Common CLINICAL Mistakes and how to avoid them: Lessons from ACR CT accreditation

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Learning Objectives

- Survey of the clinical component of the ACR CT accreditation process
- “Vital” Statistics
  - Analyze number of submissions for each category
  - Number of failures by category of submission
  - Most common reason(s) for failure by submission type
- What are take home points for practices looking to gain ACR accreditation
CT accreditation and reimbursement for services

• Section 135(a) Medicare Improvements for Patients and Providers Act of 2008
  – Designates organizations to accredit advanced diagnostic imaging services
  – ACR chosen as one of 3 national organizations to designate this accreditation
    • JACHO- accredits hospital sites
    • Intersocietal Accreditation Committee- many non radiology societal sponsors
      – Interpreting MD does NOT require ABR certification or formal radiology training. Dose values do not need to be reported

• Sites MUST be accredited by 1/2012 if they expect to obtain Medicare payment for services.
Clinical Errors are major source of failure
CT accreditation-Clinical Images-Overview

- Site must submit 1 examination from each of 3 areas
  - Head/neck
  - Chest
  - Abdomen/Pelvis
- If site examines pediatric patients (1-15 years) 1 of 3 submissions MUST be a pediatric case
- 1 examination MUST be a subspecialty examination
  - This can be adult or pediatric
CT accreditation Clinical Images: Head/neck

- Head
  - Headache, neoplasm
- Temporal Bone
  - Hearing loss
- Cervical Spine
  - Trauma
- Pediatric
  - Head-seizures
  - Sinus
  - Temporal Bones
CT accreditation Clinical Images: Chest

- Chest
  - Lung cancer
- Pulmonary Embolus
- HRCT
- Aortic Dissection
- Pediatric
  - Metastases, cough, infection
  - HRCT- diffuse lung disease
CT accreditation Clinical Images: Abdomen

- “Routine”
  - Lymphoma
  - Liver metastases
- Known Renal Mass
- Known cirrhosis
- Suspected Pancreatic cancer
- Pediatric
  - Routine abdomen- trauma
  - Renal or adrenal mass
CT accreditation

• ACR provides detailed instructions as to how the study should be performed
  – Clinical indication
  – Appropriate number(s) of images for each film sheet
  – Need for “scoutview” both plain and annotated

• Clinical CT accreditation is a QA exercise; attention to detail and ability to follow instruction are as important as “nice” images
CT Accreditation: Evaluation Parameters

- Technique
- Anatomic Coverage and Display
- Filming technique
- Artifacts
- Exam Identification
- Exam Protocol
CT accreditation; Components of Clinical Evaluation (1)

- **Technique**
  - Radiation dose as function of mAs, kVp, pitch
  - Reconstruction algorithm
  - Intestinal opacification
  - IV contrast timing
  - Appropriate use of ROI cursors
  - Appropriate vs. excessive acquisitions in same body region
CT accreditation; Components of Clinical Evaluation (2)

- Anatomic Coverage/Display
  - Complete z-axis coverage
  - Appropriate windows are displayed
    - EG- bone windows/soft tissue windows
  - Appropriate window/levels used
  - Proper DFOV
    - Includes patient centering
  - Ancillary image data windowed appropriately
    - Liver and lung windows
CT accreditation; Components of Clinical Evaluation (3)

- Filming
  - Number of images/sheet
  - BOTH annotated and Non annotated scout views are displayed
  - Film density
**CT accreditation; Components of Clinical Evaluation (4)**

- **Artifacts**
  - Missing slices
  - Scans with excessive motion
CT accreditation; Components of Clinical Evaluation (5)

- Exam Identification
  - Appropriate alpha numerics
  - Technologist name
  - Institution
  - Recon algorithm/kernel
CT accreditation; Components of Clinical Evaluation (6)

• Protocol
  – Concordance with submitted protocol
  – Adequacy of protocol
  – Proper exam submission
**Scoring**

- Each category scored 1 (worst) to 5 (best)
  - Check marks for each component of that category

- If site gets a single “1” or two “2” the submission fails
  - Reviewer may further elaborate in free text
CT Accreditation: General Assumptions

• Submitted case should reflect BEST available
• Film contrast/brightness should appear “true” to scanner output
• Alpha numeric information should be crisp, without gaps
• Slice width, slice interval, table position must be visible to the reviewer
• A protocol sheet must be included for each submission
• Protocols should be designed to answer clinical question with *minimal* radiation
Dose and accreditation: Critical Link

- Site MUST complete CTDIvol measurements for each SCANNER using site specific protocols for
  - Adult head: Routine head CT for evaluation of patient with headaches to exclude neoplasms
  - HRCT chest: CT exam of the chest for evaluation of diffuse lung disease
  - Adult abdomen: Routine oncologic CT survey of the abdomen for detection of possible liver metastases
  - Pediatric abdomen (assume pt. is 5 years old) abdomen for the evaluation of blunt trauma injuries

- These results are reported in Table 1 by the physicist.
- Site MUST report CTDIvol for each submission
- Not all scanners in field can report CTDIvol
  - Although most MDCT built >2002 can report this
  - CTDIvol measurements are NOT required to be included in the submission
**Radiation Dose**

- ALL reviewers are highly sensitive to the need for assuring the site uses technique parameters that deliver a low radiation dose without loss of quality.
- However, experienced CT radiologists cannot predict delivered dose (as CTDIvol) from:
  - Visual inspection of the image
  - Factoring the reported kVp, ma, mAs
Using kVp and mAs values on the images allowed recognition that submitted study EXCEEDED diagnostic reference level (DRL) in 21.3% (2002-4 values).

Performance DECREASED to 13.1% success in predicting that the delivered dose was too high using post 2008 standards.

mAs is NOT the proper measure of CT dose.
Dose is decreasing – (at least the numbers are getting smaller!)

<table>
<thead>
<tr>
<th>YEAR</th>
<th>% Of submissions &gt; Recommended RV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adult Head</td>
</tr>
<tr>
<td>2002</td>
<td>50</td>
</tr>
<tr>
<td>2003</td>
<td>32.4</td>
</tr>
<tr>
<td>2004</td>
<td>23.5</td>
</tr>
</tbody>
</table>

Courtesy Zeman B, McCollough C: ACR CT accreditation subcommittee 2006
Adult Head

<table>
<thead>
<tr>
<th>Year</th>
<th>75% Tile</th>
<th>90% Tile</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>76.8</td>
<td>99.0</td>
</tr>
<tr>
<td>2003</td>
<td>63.9</td>
<td>82.2</td>
</tr>
<tr>
<td>2004</td>
<td>60.0</td>
<td>74.0</td>
</tr>
<tr>
<td>2002-2004</td>
<td>64.3</td>
<td>81.3</td>
</tr>
</tbody>
</table>

(n=117)  (n=305)  (n=208)  (n=630)

Courtesy Zeman B, McCollough C: ACR CT accreditation subcommittee 2006
Adult Abdomen

2002 (n=113)  2003 (n=290)  2004 (n=197)  2002-2004 (n=600)

22.6  23.4  21.1  22.2  29.5  30.6  25.8  29.5  20  22  24  26  28  30  32

75% tile
90% tile

CTDIvol (mGy)

Courtesy Zeman B, McCollough C: ACR CT accreditation subcommittee 2006
Pediatric Abdomen

<table>
<thead>
<tr>
<th>Year</th>
<th>n</th>
<th>CTDIvol (mGy)</th>
<th>75%tile</th>
<th>90%tile</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>91</td>
<td>20.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>224</td>
<td>20.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>151</td>
<td>18.4</td>
<td></td>
<td>23.4</td>
</tr>
<tr>
<td>2002-2004</td>
<td>466</td>
<td>24.9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Courtesy Zeman B, McCollough C: ACR CT accreditation subcommittee 2006
Clinical Accreditation: Vital Statistics

• Between 1/2007-12/2009
  – Total Exams submitted- 16384
  – Total Failures (all cycles)- 2075

<table>
<thead>
<tr>
<th>Year</th>
<th>% Fail on 1st attempt</th>
<th>% Fail on 2nd Attempt</th>
<th>% Fail on 3rd attempt</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>36% initial 26% renewal</td>
<td>16% initial 10% renewal</td>
<td>12.5% initial 15% renewal</td>
</tr>
<tr>
<td>2008</td>
<td>37% initial 27% renewal</td>
<td>12% initial 18% renewal</td>
<td>16% initial 33% renewal</td>
</tr>
<tr>
<td>2009</td>
<td>33% initial 26% renewal</td>
<td>10% initial 10% renewal</td>
<td>No data</td>
</tr>
</tbody>
</table>
## Failures by Submission Type - Routine Studies 2007-2009

<table>
<thead>
<tr>
<th>Exam</th>
<th># Submissions</th>
<th># Failures</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abd CT Adult</td>
<td>3265</td>
<td>369</td>
<td>11.3%</td>
</tr>
<tr>
<td>Chest CT-Adult</td>
<td>1959</td>
<td>75</td>
<td>3.8%</td>
</tr>
<tr>
<td>Head CT Peds</td>
<td>1716</td>
<td>158</td>
<td>9.2%</td>
</tr>
<tr>
<td>Head CT Adult</td>
<td>1709</td>
<td>265</td>
<td>15.5%</td>
</tr>
<tr>
<td>Sinus Peds</td>
<td>1015</td>
<td>96</td>
<td>9.5%</td>
</tr>
<tr>
<td>Abd CT Peds</td>
<td>685</td>
<td>69</td>
<td>10.1%</td>
</tr>
<tr>
<td>Chest CT Peds</td>
<td>74</td>
<td>2</td>
<td>2.7%</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>10423</strong></td>
<td><strong>1034</strong></td>
<td><strong>9.9%</strong></td>
</tr>
</tbody>
</table>
# Common reasons for failures-routine

<table>
<thead>
<tr>
<th>Exam</th>
<th>Top Deficiency</th>
<th>% Exams failed that included this deficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult Abdomen</td>
<td>IV Contrast Volume</td>
<td>37.1%</td>
</tr>
<tr>
<td></td>
<td>IV contrast delay (too early/late)</td>
<td>26.4%</td>
</tr>
<tr>
<td></td>
<td>Inappropriate Oral Contrast</td>
<td>41.4%</td>
</tr>
<tr>
<td></td>
<td>Inappropriate contrast phase</td>
<td>30.0%</td>
</tr>
<tr>
<td></td>
<td>Excessive sequential images through body part</td>
<td>28.8%</td>
</tr>
<tr>
<td>Adult Head</td>
<td>IV Contrast Volume</td>
<td>52.1%</td>
</tr>
<tr>
<td></td>
<td>mAs inappropriate for examination (too high/low)</td>
<td>21.3%</td>
</tr>
<tr>
<td></td>
<td>Excessive sequential images through body part</td>
<td>10%</td>
</tr>
<tr>
<td>Peds Head</td>
<td>mAs inappropriate for examination (too high/low)</td>
<td>67.7%</td>
</tr>
<tr>
<td></td>
<td>Excessive sequential images through body part</td>
<td>12%</td>
</tr>
</tbody>
</table>
Clinical Example: Poor oral contrast
Inappropriate contrast timing
Effect of excessive sequences

<table>
<thead>
<tr>
<th>Scan</th>
<th>kV</th>
<th>mAs / ref.</th>
<th>CTDIvol</th>
<th>DLP</th>
<th>TI</th>
<th>cSL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient Position F-SP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Topogram</td>
<td>1</td>
<td>120</td>
<td>250 / 250</td>
<td>16.94</td>
<td>434</td>
<td>5.3</td>
</tr>
<tr>
<td>N_C KID</td>
<td>2</td>
<td>120</td>
<td>250 / 250</td>
<td>16.94</td>
<td>434</td>
<td>5.3</td>
</tr>
<tr>
<td>Contrast</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PreMonitoring</td>
<td>3</td>
<td>120</td>
<td>40</td>
<td>5.41</td>
<td>5</td>
<td>0.5</td>
</tr>
<tr>
<td>I.V. Bolus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>121 ml</td>
<td>0.0 ml/s</td>
</tr>
<tr>
<td>Monitoring</td>
<td>4</td>
<td>120</td>
<td>40</td>
<td>43.26</td>
<td>42</td>
<td>0.5</td>
</tr>
<tr>
<td>CTA KID</td>
<td>12</td>
<td>120</td>
<td>240 / 240</td>
<td>18.36</td>
<td>454</td>
<td>0.5</td>
</tr>
<tr>
<td>NEPHR120sec</td>
<td>13</td>
<td>120</td>
<td>225 / 240</td>
<td>18.92</td>
<td>836</td>
<td>0.5</td>
</tr>
<tr>
<td>UROGR.</td>
<td>14</td>
<td>120</td>
<td>219 / 225</td>
<td>16.79</td>
<td>432</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Total mAs 14525  Total DLP 2203
When is this protocol justified?

Never as a “routine” scan
### Failures by Submission type—Specialty Studies 2007-2009

<table>
<thead>
<tr>
<th>Exam</th>
<th># Submission</th>
<th># Failure</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulmonary Embolus</td>
<td>2158</td>
<td>229</td>
<td>10.6%</td>
</tr>
<tr>
<td>Renal Mass</td>
<td>1172</td>
<td>515</td>
<td>43.9%</td>
</tr>
<tr>
<td>HRCT Chest</td>
<td>1097</td>
<td>101</td>
<td>9.2%</td>
</tr>
<tr>
<td>Temporal Bones</td>
<td>306</td>
<td>39</td>
<td>12.7%</td>
</tr>
<tr>
<td>Pancreatic Carcinoma</td>
<td>304</td>
<td>59</td>
<td>19.4%</td>
</tr>
<tr>
<td>Known Cirrhosis</td>
<td>160</td>
<td>18</td>
<td>11.3%</td>
</tr>
<tr>
<td>Aortic Dissection</td>
<td>136</td>
<td>16</td>
<td>11.8%</td>
</tr>
<tr>
<td>Temporal Bones Peds</td>
<td>133</td>
<td>19</td>
<td>14.3%</td>
</tr>
<tr>
<td>C-spine Peds</td>
<td>59</td>
<td>6</td>
<td>10.2%</td>
</tr>
<tr>
<td>HRCT Chest Peds</td>
<td>11</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Adrenal Renal Mass- Peds</td>
<td>3</td>
<td>2</td>
<td>66.7%</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>5961</strong></td>
<td><strong>1041</strong></td>
<td><strong>17.5%</strong></td>
</tr>
</tbody>
</table>
## Common Reason for failure: Specialty

<table>
<thead>
<tr>
<th>Exam</th>
<th>Top Deficiencies</th>
<th>% Exams failed that included this deficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renal Mass</td>
<td>Inappropriate or no use of ROI measurement</td>
<td>37.1%</td>
</tr>
<tr>
<td></td>
<td>Slice thickness &gt;3mm</td>
<td>30.8%</td>
</tr>
<tr>
<td>Adult PE</td>
<td>Excessive Sequential Images</td>
<td>23.3%</td>
</tr>
<tr>
<td></td>
<td>Lungs not completely scanned</td>
<td>52.3%</td>
</tr>
<tr>
<td></td>
<td>&gt;12:1 film format</td>
<td>57.4%</td>
</tr>
</tbody>
</table>
Renal Mass example: No cursor
Renal Mass example: Inappropriate placement
Renal Mass example: Correct placement
Failure: PE protocol
Technology Assessment Institute: Summit on CT Dose

5 pointers for radiologists-
from a “battle tested” reviewer

• 1. Follow directions CAREFULLY
  – I will fail you for errors such as wrong number of images/film, not providing scouts etc.

• 2. Follow your protocol
  – IF there is a mismatch, between what you say you do and you submit, I will fail you
  – Correlate the values your physicist enters in table 1 with your clinical work- this communication is crucial

• 3. Submit a set of images that you would like to “show-off” your practice
  – Cases that appear to be thrown together to satisfy an exam type will trigger me to look for objective reasons to fail you

• 4. Do NOT try to over scan with multiple phases unless it is indicated
  – I will assume you get multiphase acquisitions on every case that comes through the door- and that means you are delivering too much dose, and you will fail

• 5. Delegate one of your techs to choose the best case, assure compliance with protocol
  – Radiologists are generally too busy (or at least perceive themselves to be) to look at the detail needed for an ACR submission
  – The same tech should be empowered to collect the submissions at all of the sites in your “enterprise”