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# CT Protocol Review: Practical Tips for the Imaging Physicist

Physicist

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# Goals

- Understand purpose and importance of CT Protocol Review
- Understand AAPM MPPG 1a
- Utilize AAPM support tools





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TG225 - Medical Physics Practice Guidelines Task Group #2: CT Protocol

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There are 22 members and guests.

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**Fairobent, Lynne A**



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The AAPM will periodically define new practice guidelines for medical physics practice to help

# **AAPM Medical Physics Practice Guideline 1.a. AAPM CT Protocol Management and Review Practice Guideline**

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 guidelines and technical standards by those entities not providing these services is not authorized.

Approved [March 8, 2013]\*

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**AAPM Medical Physics Practice Guideline 1.a.  
AAPM CT Protocol Management and Review Practice Guideline**

**Sept. 2013 issue of JACMP**



# **Organization of the Practice Guideline**

- 1. Introduction**
- 2. Definitions**
- 3. Staffing Qualifications and Responsibilities**
- 4. Essential Elements of the Protocol Management Process**
- 5. Conclusion**
- 6. References**



# Introduction

- The **review and management of CT protocols**
  - ongoing mechanism to ensure exams
  - achieve the desired diagnostic image quality
  - lowest radiation dose possible
  - properly exploiting the capabilities of the equipment
  - diagnostic images are produced.
  - essential activity in ensuring patient safety
- The AAPM considers these activities
  - essential to any quality assurance (QA) program for CT
  - ongoing investment in improved quality of patient care.



# Introduction

- Review and improvement of CT protocols
  - **complex undertaking** in the present environment
  - balance dose and image quality
  - compounded by a lack of an automated mechanism to collect and modify protocols
  - manual labor involved is not inconsequential
    - identifying
    - recording
    - compiling for review
    - subsequent implementation of all relevant parameters of active protocols



# Application of the MPPG

- This MPPG **only applies** to CT scanners used for diagnostic imaging. **It is not applicable** to scanners used **exclusively** for:
  - Therapeutic radiation treatment planning or delivery;
  - Only calculating attenuation coefficients for nuclear medicine studies; or
  - Image guidance for interventional radiologic procedures.

**However, CT protocol review is encouraged in these settings!!**





# The Team

- **Must** be responsible for protocol design and review of all parameter settings.
- Each team member brings different expertise and may have different responsibilities in the Protocol Review and Management process.
- To be successful, it is very important that the expectations of roles and responsibilities of each member are clearly described.
- The ability to work together as a team will be important attributes of each member of this group.



# Responsibilities of the QMP

## CT Protocol Management and Review

- QMP's responsibilities may vary, depending on the type of facility they are supporting; regardless, the QMP **must be** involved in the review of all protocols.
- Lead CT Radiologist, should lead the CT Protocol Management and Review process; the QMP is an integral member of the team.
- Balanced with adequate response times to facility inquiries.



# The QMP's Time

- A QMP's time at a facility **should** include but not be limited to:
  - meeting with the CT Protocol Management and Review team; clinical observation;
  - phantom measurements; side-by-side image review with radiologist(s);
  - artifact review with technologist(s) and/or radiologist(s);
  - discussion of equipment performance and operation; etc.



# In House QMP

- QMP **should** be sure to adequately communicate with his/her supervisor(s) regarding time commitment to this process
- CT Protocol Management and Review process is an ongoing investment in improved quality of patient care.



# In House QMP (continued)

- In-house QMP's may be able to arrange more frequent meetings with CT Protocol Management and Review team members than their consulting colleagues;
- Six to twelve meetings annually may be more appropriate for facilities with in-house QMP's, with the meeting frequency likely decreasing as time goes on and the facility's protocols are sufficiently improved.



# Consulting QMP

- CT Protocol Management and Review services are above and beyond normal QMPs consulting services (e.g., the annual physics survey), which have traditionally been limited to image quality, dosimetry and basic protocol review for a few selected examinations.
- Consultant QMPs **should** make this clear to their clients, and negotiate their services appropriately.
- Consulting QMP's **should** work with the facility to arrange mutually agreeable times to visit the facility for CT protocol review activities. Three to four visits annually may be reasonable.



# The Protocol Management Review Process

- All new or modified protocol settings for existing and new scanners
- Ensure that both image quality and radiation dose aspects are appropriate.
- Review of existing protocols
- Implementation of new and innovative technologies that can improve image quality and/or lower patient dose in comparison to the older protocol.



# The Protocol Management Review Process (continued)

- Specific capabilities of each individual scanner (e.g., minimum rotation time, automatic exposure controls including both tube current modulation as well as kV selection technologies, iterative reconstruction, reconstruction algorithms, etc.) to ensure maximum performance of the system is achieved.
- It **should** include a review of the most current literature.



# Considerations Important During Review of a Protocol

- **Recommendations for State and National Guidance**
  - The QMP **must** be familiar with applicable federal law and the specific requirements for the state or local jurisdiction where the facility is located.
  - Protocol review and management, while not always explicitly required by state law or regulation, may often facilitate compliance with many provisions within state laws and regulations relating to radiation dose from CT.



# Considerations Important During Review of a Protocol (continued)

- **Frequency of Review**

- The review process **must** be consistent with federal, state and local laws and regulations.
- If there is no specific regulatory requirement, the frequency of protocol review **should** be no less frequent than 24 months.
- This review **should** include all new protocols added since the last review.
- However, the best practice would be to review a facility's most-frequently-used protocols at least annually.



# Considerations Important During Review of a Protocol (continued)

- **Clinically Significant Protocols that Require Annual Review**
  - If a facility performs the **following six clinical protocols**, the CT Protocol Review and Management team **must** review these annually (or more frequently if required by state or local regulatory body).
    - Pediatric Head (1 year old) (if performed at the institution)
    - Pediatric Abdomen (5 year old; 40-50 lb. or approx. 20 kg) (if performed at the institution)
    - Adult Head
    - Adult Abdomen (70 kg)
    - High Resolution Chest
    - Brain Perfusion (if performed at the institution)



# Clinically Significant Protocols that Require Annual Review

- Facilities that do not perform these “six protocols” **must** select additional protocols at their facility, either the most frequently performed or higher-dose protocols, to total at least six for annual review.



# Considerations Important During Review of a Protocol (continued)

- **Protocol Naming**

- Consider naming CT protocols in a manner consistent with the RadLex Playbook ID.
- This would provide a more consistent experience for patients and allow more direct comparison among various facilities.
- This practice may also allow more direct utilization of the ACR Dose Index Registry tools and provide more efficient automated processes with post-processing workstations.
- Appropriate protocol naming will likely result in fewer technologist errors and allow more efficient comparison of protocol parameters between scanners.
- Consider incorporating version dates in protocol names to easily confirm correct version.



# Considerations Important During Review of a Protocol (continued)

- **Permissions**
  - Document who has permission to change protocol parameters on the scanner(s).
    - Encourage use of password protection if available.
  - Document process of making protocol adjustments and the frequency of these adjustments.
    - Approvals (e.g., a change control log documenting the rationale and who authorized or motivated the change).



# Considerations Important During Review of a Protocol (continued)

- **Acquisition Parameters** should be reviewed to ensure they are appropriate for the diagnostic image quality (noise level, spatial resolution, etc.) necessary for the clinical indication(s) for the protocol, while minimizing radiation dose. For example, a slow rotation time and/or low pitch value would not be appropriate for a chest CT exam due to breath-hold issues.
- Parameters include:
  - kV,
  - mA,
  - rotation time,
  - collimation or detector configuration,
  - pitch, etc.



# Considerations Important During Review of a Protocol (continued)

- **Reconstruction parameters** should also be reviewed to ensure appropriate diagnostic image quality (noise level, spatial resolution, etc.) necessary for the clinical indication(s) for the protocol.
- The parameters include:
  - the width of the reconstructed image (image thickness),
  - distance between two consecutive reconstructed images (reconstruction interval),
  - reconstruction algorithm/kernel/filter,
  - the use of additional image planes (e.g., sagittal or coronal planes, etc.)



# Considerations Important During Review of a Protocol (continued)

- **Advanced dose reduction techniques should be considered**, provided the use of such techniques is consistent with the goals of the exam.
- Depending on the capabilities of each specific scanner, consider use of the following if they are available:
  - Automatic exposure control (e.g., tube current modulation or kV selection) methods
  - Iterative reconstruction techniques



# Considerations Important During Review of a Protocol (continued)

- **Adjustments of acquisition parameters** should be adjusted for patient size,
  - manual adjustments
  - automatic techniques (such as tube current modulation methods that adjust for patient size)
  - both



# Considerations Important During Review of a Protocol (continued)

- **Radiation dose management tools**
  - Identify when potentially high radiation dose scans are being prescribed **should** be implemented when available. MITA XR25 standard (“CT Dose Check”).
  - Monitor doses from routine exams and collect data. These would allow statistical analysis of dose parameter values for a specific exam or clinical indication (e.g., average CTDI<sub>vol</sub> for a routine non-contrast head).
    - Participation in a national registry (such as the ACR Dose Index Registry).
    - Commercial products now available for this purpose.



# Considerations Important During Review of a Protocol (continued)

- **Updating Protocols Across Scanners**
  - Process by which protocol parameters are populated across additional scanners
    - manually
    - copy/paste
  - ‘Master’ scanners in the facility where manual protocol adjustments are made and archived, and that set of protocols moved to the other similar scanners.



# Considerations Important During Review of a Protocol (continued)

- **Documentation**

- All changes to protocols and historical protocols **should** be available for review.
- Include the rationale for changes.
- Latest protocol **should** be readily and obviously available to users during clinical protocol selection.
- Who is responsible for maintaining the overall protocol description documentation.
- Describe whether the protocol description documentation is accessible to others for reference, how often it is updated and how all protocols are archived.



# Considerations Important During Review of a Protocol (continued)

- Periodic vendor specific education/refresher sessions
  - Each member of the CT Protocol Management Process team **should** receive refresher training no less than annually or when new technology is introduced that substantially impacts image quality or dose to the patient.
    - Available educational resources **should** be considered in order to keep staff updated on current best practices.
    - Periodic refresher training **should** be scheduled for all members of the CT Protocol Management Process team.
    - Attendance **should** be taken at initial and all refresher-training sessions, and consequences identified for failure to complete training.



# Considerations Important During Review of a Protocol (continued)

- **Verification**

- Regular review process of protocols to be sure that no unintended changes have been applied that may degrade image quality or unreasonably increase dose.
- As a best practice, the CT Protocol Review and Management team **should** conduct a random survey of specific exam types to verify that the protocols used are acceptable and consistent with protocols specified above.
  - Acquisition and reconstruction parameters
  - Image quality
  - Radiation dose.



# Conclusion

- CT protocol management and review is an important part of a CT facility's operation and is considered important by many state regulatory bodies, accrediting and professional organizations.
- Protocol parameter control and periodic review will help maintain the facility's image quality to acceptable levels, and will serve to assure patient safety and continuous improvement in the imaging practice.

