AAPM Computed Tomography Radiation Dose Education Slides
Hitachi Version

Many of the terms used in these slides can be found in the CT Terminology Lexicon

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Disclaimer

- Screen captures are examples of a common (or latest) software version only and all software versions are not represented
- The information contained herein is current as of the date shown on the title slide
- The master version of these slides is located at:
- Modification of the content of these slides is not allowed.
**Vendor Specific Slide Details**

- The presence of a vendor name in the title of the slide indicates that the slide is vendor specific slide
- White text is used throughout to indicate vendor specific language
- An example of a vendor specific slide follows
Vendor: **Generic Parameter/Topic Name**

Vendor Specific Name

Vendor screen capture of how the acquisition parameter is set or how information on the topic is displayed

Text describing acquisition parameter or topic
Motivation

- These slides are provided to aid in understanding the factors that affect radiation dose in CT studies
- Image patients wisely and gently
  - A CT study should use as little radiation as possible, while still meeting the image quality needs of the exam
  - A CT study that is non-diagnostic because the radiation dose is too low may require rescanning the patient – increasing the total patient dose
Outline

• What is Dose?
• Acquisition Parameter Settings
• Dose Modulation and Reduction
• Dose Display


How is $CTD_I_{vol}$ related to patient dose?

- $CTD_I_{vol}$ is not patient dose
- The relationship between the two depends on many factors, including patient size and composition
- AAPM Report 204 introduces a parameter known as the Size Specific Dose Estimate (SSDE) to allow estimation of patient dose based on $CTD_I_{vol}$ and patient size
- For the same $CTD_I_{vol}$, a smaller patient will tend to have a higher patient dose than a larger patient

http://www.aapm.org/pubs/reports/RPT_204.pdf
How is $CTD_{vol}$ related to patient dose?

120 kVp at 200 mAs

120 kVp at 200 mAs

32 cm Phantom

32 cm Phantom

$CTD_{vol} = 20 \text{ mGy}$

$CTD_{vol} = 20 \text{ mGy}$

Both patients scanned with the same $CTD_{vol}$

Patient dose will be higher for the smaller patient

What is Dose?
How is $\text{CTDI}_{\text{vol}}$ related to patient dose?

120 kVp at 100 mAs

32 cm Phantom

$\text{CTDI}_{\text{vol}} = 10 \text{ mGy}$

120 kVp at 200 mAs

32 cm Phantom

$\text{CTDI}_{\text{vol}} = 20 \text{ mGy}$

Smaller patient scanned with a lower $\text{CTDI}_{\text{vol}}$

Patient doses will be approximately equal

What is Dose?
Size Specific Dose Estimate (SSDE)

- AAPM report 204 describes a method to calculate SSDE using CTDI<sub>vol</sub>
- Conversion factors based on patient size (e.g., AP or lateral width, effective diameter) are provided to estimate patient dose for a patient of that size
- However, SSDE is still not the exact patient dose, as factors such as scan length and patient composition may differ from the assumptions used to calculate SSDE
- SSDE is not dose to any specific organ, but rather the mean dose in the center of the scanned volume
How is $\text{CTDI}_{\text{vol}}$ related to patient dose?

120 kVp at 100 mAs

- 9 cm
- 32 cm Phantom
- $\text{CTDI}_{\text{vol}} = 10 \text{ mGy}$
- SSDE = 13.2 mGy

120 kVp at 200 mAs

- 27 cm
- 32 cm Phantom
- $\text{CTDI}_{\text{vol}} = 20 \text{ mGy}$
- SSDE = 13.2 mGy

Patients have equivalent SSDE

What is Dose?
Why Use $CTD_{vol}$?

- $CTD_{vol}$ provides information about the amount of radiation used to perform the study
- $CTD_{vol}$ is a useful index to track across patients and protocols for quality assurance purposes
- $CTD_{vol}$ can be used as a metric to compare protocols across different practices and scanners when related variables, such as resultant image quality, are also taken in account
- The ACR Dose Index Registry (DIR) allows comparison across institutions of $CTD_{vol}$ for similar exam types (e.g., routine head exam)

Dose Length Product

- The Dose Length Product (DLP) is also calculated by the scanner.
- DLP is the product of the length of the irradiated scan volume and the average CTDI_{vol} over that distance.
- DLP has units of mGy*cm.
Useful Concepts/Terms

- The relationships between acquisition parameters and CTDI$_{vol}$ described in the following slides assume all other parameters are held constant.
- The relationship between a parameter and CTDI$_{vol}$ is often described as proportional in some way.
  - The symbol $\propto$ is used to indicate "proportional to".
- Directly proportional means that a change in the parameter results in the same change in CTDI$_{vol}$.
  - Example: Doubling the rotation time from 0.5 to 1.0 seconds will double the CTDI$_{vol}$.
- Inversely proportional means that a change in a parameter has the opposite effect on CTDI$_{vol}$.
  - Example: Doubling the pitch from 1 to 2 will reduce the CTDI$_{vol}$ by half.
Acquisition Parameter Settings

- Acquisition Parameters define the technique that will be used and how the scan will proceed
- Acquisition Parameters are set in the user interface where scans are prescribed
- Changing a single Acquisition Parameter while holding everything else constant will typically affect the CTDI_{vol} for that scan
- The following slides describe what that affect is for each parameter
Scan Mode

- CT Scanners offer a variety of Scan Modes which describe how the table moves during an exam
- Scan Modes include
  - Axial
  - Helical or Spiral
  - Dynamic

The Acquisition Parameters that affect CTDIvol may change amongst different Scan Modes

Acquisition Parameter Settings
Dynamic Scan Mode Notes

- In the Dynamic Scan Mode multiple acquisitions covering the same body region are acquired. Examples of these study types include:
  - Perfusion Studies
  - Bolus Tracking Studies
  - Test Bolus Studies
- Dynamic Scans often have large \( CTDI_{vol} \) values because the scanner reports the sum of the \( CTDI_{vol} \) values from each rotation
- The reported \( CTDI_{vol} \) is NOT skin dose or organ dose

For Hitachi users:
Normal = Axial scanning
Volume = Helical/Spiral scanning
Predict = Bolus tracking
guideShot = snap shot needle localization
Hitachi calls this feature TABLE INDEX.

**Table Feed/Increment**

- Is the movement of the table through the bore of the scanner over a full 360 degree rotation
- Units: millimeters/rotation or millimeters/second
- The parameter is known both as Table Feed (helical/spiral acquisition) & Table Increment (axial acquisition)

*Table Feed may affect CTDI*$_{vol}$* through its inclusion in Pitch (discussed later)*

**Acquisition Parameter Settings**
Examples of how Table Index is displayed for an Axial and a Volume scan
Detector Configuration

- Is the combination of the number of data channels and the width of the detector associated with each data channel.
- The Detector Configuration determines the Beam Width or Beam Collimation (nT), which is the number of channels (n) times the detector width associated with each data channel (T).
- For a selected detector width per data channel, a smaller total Beam Collimation usually has a higher CTDI<sub>vol</sub> than a larger Beam Collimation.
  - Example: On a 16 slice scanner with a detector width per channel of 1.25 mm, a collimation of 4x1.25mm is generally less dose efficient than a collimation of 16x1.25mm.

Users should monitor CTDI<sub>vol</sub> values when changing detector configuration.
Detector Configuration

Acquisition Parameter Settings
**Hitachi: Detector Configuration**

**Collimation**

**Normal (axial) mode**

**Volume (helical) mode**

*Hitachi*
Pitch

- Is the Table Feed per gantry rotation divided by the beam width/collimation
- Pitch is the ratio of two distances and therefore has no units
- Users should monitor other parameters when changing Pitch. The scanner may or may not automatically compensate for changes in Pitch (for example, by changing the tube current) to maintain the planned CTDI$_{vol}$.

CTDI$_{vol}$ $\propto$ 1/Pitch:
- Hitachi, Toshiba (no AEC)

CTDI$_{vol}$ independent of Pitch:
- GE, Siemens, Philips, Neusoft, Toshiba (AEC)

Acquisition Parameter Settings
Pitch

- \( \text{CTDI}_{\text{vol}} \) may not change in the expected manner if the scanner automatically adjust other parameters when the pitch is changed

- The relationships between \( \text{CTDI}_{\text{vol}} \) and pitch for the different vendors are described below
  - \( \text{CTDI}_{\text{vol}} \) inversely proportional to change in pitch: Hitachi, NeuroLogica
  - \( \text{CTDI}_{\text{vol}} \) constant when pitch is changed due to changes to other parameters: GE, Neusoft, Philips and Siemens
  - The relationship between \( \text{CTDI}_{\text{vol}} \) and pitch depends on scan mode or Software version: Toshiba
Pitch

Pitch < 1
Beam Width has some overlap at each view angle from rotation to rotation

Pitch = 1
No overlap of Beam Width at each view angle and no view angles not covered at certain table positions

Pitch > 1
Some view angles are not covered by the beam width at certain table positions

Acquisition Parameter Settings
Pitch is indicated on the Thickness/Collimation parameter indicated with a “P” (i.e. P1.3)
In order to change the pitch, click on the Thickness/Collimation parameter and the Thickness window will open to give the user the ability to change the Table Pitch parameter.
**Exposure Time per Rotation**

- Is the length of time, in seconds, that the X-ray beam is “on” during a gantry rotation
  - It takes into account the gantry rotation time and angular acquisition range
- Units: seconds
- Users should monitor other parameters when changing Exposure Time per Rotation. The scanner may or may not automatically compensate for changes in Exposure Time per Rotation (for example, by changing the tube current)

\[
\text{CTD}_{\text{vol}} \propto \text{Exposure Time per Rotation}
\]

**Hitachi, NeuroLogica, Toshiba (no AEC)**

**CTD}_{\text{vol}} \text{ independent of Exposure Time per Rotation:**

**GE, Siemens, Philips, Neusoft, Toshiba (AEC)**

Acquisition Parameter Settings
Exposure Time per Rotation

- CTDI_{vol} may not change in the expected manner if the scanner automatically adjust other parameters when the exposure time per rotation is changed.
- The relationships between CTDI_{vol} and exposure time per rotation for the different vendors are described below:
  - CTDI_{vol} proportional to change in parameter: Hitachi and NeuroLogica
  - CTDI_{vol} constant when the parameter is changed due to changes to other parameters: GE, Neusoft, Philips and Siemens
  - The relationship between CTDI_{vol} and the parameter depends on scan mode or Software version: Toshiba
Scan Time (s) is located under the mAs/Tube Voltage parameter.

In order to change the scan time, click on the mAs/Tube Voltage parameter and the mAs, Tube Voltage window will open to give the user the ability to change the Scan Time (s) parameter.
**Tube Current**

- Determines the number of electrons accelerated across the x-ray tube per unit time
- Units: milliAmperes (mA)
- $\text{CTDI}_{\text{vol}}$ is directly proportional to Tube Current

$$\text{CTDI}_{\text{vol}} \propto \text{Tube Current}$$

Acquisition Parameter Settings
Tube Current (mA) is located under the mAs/Tube Voltage parameter.
In order to change the Tube Current (mA), click on the mAs/Tube Voltage parameter and the mAs, Tube Voltage window will open to give the user the ability to change the Tube Current (mA) parameter.
**Tube Potential**

- Is the electrical potential applied across the x-ray tube to accelerate electrons toward the target material.
- Units: kiloVolts (kV or kVp).
- \( \text{CTD}_\text{vol} \) is approximately proportional to the square of the percentage change in Tube Potential.

\[
\text{CTD}_\text{vol} \propto \left( \frac{kV_{\text{new}}}{kV_{\text{old}}} \right)^n
\]

\( n \approx 2 \text{ to } 3 \)
Tube Voltage (kV) is located under the mAs/Tube Voltage parameter. In order to change the Tube Voltage (kV), click on the mAs/Tube Voltage parameter and the mAs, Tube Voltage window will open to give the user the ability to change the Tube Voltage (kV) parameter.
**Tube Current Time Product**

- Is the product of Tube Current and the Exposure Time per Rotation
- Units: milliAmpere-seconds (mAs)
- \( \text{CTDI}_{\text{vol}} \) is directly proportional to Tube Current Time Product

\[
\text{CTDI}_{\text{vol}} \propto \text{Tube Current Time Product}
\]

Acquisition Parameter Settings
**Hitachi: Tube Current Time Product**

### mAs

<table>
<thead>
<tr>
<th>No.</th>
<th>Scan Type</th>
<th>Scan Period</th>
<th>Tube DLP</th>
<th>Start Mode</th>
<th>Contrast</th>
<th>Focus Size</th>
<th>Joint Mode</th>
<th>Series Link</th>
<th>mAs</th>
<th>Tube Voltage</th>
<th>No. of Scans</th>
<th>No. of Images</th>
<th>FOV</th>
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<tbody>
<tr>
<td>1</td>
<td>N</td>
<td>83.0%</td>
<td>52.1mGy</td>
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<td></td>
<td></td>
<td></td>
<td>300mAs</td>
<td>120kV</td>
<td>8</td>
<td>32img</td>
<td>S220</td>
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</tbody>
</table>

**Hitachi**

Acquisition Parameter Settings
**Field Of Measurement**

- Is the diameter of the primary beam in the axial plane at the gantry iso-center
- Units: millimeters (mm)
- $\text{CTDI}_{\text{vol}}$ may decrease with a decrease in the Field of Measurement
  - The relationship is vendor specific

**Users should monitor the $\text{CTDI}_{\text{vol}}$ values when changing the Field of Measurement**

*Acquisition Parameter Settings*
Hitachi: Field of Measurement

FOV (Field of View)

Acquisition Parameter Settings
Beam Shaping Filter

- Is the scanner component that modifies the energy spectrum and spatial distribution of the primary beam
- Beam Shaping may include a bow tie filter and/or flat filters
- CTDI\textsubscript{vol} is affected by a change in Beam Shaping Filters
  – The relationship is vendor and filter specific

**Users should monitor CTDI\textsubscript{vol} values when changing the Beam Shaping Filter**
The “S” in front of the FOV value indicates the Small Bow Tie filter is in use. The Small Bow Tie filter can be used when the FOV is below 240mm.

The Small Bow Tie filter can be automatically turned on when the Auto Switch button is depressed in Scan Protocol Settings and saved permanently within the protocol.
# Acquisition Parameter Settings Summary

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Relationship to CTDI&lt;sub&gt;vol&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scan Mode</td>
<td>Changes in the Scan Mode may affect CTDI&lt;sub&gt;vol&lt;/sub&gt;</td>
</tr>
<tr>
<td>Table Feed/Increment</td>
<td>Table Feed affects CTDI&lt;sub&gt;vol&lt;/sub&gt; through its inclusion in Pitch</td>
</tr>
<tr>
<td>Detector Configuration</td>
<td>Decreasing the Beam Collimation typically, but not always, increases the CTDI&lt;sub&gt;vol&lt;/sub&gt;</td>
</tr>
<tr>
<td>Pitch</td>
<td>CTDI&lt;sub&gt;vol&lt;/sub&gt; relationship to pitch is vendor dependent</td>
</tr>
<tr>
<td>Exposure Time Per Rotation</td>
<td>CTDI&lt;sub&gt;vol&lt;/sub&gt; relationship to exposure time per rotation is vendor dependent</td>
</tr>
<tr>
<td>Tube Current</td>
<td>CTDI&lt;sub&gt;vol&lt;/sub&gt; ∝ Tube Current</td>
</tr>
<tr>
<td>Tube Potential</td>
<td>CTDI&lt;sub&gt;vol&lt;/sub&gt; ∝ (kV&lt;sub&gt;p1&lt;/sub&gt;/kV&lt;sub&gt;p2&lt;/sub&gt;)&lt;sup&gt;n&lt;/sup&gt; n ∼ 2 to 3</td>
</tr>
<tr>
<td>Tube Current Time Product</td>
<td>CTDI&lt;sub&gt;vol&lt;/sub&gt; ∝ Tube Current Time Product</td>
</tr>
<tr>
<td>Effective Tube Current Time Product</td>
<td>CTDI&lt;sub&gt;vol&lt;/sub&gt; ∝ Effective Tube Current Time Product</td>
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<tr>
<td>Field of Measurement</td>
<td>Changes in the Field of Measurement may affect CTDI&lt;sub&gt;vol&lt;/sub&gt;</td>
</tr>
<tr>
<td>Beam Shaping Filter</td>
<td>Changes in the Beam Shaping Filter may affect CTDI&lt;sub&gt;vol&lt;/sub&gt;</td>
</tr>
</tbody>
</table>
Dose Modulation and Reduction

- Many CT scanners automatically adjust the technique parameters (and as a result the CTDI$_{vol}$) to achieve a desired level of image quality and/or to reduce dose
- Dose Modulation and Reduction techniques vary by scanner manufacturer, model and software version
Automatic Exposure Control (AEC)

- Automatically adapts the Tube Current or Tube Potential according to patient attenuation to achieve a specified image quality
  - Automatic adjustment of Tube Current may not occur when Tube Potential is changed
  - Centering the patient in the gantry is VITAL for most AEC systems
- AEC aims to deliver a specified image quality across a range of patient sizes. It tends to increase CTDI$_{vol}$ for large patients and decrease it for small patients relative to a reference patient size

The use of Automatic Exposure Control may decrease or increase CTDI$_{vol}$ depending on the patient size and body area imaged and image quality requested

Dose Modulation and Reduction
For the Hitachi Scenaria scanner, IntelliEC is based on one PA scanogram
Image Quality Reference Parameter

- Is the AEC parameter that is set by the user to define the desired level of image quality
- Changing the Image Quality Reference Parameter will affect the CTDI_{vol}

The effect on CTDI_{vol} when changing the Image Quality Reference Parameter is vendor dependent

Dose Modulation and Reduction
Inversely proportional
Increasing SD will decrease the dose but increase the noise
Decreasing the SD will increase the dose but decrease the noise

The user will be able to determine SD is turned “ON” by the indication of the “S” in front of the mAs value.
**Image Quality Reference Parameter**

- A change in the Image Quality Reference Parameter will affect the CTDI\textsubscript{vol}.
  
- Setting the parameter for “increased” image quality (e.g., lower noise) will result in more dose.
  - Decreasing the SD\# (standard deviation) will result in an increase in the CTDI\textsubscript{vol}.

- Setting the parameter for “decreased” image quality (e.g., more noise) will result in less dose.
  - Increasing the SD\# (standard deviation) will result in a decrease in the CTDI\textsubscript{vol}.

*Dose Modulation and Reduction*
Angular and Longitudinal Tube Current Modulation

- Is an AEC feature that incorporates the properties of both Angular and Longitudinal Tube Current Modulation to
  - Adjust the Tube Current based on the patient’s overall attenuation
  - Modulate the Tube Current in the angular (X-Y) and longitudinal (Z) dimensions to adapt to the patient’s shape

The use of Angular and Longitudinal Tube Current Modulation may decrease or increase CTDI\textsubscript{vol} depending on the patient size and body area imaged and image quality requested

Dose Modulation and Reduction
Angular and Longitudinal Tube Current Modulation

Angular Modulation
mA during 1 rotation

Longitudinal (z) Modulation
Average mA per rotation

Longitudinal (z) and Angular Modulation
mA

Dose Modulation and Reduction
For the Hitachi Scenaria scanner, IntelliEC is based on one PA scanogram
Iterative Reconstruction

- Is a feature that uses the information acquired during the scan and repeated reconstruction steps to produce an image with less “noise” or better image quality (e.g., higher spatial resolution or decreased artifacts) than is achievable using standard reconstruction techniques.

The use of Iterative Reconstruction by itself may not decrease CTDI\textsubscript{vol}; with use of Iterative Reconstruction, image quality will change and this may allow a reduction in the CTDI\textsubscript{vol} by adjusting the acquisition parameters used for the exam.

Dose Modulation and Reduction
Hitachi: Iterative Reconstruction

Intelli IP

Dose Modulation and Reduction
Iterative Reconstruction

- Iterative Reconstruction using Intelli IP is completed using Image and Projection Data
- Changing the Letter of Intelli IP will affect the resultant image quality; it WILL NOT affect the CTDI_{vol} of the scan
- In consultation, the radiologists and medical physicists may adjust the acquisition parameters for studies reconstructed using Intelli IP based on the imaging task and patient population, dose concerns, and the needs of the interpreting radiologist(s)

Dose Modulation and Reduction
Dose Display

• Information about the CTDI$_{vol}$ planned for each scan is typically displayed before the exam on the user console.

• Information about the CTDI$_{vol}$ delivered by each scan is typically reported in a data page or DICOM structured dose report.

• Dose information provided after the exam typically also includes the DLP and the CTDI phantom size. These may also be included in information displayed before the scan.
Display of Planned $CTD_{vol}$

- $CTD_{vol}$ is displayed before a study is performed based on the selected technique parameters.
- It is important to check $CTD_{vol}$ before a study is performed to ensure that the output of the scanner is appropriate for the specific patient and diagnostic task.

$CTD_{vol}$ is displayed for each planned acquisition.

Dose Display
Hitachi: Display of Planned $CTD_{vol}$

$CTD_{vol}$

<table>
<thead>
<tr>
<th>No.</th>
<th>Scan Type</th>
<th>Geo. Effic.</th>
<th>Scan Period</th>
<th>CTD_{vol}</th>
<th>DLP</th>
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<tr>
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<td>83.0%</td>
<td>22s</td>
<td>52.1mGy</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>834.2mGy·cm</td>
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Dose Display

Hitachi
**Post Study Data Page**

- Following the completion of a study, a Post Study Data Page is created that includes information on the delivered CTDI$_{vol}$ and DLP and the phantom size used to calculate these values.
- Information is displayed for each series.
### Dose History

<table>
<thead>
<tr>
<th>Patient ID</th>
<th>Patient Name</th>
<th>Exam Date</th>
<th>Region</th>
<th>Total CTDD [mGy]</th>
<th>CTDI [mGy]</th>
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<td>Head</td>
<td>117.2</td>
<td>116.9</td>
<td>GS</td>
</tr>
</tbody>
</table>

**Total CTDD [mGy]:** 200.0

**Total CTDI [mGy]:** 230.0
Post Study Data Page - $CTD_{vol}$

- $CTD_{vol}$ is displayed for each series after a study is performed and is calculated based on the technique factors used to acquire the data.
- It is useful to check $CTD_{vol}$ after a study is performed to ensure that the output of the scanner was as expected.

$CTD_{vol}$ is displayed for each completed acquisition.

Dose Display
Post Study Data Page - DLP

- DLP is displayed for each series after a study is performed and is calculated based on the technique factors and scan length used

DLP is displayed for each completed acquisition and is typically summed for all of the acquisitions

Dose Display
### Detail Information

<table>
<thead>
<tr>
<th>Patient</th>
<th>TID (mmHg)</th>
<th>DLP (mGy*cm)</th>
<th>Tube Current (mA)</th>
<th>Tube Voltage (kV)</th>
<th>Beam ON/Off</th>
<th>Slice Time (s)</th>
<th>Slice Count</th>
<th>Exposure Time (s)</th>
<th>Dose Validation Phantom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>123</td>
<td>1457</td>
<td>200</td>
<td>128</td>
<td>OFF</td>
<td>1.00</td>
<td>1</td>
<td>1.08</td>
<td>Head Phantom</td>
</tr>
<tr>
<td>Head</td>
<td>138.8</td>
<td>20.8</td>
<td>622</td>
<td>128</td>
<td>OFF</td>
<td>1.00</td>
<td>1</td>
<td>1.08</td>
<td>Head Phantom</td>
</tr>
</tbody>
</table>
Post Study Data Page – CTDI Phantom

• The CTDI Phantom used for each acquisition in the study is typically displayed

• Different phantoms may be used to calculate the CTDI_{vol} for different acquisitions in the same study (and may vary by vendor)
  – Head and C-Spine Example
    • Body Phantom used to report CTDI_{vol} for C-Spine portion of exam
    • Head Phantom used to report CTDI_{vol} for Head portion of exam

Dose Display
### Hitachi: Post Study Data Page – CTDI Phantom

#### Detail Information per Sequence

<table>
<thead>
<tr>
<th>Sequence</th>
<th>CTDI (mgY)</th>
<th>CTDI (mGy)</th>
<th>CTDI (mgY)</th>
<th>CTDI (mGy)</th>
<th>CTDI (mgY)</th>
<th>CTDI (mGy)</th>
<th>CTDI (mgY)</th>
<th>CTDI (mGy)</th>
<th>CTDI (mgY)</th>
<th>CTDI (mGy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Phantom</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
</tbody>
</table>

#### Dose Display
Summing Dose Report Values

- CTDI$_{vol}$ values for separate series are NOT to be summed to give a “total” CTDI$_{vol}$ for a study
  - This is especially true if the series cover different anatomic regions
- DLP is typically summed over all series in the Post Study Data Page to provide an estimate of the total patient exposure
  - Extreme care should be taken when considering summed DLPs because different phantoms may have been used to calculate the CTDI$_{vol}$ values used to determine DLP
- A medical physicist should be contacted if patient specific dose estimates are required

Dose Display
Dose Alert Levels

- Dose Alert Levels require specific action by the operator to continue scanning
- Dose Alert Levels are typically much higher than Notification Levels and take into account all series within the exam
- Triggering a Dose Alert requires that the operator confirm the protocol and settings are correct by entering in his or her name. Optionally, sites may require that the operator provide a brief explanation in the provided field

Dose Display
Hitachi: Dose Alert Levels

Dose Alert

The Dose Alert feature complies with the Hitachi NEMA XR-25 standard.
Radiation Dose Structured Reports

- Radiation Dose Structured Reports (RDSRs) are provided in newer software versions in a defined DICOM format
- They provide the most complete set of information regarding the irradiating events
- The reports are very detailed and require an RDSR viewer for easy visualization of relevant information

Dose Display
Hitachi: Radiation Dose Structured Reports

DICOM Dose Structured Report

Dose Display
Questions

• Please contact the medical physicist providing support for your CT practice, your lead technologist, supervising radiologist or manufacturer’s application specialist with questions regarding these important topics and concepts.
A special thank you to Dr. Mark Supanich for his considerable efforts in leading the working group in developing these slides.
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