ACR Updates - CT

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AAPM Annual Meeting
July 16, 2019

Disclosures

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

Outline

• Brief History
• Current ACR CT Accreditation Program
  Statistics and Status
• CT Accreditation Tips and Common Issues
  for the Medical Physicist
  – Clinical Involvement
  – Physics
• CT Accreditation Program Updates

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Brief History

• 1987 Mammography Accreditation
• 1994 FDA adopts the ACR’s MAP
• 1998 ACR CT Committee Formed
• 2002 CT Accreditation Program Began
• CT Quality Control Manuals

Original Submission Format
Current ACR CT Accreditation Program Statistics

- As of July 2019
  - 2019 Pass/Fail Rate: 94.5% (5.5% Overall Repeat)
  - 2018 Pass/Fail Rate: 92% (8% Overall Repeat)

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</tbody>
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*Active – Accredited & In Process

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Clinical Involvement

- Most common reason sites fail is they don’t follow the clinical guide, not image quality.
- All images are examples of best work
- Still should submit scouts or localizers with cross reference locations
- Supervising physician is ultimately responsible
  - They must review the entire submission.
  - The medical physicist can play a role.

ACR CT Testing Instructions
Clinical Image Quality Guide

Categories A & B - Old

Categories A & B - New

Categories A & B: Anatomy

Category A & B: Contrast

Category C: Artifacts
Category D: Exam Identification

E. Category D: Exam Identification

- Patient name (first and last)
- Date of birth
- Sex of patient
- Date of exam
- Institution name
- Radiologist

F. Technical parameters

- kVp
- mAs (or effective mAs or milliamp-seconds, as reported by the scanner)
- Beam size
- Pitch (if applicable)
- Reconstruction algorithm (please see CTDI help)

G. Image quality

- Image number maintained consistently based on anatomic location
- Image quality control

H. Dose report

Category E: Examination Protocol

F. Category E: Examination Protocol

- Indication
- Scanner acquisition settings (tube kV, matrix, mAs, effective mAs, collimation (8 x 7), pitch, rotation time, sagittal dose reduction methods, automatic exposure control such as AEC, current modulation, settings for dose reduction methods, etc.)
- Phase of examination
- Reconstruction algorithms and reconstructions (reconstructed image with voice thickness, reconstruction interval, reconstruction kernel/filtered back projection, field of view (FOV))
- Anatomic coverage (i.e., right leg to left knee, left lung to right lung, etc.)
- If contract (with injection rate and scan delay, if applicable)
- DAS (dose area product, if applicable)

Other Common Issues

What About Subjectivity of CTDI?

A. Technique Parameters

- Required scans
- Required projections
- Required reconstructions
- CTDI

B. Anatomic Coverage

- Coverage

Other Common Issues

A. Technique Parameters

- Required scans
- Required projections
- Required reconstructions
- CTDI

B. Anatomic Coverage

- Coverage

What About Subjectivity of CTDI?

The 31 mGy reference value for the adult chest study is based on an average size patient and may be higher for larger sized patients.
Other Issues – Grey Areas

• Make sure it’s in your typed scanning protocol
• Make sure the right images are uploaded
• Check with another facility that has passed
• Call the ACR CT Program (1-800-770-0145)
• Ultimately – Whatever you submit should have a basis for appeal.
  – Check published resources

Clinical Resources

https://www.aapm.org/pubs/CTProtocols/default.asp

Clinical Resources

https://www.acr.org/Clinical-Resources/Practice-Parameters-and-Technical-Standards/Practice-Parameters-by-Modality

XR-29 Tip
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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.

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)

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

Artifact Examples

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 (future).
- Rationale: DICOM header does not always show N x T

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.

Electronic Submission Required

– Can still use TRIAD software
– 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
– CD submission will require special approval

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Quality Control Manual

• Future Considerations
  – TG 233 - Performance Evaluation of Computed Tomography Systems
    • Gantry Tilt
    • Radiation Output Measurements
  – TG 299 - Quality Control in Multi-Energy Computed Tomography (MECT)
    • Image Quality
    • CTDI Measurement
Dual Energy CT

- Dual Tube
- Split Beam
- Dual Layer Detector
- Two Scans
- Rapid kVp Switching

Submissions - Current CT Forms

Dual Energy - Forms to Submit

Dual Energy Submission

- For the dosimetry, it is recommended at this time to use a dual energy protocol in the axial mode. The dosimetry can be acquired in one or two (add CTDMs for each independent energy) scans depending on the available energy selection modes for axial scans.
- For the image quality portion, be aware for CT numbers that you should submit an image at 120 kVp or 130 kVp of Module 1 as per the testing instructions. Page 23 states, “If you are routinely using other than 120-130 kVp for the adult abdomen protocol and your CT numbers do not meet the criteria listed below, please submit an additional scan of module 1 using 120-130 kVp.”
- Make sure to fill out all parameters using the CTAP Phantom Data/Dose Forms and submit it to me via email. Please modify as appropriate. Since there is not an area to upload additional information in the online system, you will need to forward any explanation/additional information to me, by email, and I will forward to the reviewers.
- Bottom line: Contact the ACR

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
  - Rubric has been developed – Reviewer Training
- DRLs and Pass/Fail Limits
Future Considerations

- Special Submissions:
  - Ultra High Resolution Scanners (1024, 2048)
    - 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 (CNR relies on mean)
    - Results in CNR decrease by 1/2

- Contact the ACR for guidance.

Further Tips

- Don’t submit excess images, i.e. all annual survey images
- Fill out the Phantom Data Forms and CTDI Calculation forms, and upload images yourself
- Double check that your Phantom Data Forms and CTDI forms match
- Check to make sure images open with ClearCanvas and that they are actually on the CD.

Acknowledgements

- Cynthia Davidson, RDMS; RVT; RT(R)
  Program Manager , CT/MR Accreditation

- Thomas Ruckdeschel, MS, DABR

Resources

1. ACR CT Program Requirements

2. ACR CT Program Testing Instructions
   ACR CT Program Requirements