Observations from the ACR CT Accreditation Program: Areas of Success and Areas for Improvement

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Three accrediting organizations are recognized by CMS to fulfill the MIPPA requirements for accreditation by 1/1/12:

- ACR: American College of Radiology
- ICACTL: Intersocietal Commission for Accreditation of CT Laboratories
- TJC: The Joint Commission (through its ambulatory health care program)
• Number of accredited sites:
  – ACR: 4200
  – ICACTL: 250
  – TJC: unknown*

*subset of TJC Ambulatory Health Care
Requirements

• ACR:
  – Objective dose assessment:
    • Phantom-based
      – Adult Head
      – Adult Abdomen
      – Pediatric Abdomen (5 yr)
Requirements

• ACR:
  – Subjective dose assessment:
    • Patient-based
      – Are mAs, kVp, pitch appropriate for exam, body habitus?
ICACTL:
- Does not assess dose, but has three standards that reflect awareness of dose:
  - 4.1.1 All CT laboratory professionals must have an understanding of the radiation exposure involved in CT to advise patients undergoing CT imaging
ICACTL:

4.1.2 Radiation dose for CT acquisition should be set at the lowest values that are consistent with satisfactory image quality for the study ordered.
• ICACTL:
  • 4.1.6 The laboratory should comply with the currently published ALARA recommendations for personnel and subscribe to dose optimization for patients…
• TJC:
  – Does not assess dose
  – Policies / standards are not readily available
Success #1

• ACR CT Accreditation Program has focused attention on radiation dose monitoring and control since 2002
Phantom-Based Indices

Diagnostic Reference Levels from the ACR CT Accreditation Program

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Phantom-Based Indices

- Three exams:
  - Adult Head
  - Adult Abdomen
  - Pediatric Abd. (5 yr)

- Dose indices
  - CTDIvol
  - DLP
  - Effective Dose
Phantom-Based Indices

• Dose indices judged
  – CTDIvol

• Recommended DRLs (2002):
  – Adult Head 60 mGy
  – Adult Abdomen 35 mGy
  – Pedi Abdomen 25 mGy
<table>
<thead>
<tr>
<th>Exam</th>
<th>CTDIw</th>
<th>DLP</th>
<th>Eff. Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>60</td>
<td>1050</td>
<td>2.4</td>
</tr>
<tr>
<td>Chest</td>
<td>30</td>
<td>650</td>
<td>11.1</td>
</tr>
<tr>
<td>Abd</td>
<td>35</td>
<td>800</td>
<td>12.0</td>
</tr>
<tr>
<td>Pelvis</td>
<td>35</td>
<td>600</td>
<td>11.4</td>
</tr>
</tbody>
</table>

*From Commissione Europea EUR 16260, EUR 16261, EUR 16262 -- 1998*
• DRLs analyzed from 2002 – 2004
  – Head-too low, Adult/Pedi Abdomen-too high
• 2008 DRLs (revised):

<table>
<thead>
<tr>
<th></th>
<th>DRL</th>
<th>Pass/Fail</th>
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</thead>
<tbody>
<tr>
<td>Adult Head</td>
<td>75 mGy</td>
<td>80 mGy</td>
</tr>
<tr>
<td>Adult Abdomen</td>
<td>25 mGy</td>
<td>30 mGy</td>
</tr>
<tr>
<td>Pedi Abdomen</td>
<td>20 mGy</td>
<td>25 mGy</td>
</tr>
</tbody>
</table>
### Diagnostic Reference Levels

#### Percentage of scanners above 2002 DRLs

<table>
<thead>
<tr>
<th></th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2002-2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult Head</td>
<td>49.6</td>
<td>33.3</td>
<td>23.8</td>
<td>33.4</td>
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<tr>
<td>Adult Abdomen</td>
<td>4.7</td>
<td>5.2</td>
<td>2.3</td>
<td>4.2</td>
</tr>
<tr>
<td>Pediatric Abdomen</td>
<td>15.0</td>
<td>11.7</td>
<td>6.9</td>
<td>10.8</td>
</tr>
</tbody>
</table>

*Should be 25% as DRLs are typically set at 75th percentile*
# Diagnostic Reference Levels

- Percentage of scanners above 2008 DRLs

<table>
<thead>
<tr>
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<th>2004</th>
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</thead>
<tbody>
<tr>
<td>Adult Head</td>
<td>25.6</td>
<td>12.8</td>
<td>9.1</td>
<td>14.0</td>
</tr>
<tr>
<td>Adult Abdomen</td>
<td>15.9</td>
<td>20.3</td>
<td>12.7</td>
<td>17.0</td>
</tr>
<tr>
<td>Pediatric Abdomen</td>
<td>26.4</td>
<td>27.2</td>
<td>19.2</td>
<td>24.5</td>
</tr>
</tbody>
</table>

*Should be 25% as DRLs are typically set at 75th percentile*
• Reduction in average dose from 2002 to 2004:
  – Adult Head 10.9 mGy*
  – Adult Abdomen 1.7 mGy
  – Pedi Abdomen 3.2 mGy

*data from 2003 and 2004 may have been biased by desire to meet spec (DRL), even if unhappy with image quality
Success #2

- ACR CT Accreditation Program created and revised Diagnostic Reference Levels for US practice
Limitation #1

• Diagnostic Reference Levels do not reflect true state of US practice, rather, state of US practices seeking accreditation
Diagnostic Reference Levels

Diagnostic Reference Levels in Medical and Dental Imaging: Recommendations for Applications in the United States

Recommendations of the NATIONAL COUNCIL ON RADIATION PROTECTION AND MEASUREMENTS

*presently under Council review*
Nationalwide Evaluation of X-Ray Trends (NEXT) Computed Tomography Dataset

A Nationwide Evaluation of X-ray Trends (NEXT) survey of clinical facilities performing computed tomography (CT) examinations was conducted during 2005-06. This survey was planned and conducted under the leadership of the Conference of Radiation Control Program Directors’ (CRCPD) H-4 Committee.

Approximately 260 facilities participated in the voluntary survey. The survey consisted of two components: a site visit by trained surveyors and a questionnaire completed by facility staff. Trained state radiation personnel conducted each site visit, gathering data regarding CT workload volumes, equipment data, scanning parameters for clinical exams, and radiation measurements from CT equipment. Surveyors also used a specially designed phantom to characterize CT equipment scan features that adjust radiation.

*raw data was made available in April, 2010
Can Experienced CT Radiologists use Technique Parameters to Predict Excessive Patient Dose? An Analysis of the American College of Radiology (ACR) CT Accreditation Database

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• Three clinical exams required:
  – chosen from 19 possible studies
• 3 had corresponding phantom measurements:
  – Adult Head
  – Adult Abdomen
  – Pediatric Abdomen
Clinical reviewers were asked to assess radiation dose based on technique factors:
- mAs, kVp, pitch

Reviewer comments were correlated with results of phantom measurements
Clinical reviewers were poor predictors of dose above DRL in clinical exams:

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;2002 DRL</td>
<td>21%</td>
<td>88%</td>
</tr>
<tr>
<td>&gt;2008 DRL</td>
<td>13%</td>
<td>86%</td>
</tr>
</tbody>
</table>
Reasons for poor performance:

- “High-dose bias” among reviewers
- Poor understanding of the relationship between patient size and mAs, kVp
- Automatic exposure control resulting in mAs that varies image by image
Limitation #2

- Patient-specific dose data is of limited value
  - Exam technique is a poor surrogate for patient dose
Clinical reviewers are now provided with:
- Phantom CTDIvol data
- Clinical CTDIvol data for all exams
Reviewers are asked to comment on appropriateness of kVp and CTDIvol.
Dose Index Registry

- Collect and provide feedback on dose estimate information from various modalities
  - Pilot program completed with CT
    - DICOM feed of patient-specific dose data
    - Allows participants to compare average CTDIvol and DLP values across facilities
  - Production program will launch in mid 2011