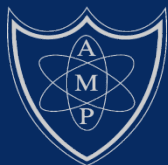


# ACR Updates - CT

Chad M. Dillon, MS, DABR (D,N), DABMP, MRSE

AAPM Annual Meeting  
July 31, 2018



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# Disclosures

- Chair, ACR CT Physics Subcommittee
- Senior Reviewer, ACR CT Accreditation Program
- Vice President, Medical Physicist, Alliance Medical Physics, LLC

# Outline

- Current ACR CT Accreditation Program Statistics
- CT Accreditation Process Updates
- 2017 ACR CT Quality Control Manual
- Future Considerations

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# Current ACR CT Accreditation Program Statistics

- As of July 2018

	Sites		CT Units	
Date	12/2016	7/2018	12/2016	7/2018
Accredited	7095	7139	9508	9849
Active	7211	7242	9885	10132

\*Active – Accredited & In Process

- 2017 Pass/Fail Rate: 91% (9% Overall Repeat)

# Current ACR CT Accreditation Program Statistics

- As of July 2018
  - Average turn around time from testing materials to final report
    - 30 Days
  - Lung Cancer Screening Designation
    - ~2800 centers



# Outline

- Current ACR CT Accreditation Program Statistics
- **CT Accreditation Process Updates**
- 2017 ACR CT Quality Control Manual
- Future Considerations

# Physics Scoring Changes

## 1. Dosimetry Images Not Submitted

### Previous:

- Major deficiency
- Results in an appeal with CTDI image submission

### New:

- Reviewer rejects submission without scoring
- ACR staff follows up with the site to have CTDI images submitted.



# Physics Scoring Changes

2. CT Beam Collimation - N x T on phantom data form does not match CTDI images exclusive of scanner limitations

Previous:

- Major deficiency

New (exclusive of scanner limitations):

- Minor deficiency – Detector configuration smaller than indicated (overestimates dose)
- Major deficiency – Detector configuration larger than indicated (underestimates dose)



# Physics Scoring Changes

## 3. Artifacts

### Previous:

- Scored on module 3 image only

### New:

- Artifacts to be scored on modules 1 through 3. Major or minor deficiency at reviewer's discretion.
- Not Deficient
  - Artifacts due to phantom construction
  - Artifacts between modules
  - Artifacts due to phantom, i.e. BBs streak on Module 1

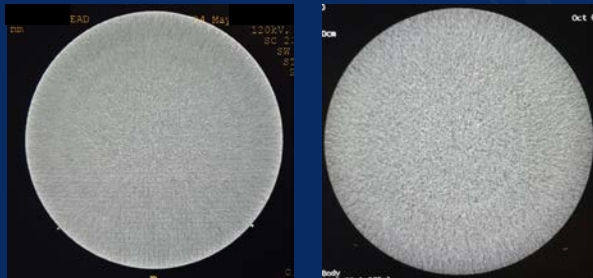


# Physics Scoring Changes

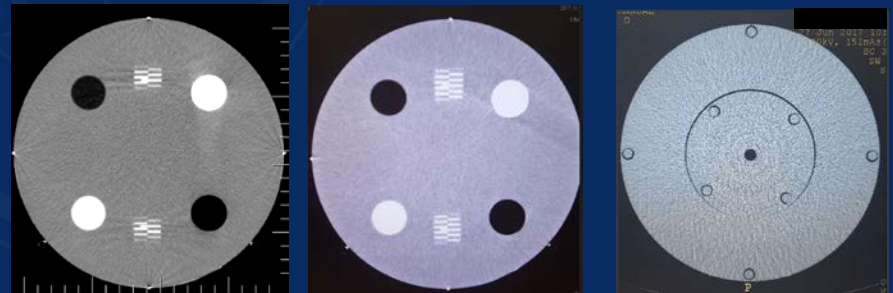
## Major Deficiency:



## Minor Deficiency:



## No Deficiency:



# Physics Scoring Changes

## 4. CTDI Minimum Images

Previous: Not specified

New:

- Submit all images in one axial rotation. Can be either:
  - 12 o'clock
  - Center
- Only one series per protocol is needed
- Minor deficiency if all images for one rotation are not submitted
- Rationale: DICOM header does not always show N x T



# Physics Scoring Changes

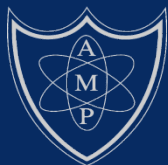
## 5. Pitch

### Previous:

- Minor deficiency – Pitch used on ACR phantom scan is more than 10% different from what is recorded in the phantom data form

### New:

- Major deficiency - Pitch is more than 10% less from what is recorded in the phantom data form
- Minor deficiency - Pitch is more than 10% greater from what is recorded in the phantom data form



# Physics Scoring Changes

## 6. Pediatric Abdomen CTDI Phantom Size

Current:

- Major Deficiency – Phantom size scanned does not match phantom size on the CTDI form.

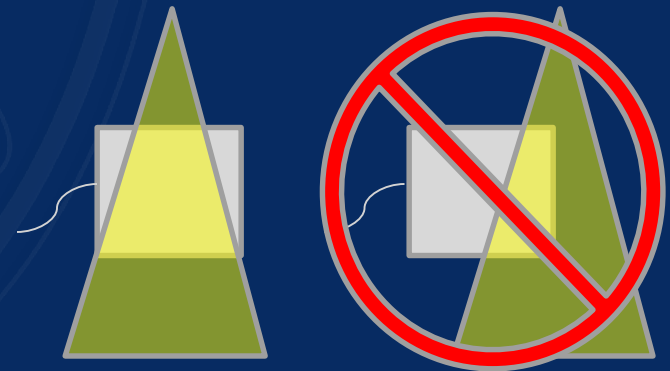
## 7. CTDI Beam Centering (Rare)

Previous:

- No deficiency

New:

- Major Deficiency- If the beam is shifted off the end of the CTDI phantom by 50% or more.








# Submission Changes

- Effective late 2018
  - Electronic submission will be required for all CT submissions.
  - CD submission will require special approval
  - Advantages:
    - No additional software needed
    - Can view images in browser
    - Could view site's clinical images prior to submission in web browser
    - Can view images after submission for a period of time



 DICOM Files

Study Description			Study Date	View Images
 ADULT HEAD DOSE			3272018	<a href="#">View</a>
Series Description	Modality	Series Number	Series Date	No of Files
ADULT HEAD DOSE	CT	3	3272018	2
ADULT HEAD DOSE	CT	4	3272018	2
 ACR PHANTOM			3272018	<a href="#">View</a>
Series Description	Modality	Series Number	Series Date	No of Files
ADULT ABDOMEN	CT	15	3272018	25
PEDIATRIC ABDOMEN	CT	20	3272018	25
Topogram 0.6 T20f	CT	12	3272018	1
ADULT ABDOMEN (120 kVp) FOR CT NUMBERS	CT	16	3272018	9
ADULT HEAD	CT	14	3272018	25
PEDIATRIC HEAD	CT	18	3272018	41
 PEDIATRIC HEAD DOSE			3272018	<a href="#">View</a>
Series Description	Modality	Series Number	Series Date	No of Files
PEDIATRIC HEAD DOSE	CT	3	3272018	3
PEDIATRIC HEAD DOSE	CT	4	3272018	3
 Customer CTDI			6162017	<a href="#">View</a>
Series Description	Modality	Series Number	Series Date	No of Files
PED ABD DOSE	CT	1	3272018	40
PED ABD DOSE	CT	0	3272018	40
 ADULT ABDOMEN DOSE			3272018	<a href="#">View</a>
Series Description	Modality	Series Number	Series Date	No of Files
ADULT ABD DOSE	CT	4	3272018	2
ADULT ABD DOSE	CT	5	3272018	2



PHANTOM, ACR

Born Jan 1, 1980 (38Y)

Sex Other

Accession No.

Patient ID CTA

Date Mar 27, 2018



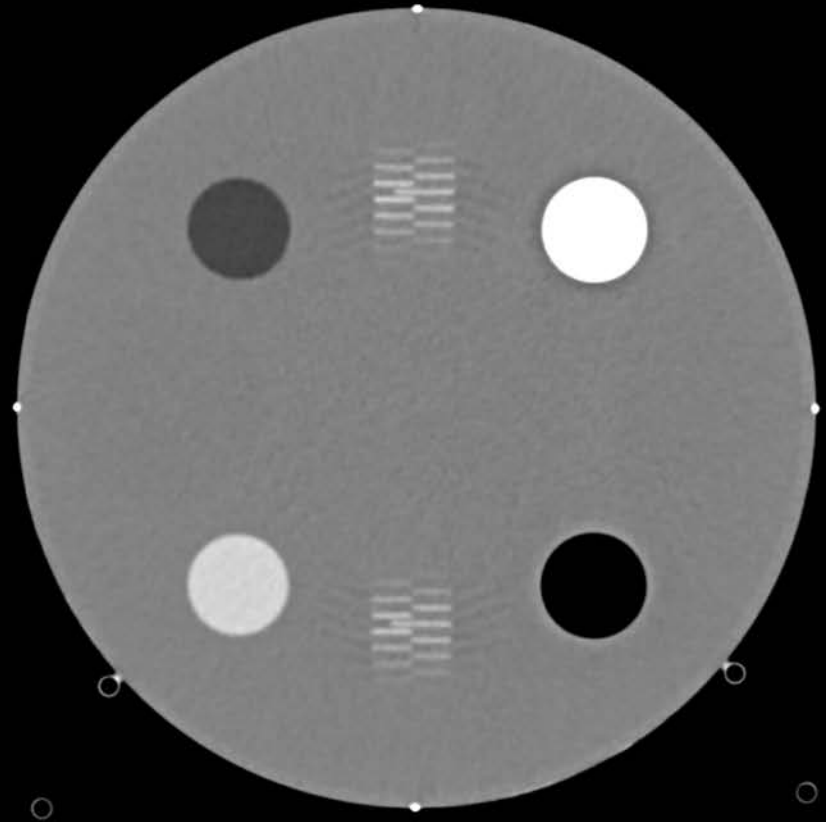
Read



- Presets
- Presentations
- View Tools
- Series
- 1
- [12] Topogram...
- 25
- [14] ADULT H...
- 25
- [15] ADULT A...
- 9
- [16] ADULT A...
- 41
- [18] PEDIATRI...
- 25
- [20] PEDIATRI...

CTAP  
PHANTOM, ACR  
O/(38Y)

ADULT ABDOMEN (120 kVp) FOR CT NUMBERS  
Mar 27, 2018  
2:52:20 PM  
Series 16 - Image 1  
Slice Pos.: 0.0 mm  
DFOV: 230.0 mm



ACR PHANTOM  
Thick.: 5.0 mm  
120 kVp, 248 mAs  
595 mA  
500 ms  
Zoom: 1.00  
WW: 400/WC: 0

9/9

# Physicist Assistants Clarification

- Program requirements document has always stated:
  - “The medical physicist **must be present** during the surveys; review, interpret, and approve all data; and provide a report of the conclusions with **his/her signature.**”
  - “Medical physicist may be assisted by properly trained individuals”
- Clarification (July 2018)
  - Medical physicist assistants must be under direct supervision.
  - QMP is responsible for determining if the individual is “properly trained”
  - QMP must be physically present (in the building or group of buildings in close proximity)

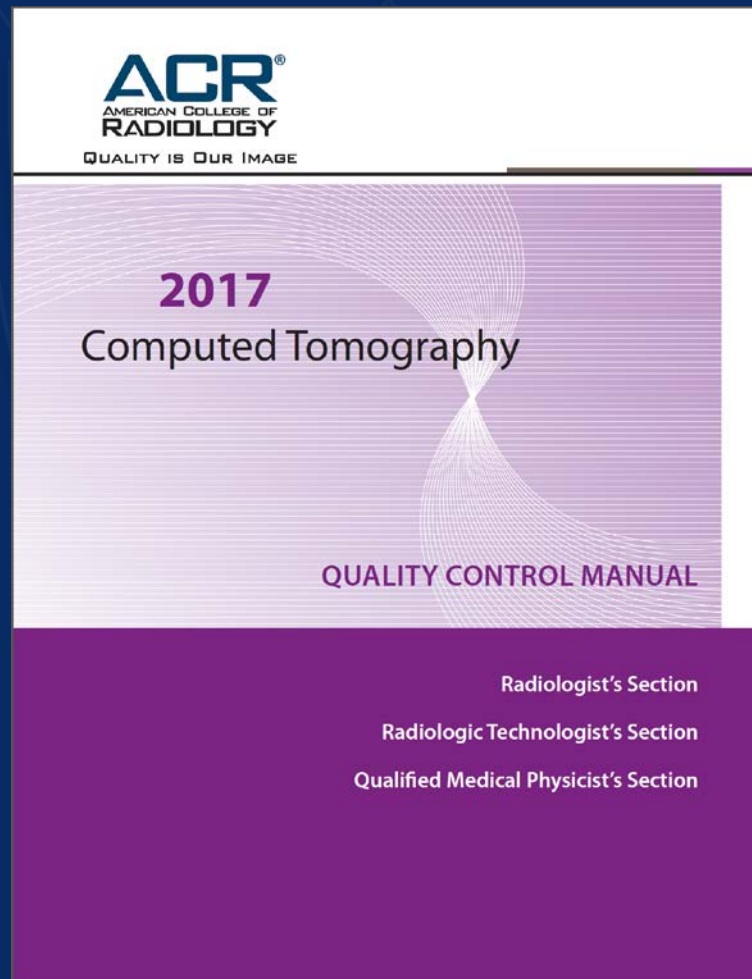
# Physicist Assistants Clarification

- Clarification (July 2018)
  - Direct supervision is NOT
    - Working at a satellite facility across town
    - Video or Teleconferencing
- Ultimately...
  - The QMP is responsible
- May be revisited following release of:
  - AAPM Medical Physics Practice Guideline 7. a.

# Outline

- Current ACR CT Accreditation Program Statistics
- CT Accreditation Process Updates
- **2017 ACR CT Quality Control Manual**
- Future Considerations

# 2017 ACR CT Quality Control Manual



# ACR CT Physics Subcommittee

## Current Members:

Will Breeden, MS

Jessica Clements, MS

Chad Dillon, MS

James Kofler, PhD

James Norweck, MS

James Tomlinson, MS

## Previous Members:

Dianna Cody, PhD

Dustin Gress, MS

Kalpana Kanal, PhD

Mike McNitt-Gray, PhD

Doug Pfeiffer, MS

Keith Strauss, MSc

Tom Ruckdeschel, MS

## ACR Staff:

Cynthia Davidson

Dina Hernandez

# General Changes

- Released October 2017
- No major additions
- Updated to reflect ACR accreditation program changes since the first revision in 2012
- Wordsmithing/Revisions for clarification or emphasis of various points
- Various References were updated to more current versions, i.e. Practice Parameters

# General Changes

For specific wording changes refer to the 2017 Spring Clinical Meeting:

Current Issues in CT Imaging	Monday - 3/20/2017	
Diagnostic Symposium - SAM	10:30 AM - 12:30 PM	Room: Ballroom C

Moderator: Jeffrey Moirano, University of Washington

<b>10:30 AM - 12:30 PM</b> Monday	MO-B-BRC-0 : <b>Current Issues in CT Imaging</b> <b>C. Dillon*</b> , <b>J. Anderson*</b> , <b>D. Beaulieu*</b>
--------------------------------------	---

<b>10:30 AM</b> MO-B-BRC-1	Updates to the ACR CT Manual <b>C. Dillon*</b>
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<https://www.aapm.org/meetings/2017SCM/PRSessions.asp?tab=2&mid=124&sid=6834>



# Radiologist Section



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# Radiologist Section – Significant Changes

- QC testing to comply with state and local regulations should be determined by a QMP.
- Acceptance testing should take place before a patient is scanned and **after major repairs**.
- Purchase Specifications and Acceptance Testing (QMP) - Updated

# Radiologist Section – Radiologist's Responsibilities

- CT protocol review section updated
  - Consistent with QMP Section
- In collaboration with the QMP:
  - Provide the **appropriate training**, test equipment and materials necessary for the technologist to perform the QC tests.

# Technologist Section



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# Technologist Section

- Updated expectation of testing after scanner repairs
- Updated Water CT Number and Standard Deviation (Noise) testing procedure and data interpretation and corrective action sections
- Clarified expectation of action limits
- Updated artifact evaluation test procedure section
- Updated links to Daily Technologist Quality Control Data Form and Weekly Laser Film Quality Control
- Removed Standard Artifact-Free Images section
- Removed link to Different Detector Configurations



# Technologist Section – Important Points – Quality Control Records

- Recommendation for keeping records updated
  - QC Documentation - 3 years
  - QC Images – 3 months (or until reviewed by the QMP)
- Added point about manufacturer standards versus ACR standards.
- After scanner repairs **water phantom testing should be completed at a minimum and complete testing may be postponed until the first feasible opportunity to complete it.”**

## Technologist Section – Water CT Number and Standard Deviation (Noise)

- Daily QC - Water CT Number and Standard Deviation:

“Images of the water phantom are acquired in **either** the axial or helical scan modes (**or both**) using predetermined scan techniques.”

- QMP should assist in setting up QC protocols
- Ideally pre-program them

## Technologist Section – Water CT Number and Standard Deviation (Noise)

- Removed repeat CT number measurement for trailing and leading slice
- Baselines should be established by QMP
  - For axial and/or helical
  - Can consult manufacturer's recommendations
  - May need a 10 day average



## Technologist Section - Water CT Number and Standard Deviation (Noise)

- Updated corrective action:
  - Check the phantom, phantom positioning, phantom image used, ROI placement, and protocol used should be double checked.
  - Run air calibrations (if recommended by the manufacturer).
  - Repeat the test.
  - If the test is still failing, consult the QMP for guidance.



# Technologist Section – Artifact Evaluation

- Some other artifacts, such as lines or streaks, can be caused by contrast material that has spilt onto the gantry.
- If these types of artifacts are present, inspect the gantry window and clean off any contrast material that may be present.
- Make sure to repeat the scan to confirm that the artifact is no longer present on the images.

# Technologist Section – Visual Checklist

- Removed:
  - High-voltage cable/other cables safely attached (and not frayed)
  - Display window width/level
  - Door interlocks functioning
- Added:
  - X-ray on indicator functioning (At the console)

# Technologist Section – Visual Checklist

- Edited:
  - Service records **maintained/accessible to the facility**
  - As opposed to “present”
- Items that do not pass the visual checklist should be replaced or corrected immediately if they are related to patient or worker safety; **and should be replaced or corrected within 30 days otherwise.**

# Technologist Section – Appendix

- New consolidated QC form
  - One Month of all QC on one form
- Can still use old or custom forms

# CT EQUIPMENT QUALITY CONTROL DATA FORM

Facility Name: \_\_\_\_\_

Month: \_\_\_\_\_ Year: \_\_\_\_\_

CT Scanner: \_\_\_\_\_

Day	Warm Up	Air Cals	Mode	CT <sub>water</sub> (HU)	Noise (SD)	Artifacts	P/F	Initials
1			Axial					
2			Helical					
3			Axial					
4			Helical					
5			Axial					
6			Helical					
7			Axial					
8			Helical					
9			Axial					
10			Helical					
11			Axial					
12			Helical					
13			Axial					
14			Helical					
15			Axial					
16			Helical					
17			Axial					
18			Helical					
19			Axial					
20			Helical					
21			Axial					
22			Helical					
23			Axial					
24			Helical					
25			Axial					
26			Helical					
27			Axial					
28			Helical					
29			Axial					
30			Helical					
31			Axial					

Action Limits: CT<sub>water</sub> = 0 ± 5 HU    Noise: A ≤ \_\_\_\_\_ H ≤ \_\_\_\_\_

**Comments/Corrective Action**

Monthly Visual Checklist	
<b>GANTRY</b>	Table height indicator.....
	Table position indicator.....
	Angulation indicator.....
	Laser localization light.....
	Smoothness of table motion.....
<b>CONTROL CONSOLE</b>	X-Ray on indicator.....
	Exposure switch.....
	Panel switches/lights/meters.....
<b>OTHER</b>	Warning labels.....
	Intercom system.....
	Postings.....
	Service records maintained/accessibile...

Monthly Acquisition Display Monitor	
<b>SMPT PATTERN</b>	0%-5% contrast is discernible.....
	95%-100% contrast is discernible.....
	Distinct gray level steps.....
	Alphanumerics discernible.....
	High contrast patterns visible.....
	Low contrast patterns visible.....
	No artifacts (distortion, burn-in, blur, etc.)

Window: \_\_\_\_\_ Level: \_\_\_\_\_

**Monthly Large Artifact Check**

If available, scan manufacturer's large phantom

Results/Artifacts:

Date of Monthly QA: \_\_\_\_\_ Initials: \_\_\_\_\_

PASS = P or ✓    FAIL = F    NOT APPLICABLE = NA

Notes:  
Air Calibration frequency is per manufacturer recommendation.  
Continue Comments/Corrective action on back of sheet, if needed.

Qualified Medical Physicist Reviewer \_\_\_\_\_ Date of Review \_\_\_\_\_



# Medical Physicist's Section

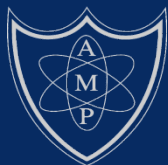


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# Medical Physicist Section – Introduction

Regarding the role of the Qualified Medical Physicist:

“Although equipment service engineers ensure the system is performing to within manufacturer’s specifications and technologists perform specified calibrations and QC, the QMP is uniquely qualified to perform certain tests and then analyze the data to determine which sets of specifications are relevant to a particular imaging problem. The QMP is able to bridge the gap between the technical aspects and clinical image quality of the system. The QMP testing allows the QMP to recognize equipment failures before they unacceptably degrade clinical images.”





# Medical Physicist Section – Introduction

“Communicating test results and recommending corrective action are areas that **should be given focused attention, as this is a vital interface between the technical assessment and the clinical practice.**”

- Regarding suggested acceptable limit criteria:

“In some cases, the manufacturer’s testing conditions (phantom, protocol) and specifications may take into account specific capabilities and functions of the scanner and therefore may be **preferred.**”

# Medical Physicist Section - QMP Annual Quality Control

“It should be noted that there is great diversity in scanner technology, phantoms, testing procedures and tolerances. The primary intent of the ACR CT QC manual is to establish a QC program and a secondary goal is to provide a reasonably uniform approach to testing. However, there may be instances where the QC manual’s described tests may not be appropriate for a specific test on a specific scanner (for some existing examples, see the [ACR CT Accreditation program FAQ](#) and specifically pages 4-7. Use of the manufacturer’s phantom, testing procedure and specifications, especially in these situations, is appropriate and encouraged.”



# Medical Physicist Section - QMP Annual Quality Control

- When ACR Test or QMP test does not pass (before service call):
  - Repeat the test to confirm the result.
  - Consult manufacturer's Technical Manual
  - Run the manufacturer equivalent test
    - If passes and not clinical image quality issue – likely OK at QMP discretion
    - If fails or degraded image quality, contact service

# Medical Physicist Section - QMP Annual Quality Control

- QMP should provide clear communication regarding the following:
  - The specific metric/issue under discussion
  - The specific tests have been performed, including test objects
  - The observed/measured results
  - The specifications (e.g. manufacturer's specifications) not being met

# Medical Physicist Section - QMP Annual Quality Control

- Site's Responsibility
  - Ensure that effective and timely corrective action is performed and documented
  - Address any comments or recommendations for quality improvement.
- If No Manufacturer Specifications
  - QMP should benchmark and monitor over time.
  - Please note additional testing outside of the manufacturer specifications may not be supported by the manufacturer.



# Medical Physicist Section - Review of Clinical Protocols - Objectives

- Previous Title: Review of Clinical Protocols
- Current Title: Participation in Review of Clinical Protocols with the CT Protocol and Management Team
- Added:
  - “The review should be consistent with the AAPM Medical Physics Practice Guideline 1.a.: AAPM CT Protocol Management and Review Practice Guideline [4]”

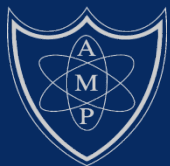
NOTE: MPPG 1.a. is currently under a mandatory five year review.

# Medical Physicist Section - Review of Clinical Protocols - Frequency

- Must be consistent with federal, state, and local laws and regulations.
- Otherwise, no less frequent than 24 months
- Include all new protocols added since the last review.
- Best practice is to review a facility's most frequently used protocols at least annually.
- It is the responsibility of the QMP and the CT Protocol Review and Management team to review annually at least the six protocols.

# Medical Physicist Section - Review of Clinical Protocols – Test Procedure

- A CT Protocol Review and Management Team
  - Radiologist
  - CT technologist
  - QMP
- Responsibilities
  - Development and review of all protocol parameter settings.
  - Reviews all new or modified protocol settings for existing and new scanners to ensure that both image quality and radiation dose are appropriate.





# Medical Physicist Section - Review of Clinical Protocols – Test Procedure

- QMP
  - Need not be physically present at meetings.
  - Should be actively involved in the review process.
  - While it may not be practical to have the QMP on-site for all discussions regarding protocol modification, their consult is critical to achieving good CT protocol performance.
  - Phone, email, and perhaps text message conversations between visits are a reasonable compromise to ensure the radiologist, technologist, and QMP are able to discuss protocol modifications as necessary.
  - The QMP protocol review need not be performed at the same time as any annual CT Physics testing, but should be performed with the frequency stated above.

# Medical Physicist Section - Review of Clinical Protocols – Test Procedure

- The facility should explicitly review the expected  $CTDI_{vol}$ .
  - Values should be compared to the reference values of the ACR CT Accreditation Program [2], AAPM CT Protocols [3], or other available reference values for the appropriate protocols.
  - NOTE: These reference values may be exceeded for individual patient scans (such as for very large patients, when the routine protocol is altered for a different clinical indication, or when the reference value only refers to a single pass in a multi-pass study).
- Review the appropriate use of advanced dose reduction techniques
  - Consider use of the following if they are available
    - Automatic exposure control (e.g., tube current modulation or kV selection) methods
    - Iterative reconstruction techniques

# Medical Physicist Section - Review of Clinical Protocols

- With respect to developing dose thresholds:  
“This may include dose notification values (XR-25/XR-29), dose thresholds for the facility’s enterprise radiation dose monitoring systems, and/or other thresholds required to satisfy state and/or other accreditation body standards.”

# Medical Physicist Section - Review of Clinical Protocols – Test Procedure

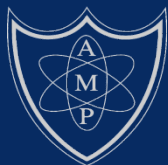
- No changes should be made by the QMP without the knowledge and agreement of the radiologist and technologist responsible for protocol changes at the site.
- It is strongly recommended that the technologist responsible for protocol changes make the change. The QMP should provide assistance if necessary.
- Do not disable the CT dose estimate interface option; ensure that the dose information is displayed during the exam prescription phase.

# Medical Physicist Section – Radiation Beam Width

“Each **unique**  $N \times T$  product that is used clinically should be measured, adjusting table position as appropriate for the detector being used”

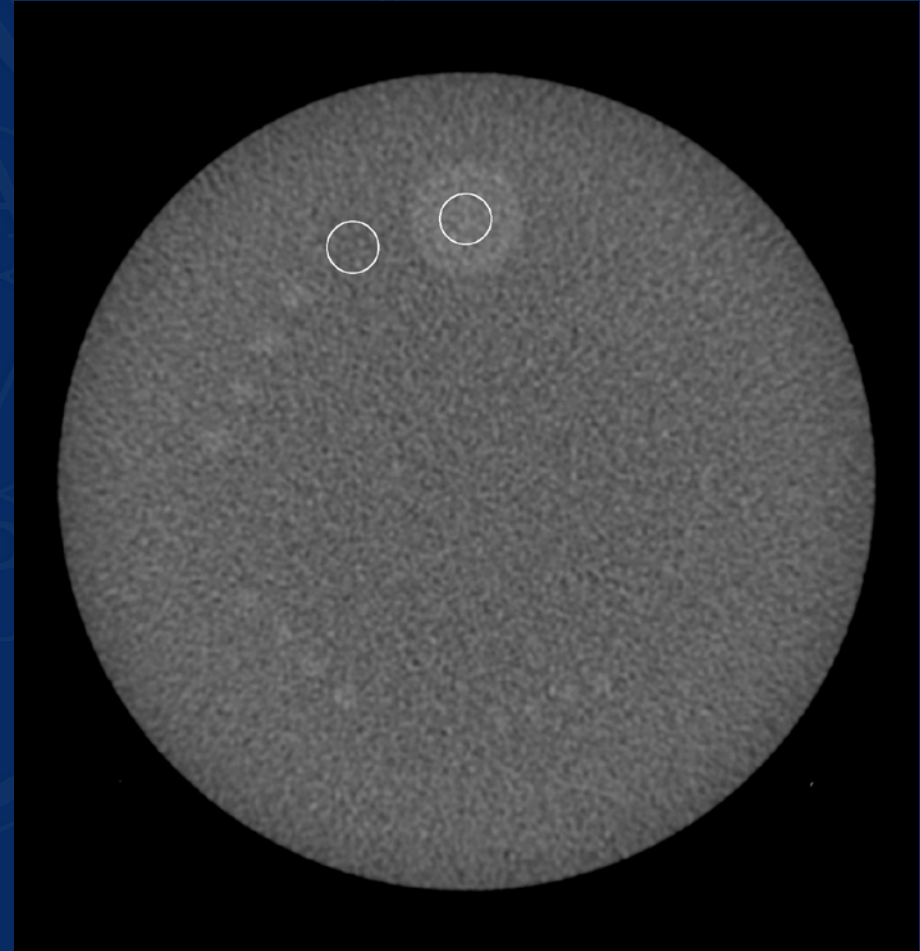
## Criteria:

- May use the manufacturer’s specifications (using their procedure)
  - Use manufacturer's technical specifications documentation.
  - If the radiation beam width is outside of manufacturer's specifications using their specified procedure, service should be contacted for corrective action.
- If no specifications
  - 3 mm or 30% of the total nominal collimated beam width ( $N \times T$ ), whichever is greater.
  - If the radiation beam width does not meet this criteria, an effort should be made to obtain the specifications from the manufacturer.
  - If these are not able to be obtained, then service should be notified to evaluate the radiation beam width.



# Medical Physicist Section - Low-Contrast Performance

- Updated to indicate area ROI 100 mm<sup>2</sup>
- New image with appropriate ROI size and location
- Removed visual analysis



# Medical Physicist Section - Low Contrast Performance

Previous Limits

Scan protocol	CNR
Adult Head	1.0
Pediatric Head	1.0
Adult Abdomen	1.0
Pediatric Abdomen	0.5

Updated Limits

Scan protocol	CNR
Adult Head	1.0
Pediatric Head	0.7
Adult Abdomen	1.0
Pediatric Abdomen	0.4

- Corrective action time frame:  
“**As soon as feasible** upon determination of suboptimal performance.”

# Medical Physicist Section - CT Number Accuracy

“Perform scans of the CT number accuracy section of the phantom with each kV setting available on the scanner **for one protocol (i.e. it is not required to test all CT number accuracies at each kV for each protocol).**”



# Medical Physicist Section

## CT Number Accuracy - Criteria

- If measured values fall outside of the specified ranges
  - Run scanner calibrations
  - Repeat the test.
  - Consult manufacturer's technical manual
  - Perform manufacturer's equivalent test.
  - Contact service if outside manufacturer's ranges.
  - If it has been verified that the scanner is properly calibrated and the numbers remain outside of the ranges, then the QMP should establish new baseline values and acceptable ranges.

# Medical Physicist Section - Artifact Check - Required Equipment

- Recommend a large diameter phantom also be used, if available.
- CTDI phantom could be used.
- ACR FAQ's describes an air scan method

# Medical Physicist Section – Artifact Check - Precautions and Caveats

- Some scanners will demonstrate a noticeable bright ring just inside the phantom border. This is sometimes from the automatic corrections a scanner makes **when a “routine head” scan protocol is performed and** the scanner anticipates a skull will be present. This artifact may be excluded from consideration.

# Medical Physicist Section – Dosimetry

Note: For pediatric (40-50 pounds) abdomen protocols, some CT scanners report CTDI<sub>vol</sub> using the 16 cm phantom, while others use the 32 cm phantom. The physicist should select the phantom (16 or 32 cm) that is used by the scanner to report CTDI<sub>vol</sub>.

- Added: In some cases, or under certain scan conditions, the manufacturer's specifications allow larger deviations between measured and displayed value (up to +/- 30 or 40%).

# Medical Physicist Section – Dosimetry

## – Timeframe for Corrective Action

“For  $CTDI_{vol}$  values exceeding ACR CTAP limits, efforts to reduce dose by modifying protocol settings should begin **as soon as possible, in consultation with the technologist and the radiologist.**”

# CT Scanner Display Calibration

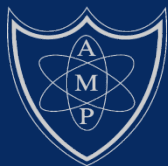
## – Test Procedure

Added:

“In the scan room displays used for interventional/biopsy procedures must provide good low-contrast visualization in typically bright room conditions. Consider repeating the above on all CT image acquisition displays.”

Revised:

“The maximum brightness should be greater than or equal to  $100 \text{ cd/m}^2$ , and the luminance ratio should be greater than equal to 100.”



# CT Scanner Display Calibration

## – Test Procedure

- If monitor does not meet spec after corrective action
  - Lead interpreting physician should consult with a QMP to determine action.
  - If the monitor is exclusively used for image acquisition and localization and not for clinical image interpretation, then it may be determined that it is acceptable to continue to use it

# Medical Physicist Section

- Removed:
  - Image Thickness Section

**Caution!**

- This is still required by:
  - The Joint Commission (Until Jan 1, 2019)
  - IAC
  - Possibly State/Local Regulations



# Outline

- Current ACR CT Accreditation Program Statistics
- CT Accreditation Process Updates
- 2017 ACR CT Quality Control Manual
- **Future Considerations**

# Future Considerations

- Iterative Reconstruction Usage
  - Should use if used clinically
  - Can record under Reconstruction Algorithm
    - Type and Strength
  - May be a minor in the future if not indicated properly
- More consistent reviewer scoring
  - Inconsistent technique factors on forms and images
  - Better rubric under development

# Future Considerations

- Special Submissions:
  - Dual Energy Submissions
    - Currently evaluating image quality
    - CTDI is additive
  - Ultra High Resolution Scanners (1024, 2048)
    - 512 to 1024
      - Noise Variance increases by 4x (1/4 photons per pixel)
        - »  $\sigma$  increases by 2x
      - Signal power increases by 4x (4x as many pixels)
        - » No effect on CNR
      - Results in CNR decrease by 1/2
- If you have either situation, contact the ACR for guidance.

# Resources

## 1. ACR CT Program Requirements

<https://www.acraccreditation.org/-/media/ACRAccreditation/Documents/CT/Requirements.pdf?la=en>

2. Dillon CM, et al., ACR 2017 Computed Tomography Quality Control Manual, October 2017, p. 58.

3. ACR CT, Nuclear Medicine, PET, MRI/Breast MRI Accreditation Program Requirements for Medical Physicists/MR Scientists: Frequently Asked Questions

[https://www.acraccreditation.org/-/media/ACRAccreditation/Documents/Medical-Physicists/MP-Qual-FAQs\\_12-10-09-rev-\(2\).pdf?la=en](https://www.acraccreditation.org/-/media/ACRAccreditation/Documents/Medical-Physicists/MP-Qual-FAQs_12-10-09-rev-(2).pdf?la=en)