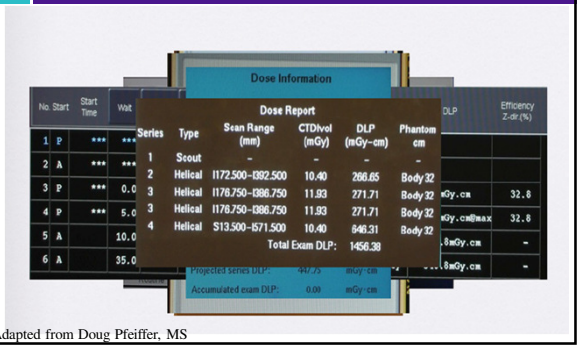
Teaching CT Technologists about Dose Info



Adapted from Doug Pfeiffer, MS

How to present/document recommendations

- **Observation:** *The default __ protocol was initially set for __, for which (dose, image quality) may not be optimal. These have been discussed with the CT Protocol Review Committee*
- **Recommendation:** *Consider modifying the protocol ___ to improve (dose, image quality) as documented in Committee Minutes. Dr. Rogers to assess clinical acceptability. Notify Committee members if problems are reported.*
- **Caution:** *Changing default protocols without team consensus could compromise patient care (image quality and dose).*

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If facility isn't willing to pay for more support…

- **Added Caution:** *Changing default protocols without a medical physics consultation could compromise patient care.*
- ***CTDI displays are not patient dose displays*** *and can be complex to interpret. Without further medical physics consultation regarding changes, we are unable to assess the potential for patient injury due to excessive radiation exposure.*

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If site is unwilling to **start** paying for support…

- **Added Caution:** *This report of routine medical physics service is limited to evaluation of image quality and dose for specific protocols specified in the ACR CT accreditation program (routine head, abdomen and pediatric abdomen).*
- *We have not been engaged to participate in an overall review of facility protocols.* ***Hence, we are unable to assess the potential for patient injury due to excessive radiation exposure from protocols we have not been retained to evaluate.***

AAPM Resources

Task Group No. 225 - Medical Physics Practice Guidelines Task Group #2: CT Protocol Management and Review

- **bookmark this page** (bookmarks show under "My AAPM" in the menu to left)

No Website on file. | **Wiki Lite** | **Wiki Full** | **Directory: Committee** | **Membership**

Email You may send email to this group now using **gmail** or **outlook**.
- or -
You may save the address *2012.zTG225@mail.aapm.org* to your local address book. This alias updates hourly from the AAPM Directory.

Bylaws: Not Referenced. **Rules:** Not Referenced.

Approved Date(s) Start: 2/6/2012

Committee Keywords: TG225

- Board of Directors [Status]
  - Professional Council [Status]
    - Clinical Practice [Status]
      - SC on Practice Guidelines [Status]
        - **TG225 - Medical Physics Practice Guidelines Task Group #2: CT Protocol Management and Review** [Status]

Cody, Dianna D.
2/6/2012 **Task Group Chair** -

no photo available

Fisher, Tyler S
2/6/2012 Member -

Gress, Dustin A.
2/6/2012 Member -

Layman, Rick Robert Jr.
2/6/2012 Member -

McNitt-Gray, Michael F.
2/6/2012 Member -

Pizzutiello, Robert J. Jr., FACR
2/27/2012 Member -

Staff Assigned to Committee - 2012 Roster
(dates shown below are begining date of position)

Fairobent, Lynne A
2/1/2012 AAPM Staff - *Legislative and Regulatory Affairs Manager - (ex officio, nonvoting)*

Draft #1 – CT Protocol Review 07-09-2012 Page 1

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The American Association of Physicists in Medicine (AAPM), with more than 7,500 members, is the principal organization of medical physicists in the United States. The AAPM is a nonprofit professional society whose primary purposes are to advance the science, education and professional practice of medical physics.

The AAPM will periodically define new practice guidelines for medical physics practice to help advance the science of medical physics and to improve the quality of service to patients throughout the United States. Existing medical physic practice guidelines will be reviewed for revision or renewal, as appropriate, on their fifth anniversary or sooner, if indicated.

Each medical physic practice guideline, representing a policy statement by the AAPM, has undergone a thorough consensus process in which it has been subjected to extensive review, requiring the approval of the Professional Council. The medical physics practice guidelines recognize that the safe and effective use of diagnostic and therapeutic radiology requires specific training, skills, and techniques, as described in each document. Reproduction or modification of the published practice guideline and technical standard by those entities not providing these services is not authorized.

Approved [insert date]*

AAPM CT Protocol Management and Review Practice Guideline

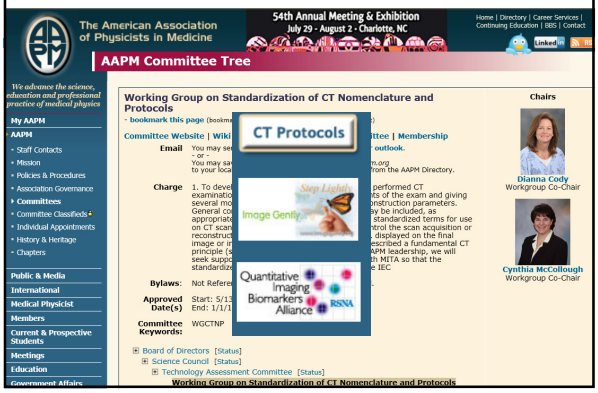
1. Introduction

Organization of Practice Guideline

- Introduction
- Definitions
- Staffing Qualifications and Responsibilities
  - Protocol Review and Management Team
  - CT radiologist, CTRT, In-house MP, Consulting MP
- Essential Elements of the Protocol Mgmt Process
- Recommended Elements of the Protocol Mgmt Process
- Conclusion

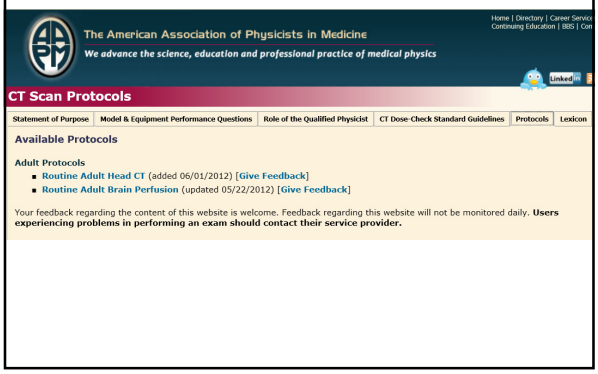
Coming soon!

AAPM CT Tools



CT Scan Protocols

- Statement of Purpose
- Model & Equipment Performance Questions
  - Contact info
- Role of QMP
- CT Dose Check Standard Guidelines
- Protocols
- Lexicon
  - Translation of Terms for different manufacturers



ROUTINE ADULT HEAD (BRAIN)

Indications

- Acute head trauma;
- Suspected acute intracranial hemorrhage;
- Immediate postoperative evaluation following brain surgery;
- Suspected shunt malfunctions, or shunt revisions;
- Mental status change;
- Increased intracranial pressure;
- Headache;
- Acute neurologic deficits;
- Suspected hydrocephalus;
- Evaluating psychiatric disorders;
- Brain herniation;
- Drug toxicity;
- Suspected mass or tumor;
- Seizures;
- Syncope;
- Detection of calcification;
- When magnetic resonance imaging (MRI) imaging is unavailable or contraindicated, or if the supervising physician deems CT to be most appropriate.

Diagnostic Task

- Detect collections of blood;
- Identify brain masses;
- Detect brain edema or ischemia;
- Identify shift in the normal locations of the brain structures including in the cephalad or caudal directions;

AXIAL VERSUS HELICAL SCAN MODE (both are provided in the following sample protocols):

There are advantages and disadvantages to using either axial or helical scans for routine head CT exams. ***The decision as to whether to use axial or helical should be influenced by the specific patient indication, scanner capabilities, and image quality requirements.*** Users of this document should consider the information in the following table and consult with both the manufacturer[1] and a medical physicist to assist in determining which mode to use.

AXIAL SCANS	CHARACTERISTICS	HELICAL SCANS
Slightly longer	Acquisition Time	Slightly shorter
Less artifacts in some cases, especially for < 16 detector row scanners	Artifacts	More artifacts for < 16 detector row scanners; close to or equivalent to axial for ≥ 64 detector row scanners
Better in some cases, especially for < 16 detector row scanners	Image Quality	Equivalent in many cases; close to or equivalent to axial for ≥ 64 detector row scanners
Depends more on protocol than on axial or helical	Radiation Dose	Depends more on protocol than on axial or helical
Present in both helical and axial scans	Over Beaming (x-ray beam extending beyond the edge of active detector rows)	Present in both helical and axial scans

INDEX OF ROUTINE ADULT HEAD (BRAIN) PROTOCOLS

AXIAL / SEQUENTIAL scan protocols (by manufacturer)

HELICAL / SPIRAL scan protocols (by manufacturer)

ADULT HEAD – ROUTINE (AXIAL) (selected GE scanners) (Back to INDEX)

SCOUT: Lateral, S150-I50, 120 kV, 10 mA. PA Scout optional.

GE	LightSpeed Ultra (8)	BrightSpeed 16 Select	LightSpeed 16 BrightSpeed 16	LightSpeed Pro 16
Scan Type	AXIAL	AXIAL	AXIAL	AXIAL
Rotation Time (s)	2	2	2	2
Detector Configuration	4 x 2.5 (10mm, 2i)	4 x 2.5 (10mm, 2i)	16 x 0.625 (10mm, 2i)	16 x 0.625 (10mm, 2i)
Pitch	-	-	-	-
Table Feed/Interval (mm)	10	10	10	20
kV	120	120	120	120
mA	140	140	140	140
Auto-mA	no	No	no	no
SFOV	HEAD	HEAD	HEAD	HEAD
Breath-hold	--	--	--	--
Prep Delay	--	--	--	--
CTDI-vol (mGy)	58.2	62.8	57.7	62.2
Recon 1				
Recon Start	Base of Skull	Base of Skull	Base of Skull	Base of Skull
Recon End	Vertex	Vertex	Vertex	Vertex
Plane	Axial	Axial	Axial	Axial
Algorithm	Stnd	Stnd	Stnd	Stnd
Recon Mode	Full	Full	Full	Full
Thickness (mm)	5	5	5	5
Interval (mm)	5	5	5	5
Recon 2				
Recon Start	Base of Skull	Base of Skull	Base of Skull	Base of Skull
Recon End	Vertex	Vertex	Vertex	Vertex
Plane	Axial	Axial	Axial	Axial
Algorithm	Bone	Bone	Bone	Bone
Recon Mode	Full	Full	Full	Full
Thickness (mm)	5	5	5	5
Interval (mm)	5	5	5	5

AAPM CT Lexicon ver 1.2 03/20/2012

Table of Contents

1. Scan acquisition and user interface basics

Generic description	GE	PHILIPS	SIEMENS	TOSHIBA	HITACHI	NEUSOFT
The portion of the **user interface** where scans are prescribed	Exam Rx	Scan Procedure	Examination	eXam Plan	Scan Protocol	Scan Procedure (Neuviz 16); Main Scan Interface (Neuviz DUAL)
Other portions of the **user interface**, such as were reconstructed images are viewed	Desktop	Active viewer	Various "task cards", such as "Viewing"	Active display	Image Viewer	Image Display Area (Neuviz 16); Viewer (Neuviz DUAL)
CT localizer radiograph (i.e. the scanned projection radiograph, often acquired by the CT system to allow the user to prescribe the start and end locations of the scan range)	Scout	Surview	Topogram	Scanogram	Scanogram	Surview
Axial scan mode: Data acquisition while the patient table remains stationary; the table position may be incremented between x-ray exposures to collect data over a longer z axis range.	Axial	Axial	Sequence	Scan & View, Scan & Scan, Volume, Wide Volume (Aquilion One)	Normal	Axial
Helical or Spiral scan mode: Data acquisition while the patient table is continuously moving along the z axis.	Helical	Helical	Spiral	Helical	Volume	Helical
Dynamic scan mode - single detector width: Data acquisition at multiple time points over the same anatomic location(s) while the patient table remains stationary; x-ray exposure can be continuous or intermittent	Cine or zero interval Axial	CCT (Continuous CT)	Dynamic (continuous) or Serio (intermittent); scan mode name: DynMulti or DynSerio.	Dynamic (Continuous or Intermittent)	Dynamic	CCT (Neuviz 16); N/A (Neuviz DUAL)
Dynamic scan mode - multiple detector widths: Data acquisition at multiple time points over the same anatomic location(s) while the patient table cycles back and forth between designated start and end locations in order image a region wider than the detector	Shuttle	Jog	Adaptive 4D Spiral; scan mode name: DynMulti4D or DynSerio4D (ECG triggered)	N/A	N/A	N/A

1. Scan acquisition and user interface basics

Generic description	GE	PHILIPS	SIEMENS	TOSHIBA
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Axial scan mode: Data acquisition while the patient table remains stationary; the table position may be incremented between x-ray exposures to collect data over a longer z axis range.	Axial	Axial	Sequence	Scan & View, Scan & Scan, Volume, Wide Volume (Aquilion One)
Helical or Spiral scan mode: Data acquisition while the patient table is continuously moving along the z axis.	Helical	Helical	Spiral	Helical
Dynamic scan mode - single detector width: Data acquisition at multiple time points over the same anatomic location(s) while the patient table remains stationary; x-ray exposure can be continuous or intermittent	Cine or zero interval Axial	CCT (Continuous CT)	Dynamic (continuous) or Serio (intermittent); scan mode name: DynMulti or DynSerio.	Dynamic (Continuous or Intermittent)
Dynamic scan mode - multiple detector widths: Data acquisition at multiple time points over the same anatomic location(s) while the patient table cycles back and forth between designated start and end locations in order image a region wider than the detector	Shuttle	Jog	Adaptive 4D Spiral; scan mode name: DynMulti4D or DynSerio4D (ECG triggered)	N/A

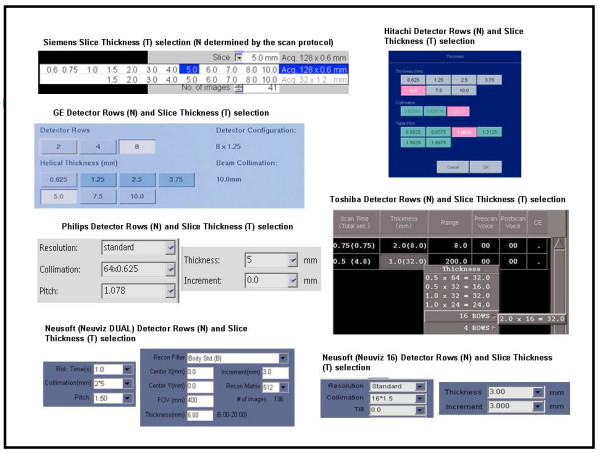
Generic description	GE	PHILIPS	SIEMENS	TOSHIBA
Table feed per 360 degree rotation of the x-ray tube (helical scan mode)	Speed (mm/rot)	Table speed (mm/rot)	Table Feed (mm/rot)*	Couch speed (mm/Rot)
Acquisition field of view: Diameter of the circular region within the scan plane over which projection data are collected. Nominally equal to the diameter of the primary beam at isocenter in the axial plane.	Scan Field of View (SFOV, cm)	Not determined by tech; built into protocol	Not determined by tech; built into protocol	CFOV (Calibrated Field of View)
Tube current: Number of electrons accelerated across an x-ray tube per unit time, expressed in units of milliampere (mA)	mA	mA*	mA*	mA
Tube current-time product: The product of tube current and exposure time per rotation, expressed in units of milliampere • seconds (mAs). In axial scan mode, this is equal to tube current × (scan angle ÷ 360) × rotation time. In helical scan mode, this is equal to tube current × rotation time.	Not used in this system	mAs	mAs	mAs
Effective tube current-time product: In helical scan mode, this is the product of tube current and rotation time (expressed in units of milliampere • seconds (mAs) ÷ pitch)	Not used in this system	mAs per slice (= mAs/pitch)	Effective mAs (= mAs/pitch)	Effective mAs (= mAs/pitch)
Tube potential: The electric potential applied across an x-ray tube to accelerate electrons towards a target material, expressed in units of kilovolts (kV)	kV	kVp	kV	kV
Pitch: Unitless parameter used to describe the table travel during helical CT, equal to table travel (mm) per gantry rotation ÷ total nominal beam width (mm)	Pitch	Pitch	Pitch	CT Pitch Factor
Automated patient instructions	AutoVoice	Auto voice	API (Automated Patient Instructions)	Breath Control

Not able to be directly modified on the user interface. Value is calculated/determined by other settings.

Generic description	GE	PHILIPS	SIEMENS	TOSHIBA
Automatic exposure control (AEC): A scanner feature that automatically adapts the x-ray tube current to the overall patient size to achieve a specified level of image quality	Available in AutomA and SmartmA	Available in DoseRight Automatic Current Selection (ACS)	Available in CARE Dose4D	Available in SURE Exposure
Angular tube current modulation	SmartScan (CT/i only)	D-DOM (Dose Modulation)	CARE Dose	not available as a separate item
Longitudinal tube current modulation	AutomA	Z-DOM	not available as a separate item	SURE Exposure
Angular and longitudinal tube current modulation	SmartmA (x, y, z)	Work in progress	CARE Dose4D	SURE Exposure 3D (X, Y and Z Modulation)
ECG-based tube current modulation	ECG Modulated mA	DoseRight Cardiac	All features available in HeartView package (except (3), only available for SOMATOM Definition Flash) (1) Retrospective gated spiral mode: use "Pulsing" settings in Trigger card (2) Prospective triggered sequence: use "Adaptive Cardio Seq." and "Pulsing" settings in Trigger card. (3) Prospectively triggered spiral ("Flash" mode)	ECG Modulation
Image quality reference parameter for AEC	Noise Index	Reference image	Quality reference mAs	Standard Deviation or standard, low-dose, or high-quality

3. Multi-Slice Detector Geometry

Generic description	GE	PHILIPS	SIEMENS	TOSHIBA	HITACHI	NEUSOFT
Multi-slice detector array design	Fixed	Model dependent: Fixed or Asymmetric	Model dependent: Adaptive or Fixed	Fixed (32 row and above); Adaptive (16 row and below)	Asymmetric-16 slice; Fixed-64 slice	Asymmetric (Neuviz 16); Fixed (Neuviz DUAL)
Detector configuration	Detector Configuration	Collimation N x T (mm)	Detector Configuration or Acq (Acquisition) on Exam Card	Detector Configuration	Detector Configuration	Collimation N x T (mm)



Scope of Protocol Review project

- Start with highest dose impact/volume studies
  Perfusion and Pediatrics
- Review clinical considerations, dose, protocol details
- Minimize number of protocols
- Educate members about patient dose vs. CTDI
- Agree on CTDI ranges for key exams
  - And what to do if they are exceeded
- Generate recommendations (trial solutions)
- Meet regularly and re-evaluate
- Evaluate more protocols
- Document process and results

LANDAUER MEDICAL PHYSICS

Summary

How to

- ☑ Come up to speed on a wide range of scanner types
- ☑ Leverage your experience from one site to others
- ☑ Build relationships that encourages your client to seek your input on protocols
- ☑ Address protocol problems once you find them, particularly if the site isn't willing to pay for support
- ☑ Utilize AAPM support tools

Thank you!

LANDAUER MEDICAL PHYSICS