CT Protocol Review
University of Washington

Kalpana M. Kanal, PhD, DABR
Director, Diagnostic Physics Section and Resident Education
Professor, Department of Radiology

University of Washington Medical Center
Seattle, WA 98195

AAPM 2016
Washington DC
OUTLINE

- UW Medicine System
- Diagnostic Physics Section
- How we did CT protocol review
- How it is done now
UW Medicine Network

- University of Washington Medical Center
- Harborview Medical Center (Level 1 Trauma Center)
- Seattle Children’s Hospital
- Seattle Cancer Care Alliance
- Northwest Hospital & Medical Center
- Valley Medical Center
- UW Neighborhood Clinics

- Roosevelt Clinic
- Eastside Specialty Center
- HMC – NJB Outpatient Clinic
CT Protocol Review – How it was done

• Physicist initiated
• Email to the section chief for each section
• Very tedious and slow process
• Complication was trying to do this for across sites
• Physicist, radiologist and 2 lead CT techs, one from each site
• Review paper copies and make changes
• Lead CT supervisor implemented changes
• ACR QC manual - used it to enforce CT protocol review more consistently
• In a letter to Radiology leadership, I highlighted the following:
• One of the responsibilities of the lead CT radiologist is to
  – Convene a team that includes the supervising radiologist, the medical physicist, and the lead CT technologist to design and review all new or modified CT protocol settings to ensure that both image quality and radiation dose are appropriate.
  – The benefits of reviewing protocols on a regular basis are:
    ✓ Eliminating protocols not used
    ✓ Reviewing protocols known to give high dose to ensure protocol optimization
    ✓ Adding new protocols if needed
    ✓ Modifying protocols based on feedback received
    ✓ Consistent protocols used across sites (if possible)
CT Protocol Review – How it is done now

• A directive was sent from the Radiology QA committee
• Response was very good
• Regular protocol review meetings which are initiated by the section chief
• Radiologist (s), lead CT tech/supervisor, physicist present at these meetings
CT Protocol Review – How it is done now
Radiology/Imaging Services

Welcome to UWMC Department of Radiology. We provide the full range of state of the art technology for diagnostic, Interventional, and therapeutic services for patients on behalf of referring providers. Our primary focus is that Patients Are First. Our world class faculty, technologist and support staff are committed to providing the very best care and service to every patient and their family every time.
CT Protocols - Online

Excellence in Action - Employee of the Month - June 2016 - Christina Popchoi
Congratulations, Christine!

Radiology Ice Cream Social
June 30th from 12p-3pm

Excellence in Action - Employee of the Month - April 2016 - Chandra Pelton
Congratulations, Chandra Pelton!

Radiology Patient Satisfaction Survey
Survey starts April 18th

Excellence in Action - Employee of the Month - Feb 2016 - Anne Gause
Congratulations, Anne Gause!

APRIL IS RIDE TRANSIT MONTH
Come join the UWMC Radiology Team.

©UW and Kalpana Kanal, PhD
CT Protocols - Online

UWMC CT Protocols
To learn more about the CT Protocols, select from the links below

- GU
- Liver / Pancreas
- Neuro
- Vascular
- Abdomen
- Chest
- MSK
- Pediatric
- Dual Energy Body

VCT Protocols

- GU VCT
- Liver / Pancreas VCT
- Abdomen VCT
- Vascular VCT

Post Processing Check Sheets

- CVA10
- TAVR
- CTA Chest
Protocol # C3  
Chest – PULMONARY EMBOLUS

Truncus Arteriosus

Continued Arta and Pulmonary Artery
Opening Between Vertebrae

Oral contrast: none

IV contrast & Scan sequence:

100cc Visipaque, 50cc Saline chaser

Test Dose: 15cc visi @ 5cc/sec, 25cc saline @ 3cc/sec
3sec delay calculate peak + 5sec

Scan lung apex to diaphragm @peak + 5sec delay, 5cc/sec
85cc visipaque, 25cc saline @3cc/sec

Breathing technique: Inspiration w/ 7sec delay from breath-hold to start of scan
### CT Protocols - Online

#### Test dose 15cc Visi 5cc/sec, 25cc saline chaser 3cc/sec

<table>
<thead>
<tr>
<th>Scan Type</th>
<th>Start Loc</th>
<th>End Loc</th>
<th># of images</th>
<th>Thick Speed</th>
<th>Interval</th>
<th>Gantry Tilt</th>
<th>SFOV</th>
<th>Kv</th>
<th>Ma</th>
<th>Time</th>
<th>DFOV</th>
<th>Recon1</th>
<th>Recon2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axial 1.6sec</td>
<td>Carina</td>
<td>Carina</td>
<td>14</td>
<td>5.0 ft</td>
<td>0.00</td>
<td>S0</td>
<td>Large</td>
<td>120</td>
<td>50</td>
<td>3.0</td>
<td>To Vascular Phle A.</td>
<td>Std</td>
<td>None</td>
</tr>
</tbody>
</table>

### PE Scan

<table>
<thead>
<tr>
<th>Scan Type</th>
<th>Start Loc</th>
<th>End Loc</th>
<th># of images</th>
<th>Thick Speed</th>
<th>Interval</th>
<th>Gantry Tilt</th>
<th>SFOV</th>
<th>kv</th>
<th>ma</th>
<th>Time</th>
<th>DFOV</th>
<th>Recon1</th>
<th>Recon2</th>
<th>Recon3</th>
<th>Recon4</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.4sec to 0 sec</td>
<td>Lung bases</td>
<td>Lung apices</td>
<td>40mm</td>
<td>0.625</td>
<td>S0</td>
<td>Large Body</td>
<td>120</td>
<td>100</td>
<td>For BMI &gt;20</td>
<td>10</td>
<td>Adjust to cover necessary anatomy</td>
<td>0.625</td>
<td>Send to AW server ASIR 30%</td>
<td>Coronal Dmp Chart map</td>
<td>1.2mm std</td>
</tr>
</tbody>
</table>
**CT CHANGE CONTROL**

**Proposal:** Reduction of max-face doses by 20%

**Submission Date:** 05/11/2016

**Proposal:** Reduce our max face protocols by 20%

**Reason for Change:** To be within the 75 percentile of ACR recommendation

- **Requested By:** Kalpana

**Who does this potential change impact:** Patients

**Need discussion at CSIC?** ✗ Yes ☐ No

When finished with the proposed form, place the document in the “Awaiting Approval” folder in Hemingway, and distribute via Cchangecontrol@u.washington.edu

**Approval:**

- **This proposal was:** ☐ Approved ☐ Not Approved
- **Approved by:**
- **Date:**
- **Reason for Denial:**

**Who will implement this proposal:**

- **Target Date for Implementation:** ☐ ASAP ☐ Routine

**Implementation:**

**Who is responsible for this:**

**IMPLEMENTATION STEPS: (An empty box assumes “N/A”)**

<table>
<thead>
<tr>
<th>Date</th>
<th>Completed by</th>
<th>How was this done?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Comments:**

**Completion:**

- **Completed by:**
- **Completion Date:**
- **Reported to CSIC:**

When completed, convert this Word document to a .pdf document, and attach it to an email addressed to Cchangecontrol@u.washington.edu for circulation. Then move the document to the “Implementation Complete” folder, and update the Excel spreadsheet.
Other Avenues for CT Protocol Review

• Protocol Manager
  – We are a beta site for one vendor who has a CT protocol manager software installed at our site
  – Has potential but still in infancy
  – Advantage would be to compare protocols online for different scanners, review, make changes and hopefully implement from manager on to the scanner

  – Another vendor doing a demo at our site in August
## Other Avenues for CT Protocol Review

### Dose Watch

#### Reason for Notification

This alert is triggered by the following event(s):

- Examination CTDI_{hct} is over CTDI_{hct} threshold

<table>
<thead>
<tr>
<th>Alert Type</th>
<th>Series</th>
<th>Target region</th>
<th>Measure</th>
<th>Value</th>
<th>Warning</th>
<th>Alert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protocol</td>
<td>3</td>
<td>Head</td>
<td>CTDI_{hct} (mGy)</td>
<td>60.50</td>
<td>51.10</td>
<td>66.93</td>
</tr>
</tbody>
</table>

#### Study Information

**Date / Time:** 2016-07-10 - 21:34

**Device:** erct1

**Model:**

---

#### Reason for Notification

This alert is triggered by the following event(s):

- Examination CTDI_{hct} is over CTDI_{hct} threshold

<table>
<thead>
<tr>
<th>Alert Type</th>
<th>Series</th>
<th>Target region</th>
<th>Measure</th>
<th>Value</th>
<th>Warning</th>
<th>Alert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protocol</td>
<td>4</td>
<td>Chest</td>
<td>CTDI_{hct} (mGy)</td>
<td>16.25</td>
<td>14.00</td>
<td>15.16</td>
</tr>
</tbody>
</table>

#### Study Information

**Date / Time:** 2016-07-29 - 10:14

**Device:** rtct

**Model:** LightSpeed RT16

**Modality:** CT
### CT Protocol Review
#### Using ACR CT Dose Index Registry

<table>
<thead>
<tr>
<th>2015 Q3Q4</th>
<th>N</th>
<th>RPID</th>
<th>2015 Q1Q2</th>
<th>N</th>
<th>RPID</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9056</td>
<td>CT HEAD BRAIN WO IVCON</td>
<td></td>
<td>7030</td>
<td>CT HEAD BRAIN WO IVCON</td>
</tr>
<tr>
<td></td>
<td>1680</td>
<td>CT ABDOMEN PELVIS W IVCON</td>
<td></td>
<td>1702</td>
<td>CT C SPINE WO IVCON</td>
</tr>
<tr>
<td></td>
<td>1401</td>
<td>CT C SPINE WO IVCON</td>
<td></td>
<td>1513</td>
<td>CT ABDOMEN PELVIS W IVCON</td>
</tr>
<tr>
<td></td>
<td>700</td>
<td>CT NECK ANGIO WO THEN W IVCON</td>
<td></td>
<td>730</td>
<td>CT NECK ANGIO WO THEN W IVCON</td>
</tr>
<tr>
<td></td>
<td>639</td>
<td>CT CHEST PULMONARY ARTERIES W IVCON</td>
<td></td>
<td>594</td>
<td>CT CHEST PULMONARY ARTERIES W IVCON</td>
</tr>
<tr>
<td></td>
<td>610</td>
<td>CT CHEST WO IVCON</td>
<td></td>
<td>440</td>
<td>CT CHEST WO IVCON</td>
</tr>
<tr>
<td></td>
<td>479</td>
<td>CT HEAD MAXILLOFACIAL WO IVCON</td>
<td></td>
<td>392</td>
<td>CT L SPINE WO IVCON</td>
</tr>
<tr>
<td></td>
<td>428</td>
<td>CT L SPINE WO IVCON</td>
<td></td>
<td>379</td>
<td>CT HEAD ANGIO WO THEN W IVCON</td>
</tr>
<tr>
<td></td>
<td>357</td>
<td>CT CHEST ABDOMEN PELVIS W IVCON</td>
<td></td>
<td>347</td>
<td>CT HEAD MAXILLOFACIAL WO IVCON</td>
</tr>
<tr>
<td></td>
<td>320</td>
<td>CT T SPINE L SPINE WO IVCON</td>
<td></td>
<td>317</td>
<td>CT CHEST ABDOMEN PELVIS W IVCON</td>
</tr>
<tr>
<td></td>
<td>282</td>
<td>CT HEAD ANGIO WO THEN W IVCON</td>
<td></td>
<td>309</td>
<td>CT T SPINE L SPINE WO IVCON</td>
</tr>
<tr>
<td></td>
<td>242</td>
<td>CT CHEST W IVCON</td>
<td></td>
<td>217</td>
<td>CT PELVIS WO IVCON</td>
</tr>
<tr>
<td></td>
<td>235</td>
<td>CT ABDOMEN WO IVCON</td>
<td></td>
<td>212</td>
<td>CT NECK W IVCON</td>
</tr>
<tr>
<td></td>
<td>227</td>
<td>CT PELVIS WO IVCON</td>
<td></td>
<td>209</td>
<td>CT ABDOMEN WO IVCON</td>
</tr>
<tr>
<td></td>
<td>217</td>
<td>CT NECK W IVCON</td>
<td></td>
<td>191</td>
<td>CT ABDOMEN PELVIS WO IVCON</td>
</tr>
<tr>
<td></td>
<td>196</td>
<td>CT ABDOMEN PELVIS WO IVCON</td>
<td></td>
<td>155</td>
<td>CT CHEST W IVCON</td>
</tr>
<tr>
<td></td>
<td>150</td>
<td>CT T SPINE WO IVCON</td>
<td></td>
<td>133</td>
<td>CT HEAD MAXILLOFACIAL W IVCON</td>
</tr>
<tr>
<td></td>
<td>141</td>
<td>CT HEAD MAXILLOFACIAL W IVCON</td>
<td></td>
<td>128</td>
<td>CT T SPINE WO IVCON</td>
</tr>
<tr>
<td></td>
<td>140</td>
<td>CT ABDOMEN PELVIS ANGIO</td>
<td></td>
<td>117</td>
<td>CT CHEST ABDOMEN PELVIS WO THEN W IVCON</td>
</tr>
<tr>
<td></td>
<td>119</td>
<td>CT LE FOOT WO IVCON</td>
<td></td>
<td>109</td>
<td>CT ABDOMEN PELVIS ANGIO</td>
</tr>
</tbody>
</table>
CT Protocol Review
Using ACR CT Dose Index Registry

2015 Q3Q4

Median CTDI_{vol} values for HMC

- Arrows -Above 75th percentile
- Arrows -Below 25th percentile

©UW and Kalpana Kanal, PhD
## CT Protocol Review

### Using ACR CT Dose Index Registry

<table>
<thead>
<tr>
<th>N</th>
<th>RPID</th>
<th>HMC</th>
<th>All ACR Sites</th>
<th>All Trauma</th>
</tr>
</thead>
<tbody>
<tr>
<td>9056</td>
<td>CT HEAD BRAIN WO IVCON</td>
<td>45</td>
<td>50</td>
<td>49</td>
</tr>
<tr>
<td>1680</td>
<td>CT ABDOMEN PELVIS W IVCON</td>
<td>7</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>1401</td>
<td>CT C SPINE WO IVCON</td>
<td>26</td>
<td>21</td>
<td>22</td>
</tr>
<tr>
<td>700</td>
<td>CT NECK ANGIO WO THEN W IVCON</td>
<td>15</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>639</td>
<td>CT CHEST PULMONARY ARTERIES W IVCON</td>
<td>8</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>610</td>
<td>CT CHEST WO IVCON</td>
<td>10</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>479</td>
<td>CT HEAD MAXILLOFACIAL WO IVCON</td>
<td>50</td>
<td>27</td>
<td>23</td>
</tr>
<tr>
<td>428</td>
<td>CT L SPINE WO IVCON</td>
<td>19</td>
<td>24</td>
<td>23</td>
</tr>
<tr>
<td>357</td>
<td>CT CHEST ABDOMEN PELVIS W IVCON</td>
<td>9</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td>320</td>
<td>CT T SPINE L SPINE WO IVCON</td>
<td>15</td>
<td>23</td>
<td>24</td>
</tr>
<tr>
<td>282</td>
<td>CT HEAD ANGIO WO THEN W IVCON</td>
<td>45</td>
<td>51</td>
<td>51</td>
</tr>
<tr>
<td>242</td>
<td>CT CHEST W IVCON</td>
<td>10</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>235</td>
<td>CT ABDOMEN WO IVCON</td>
<td>9</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>227</td>
<td>CT PELVIS WO IVCON</td>
<td>14</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>217</td>
<td>CT NECK W IVCON</td>
<td>21</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>196</td>
<td>CT ABDOMEN PELVIS WO IVCON</td>
<td>11</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>150</td>
<td>CT T SPINE WO IVCON</td>
<td>16</td>
<td>21</td>
<td>19</td>
</tr>
<tr>
<td>141</td>
<td>CT HEAD MAXILLOFACIAL W IVCON</td>
<td>52</td>
<td>31</td>
<td>30</td>
</tr>
<tr>
<td>140</td>
<td>CT ABDOMEN PELVIS ANGIO</td>
<td>14</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td>119</td>
<td>CT LE FOOT WO IVCON</td>
<td>15</td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>
Deep Dive – Max Face WO IV

HMC MaxFace WO Contrast CT Exams  Q3Q4 2015 - CTDIvol

ACR Median = 27
• Directive to review and optimize protocols initially came from physicist
• After ACR released its new QC manual, directive from QA committee instead of physicist.
• Protocol review and optimization team includes radiologist(s), technologist(s) and physicist(s).
• Meet once a month and review by section
• Changes implemented by technologist and protocols updated on scanner and online
• Separate meeting to discuss implementation of new technology – Dual Energy and Iterative Reconstruction
• Also use Dose Watch and ACR CT Dose Index Registry to look for problematic protocols
THANK YOU FOR YOUR ATTENTION