Deploying a dose management strategy across multiple sites

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Disclosure Information

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Presentation objectives

I. Understand the challenges of implementing a **Dose Management Strategy (DMS)**, in different locations

I. Learn more about practical examples of DMS, implemented across multiple sites
DMS scope (1/2)

- CT multislice $\geq 6$ detector rows
- 6 countries
- 36 CT sites
- 3 CT manufacturers
- 12 CT models
- 27 CT systems with dose reduction algorithms
• **53** radiologists

• **70** radiographers

• **11** anatomic areas

• **29** CT protocols

• **22,000** examinations on average per month
DMS Rationale (1/2)

- Assign dose management teams
- Assess existing workflow & dose awareness culture
- Create a communication plan
- Set goals & milestones
- Foster a dose awareness culture
- Use dose tracking, monitoring, analyzing software
• **Justification**: dose alerts

• **Standardization**: QC, protocols and practice

• **Optimization**: CT operation, protocols and practice

• **Reporting**

• **Dose** benchmarking

• Implement **best practices**
Goals

- Create **standardized CT protocols list**
- Set **DRLs** for 29 protocols
- Set % **targets** for standard use of protocols, justification of dose alerts, linked protocols, protocols compliance to DRLs
- **Dose awareness culture**
- **Dose benchmarking**
- **Image quality testing**
- **Gold protocols**
Dose Awareness Culture

- Assessment of dose awareness culture through questionnaire
- Automatic alerts of high dose examinations
- Justification of each alert
- Monthly dose team meetings
- Continuing education for radiologists & radiographers
Communication plan

• Creation of communication material

• Target group I: medical centers

• Target group II: medical practitioners, patients
Recorded CT Dose Units

Dose units in CT

$\text{CTDI}_{\text{vol}}$ - CT Dose Index volume

*Unit:* mGy

*Definition:* Density of radiation received for a given axial slice level. It depends directly on the acquisition parameters.

$\text{DLP} - \text{Dose Length Product}$

*Unit:* mGy.cm

*Definition:* $\text{CTDI}_{\text{vol}} \times \text{Scanning Length}$
Dose Tracking, Monitoring, Analysis

- Connect CT systems to **dose tracking software**
- Software tools to **link site protocols to standardized protocols**
- Software tools to **set local dose reference levels**
- Software tools to **monitor and analyze high dose alerts** and **patient cumulative dose**
- Use **data consolidation** and **statistical analysis tools** for protocol optimization and dose reduction
Standardization (1/2)

- Monthly and annual **quality controls** of CT systems
- **Workflow**
- **CT protocols list**
# Standardization (2/2)

<table>
<thead>
<tr>
<th>Region/Anatomy</th>
<th>Protocol Name</th>
<th>ID</th>
<th>Clinical Indication</th>
<th>Diagnostic Task</th>
<th>NS</th>
<th>Scan Mode</th>
<th>Scan Range</th>
<th>BMI</th>
<th>75p CTDI DRL</th>
<th>75p DLP DRL</th>
</tr>
</thead>
</table>

- Choose **most frequent protocols**
- **Link** individual site CT protocols to above list
Optimization

- **Compare** dose values to DRL’s
- **Adjust** protocol parameters accordingly
- **Image Quality testing** with phantoms & blind studies
MONTHLY AND PERIODIC DATA

% of high dose examinations and % of Justified alerts

% of performed examinations with Standardized protocols

% of protocols Optimized
# Protocols Compared to DRLs

## Dose Reference Level (DRL) analysis - 2015-01-01 to 2015-01-31

<table>
<thead>
<tr>
<th>Device</th>
<th>RPID</th>
<th>NS (TNI)</th>
<th>Protocol name</th>
<th># Exams</th>
<th>P75 of Max series CTDIvol (mGy.cm)</th>
<th>P75 of Total DLP (mGy)</th>
<th>Max CTDI DRL (mGy.cm)</th>
<th>Total DLP DRL (mGy)</th>
<th>CTDI diff</th>
<th>DLP diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brightspeed 16</td>
<td>RPID242</td>
<td>1</td>
<td>7.1 Coluna lombar SmartmA</td>
<td>83</td>
<td>28.19</td>
<td>721.98</td>
<td>45.00</td>
<td>850.00</td>
<td>-37.36 %</td>
<td>-15.06 %</td>
</tr>
<tr>
<td>Brightspeed 16</td>
<td>RPID22</td>
<td>1</td>
<td>1.5 Cranio helicoidal</td>
<td>68</td>
<td>37.59</td>
<td>696.45</td>
<td>55.00</td>
<td>900.00</td>
<td>-31.66 %</td>
<td>-22.62 %</td>
</tr>
<tr>
<td>Brightspeed 16</td>
<td>RPID16</td>
<td>1</td>
<td>5.1 Torax rotina S/C 1.75 pitch booster</td>
<td>44</td>
<td>7.28</td>
<td>266.04</td>
<td>10.00</td>
<td>330.00</td>
<td>-27.25 %</td>
<td>-19.38 %</td>
</tr>
<tr>
<td>Brightspeed 16</td>
<td>RPID37</td>
<td>1</td>
<td>3.1 Coluna cervical helicoidal SmartmA</td>
<td>32</td>
<td>19.91</td>
<td>389.84</td>
<td>20.00</td>
<td>400.00</td>
<td>-0.47 %</td>
<td>-2.54 %</td>
</tr>
<tr>
<td>Brightspeed 16</td>
<td>RPID206</td>
<td>1</td>
<td>2.2 Seios paranassais</td>
<td>21</td>
<td>9.40</td>
<td>132.86</td>
<td>10.00</td>
<td>150.00</td>
<td>-6.00 %</td>
<td>-11.43 %</td>
</tr>
<tr>
<td>Brightspeed 16</td>
<td>RPID1253</td>
<td>2</td>
<td>4.3 Puinho</td>
<td>8</td>
<td>11.82</td>
<td>232.26</td>
<td>20.00</td>
<td>500.00</td>
<td>-40.90 %</td>
<td>-53.55 %</td>
</tr>
<tr>
<td>Brightspeed 16</td>
<td>RPID1241</td>
<td>2</td>
<td>9.2 JOEHA bilateral</td>
<td>5</td>
<td>14.92</td>
<td>411.06</td>
<td>20.00</td>
<td>500.00</td>
<td>-25.40 %</td>
<td>-17.79 %</td>
</tr>
<tr>
<td>Brightspeed 16</td>
<td>RPID4</td>
<td>2</td>
<td>6.1 Abdomen Pelvis (sem e com)</td>
<td>4</td>
<td><strong>18.07</strong></td>
<td><strong>1292.35</strong></td>
<td>17.00</td>
<td>1150.00</td>
<td>6.29 %</td>
<td>12.38 %</td>
</tr>
<tr>
<td>Brightspeed 16</td>
<td>RPID1241</td>
<td>2</td>
<td>9.5 Toraxesbiateral</td>
<td>4</td>
<td>8.21</td>
<td>141.62</td>
<td>20.00</td>
<td>500.00</td>
<td>-58.98 %</td>
<td>-71.68 %</td>
</tr>
<tr>
<td>Brightspeed 16</td>
<td>RPID856</td>
<td>3</td>
<td>6.3 Abdomen Pelvis (sem e tardo 3 series)</td>
<td>2</td>
<td>8.32</td>
<td>1245.34</td>
<td>17.00</td>
<td>1650.00</td>
<td>-51.06 %</td>
<td>-24.52 %</td>
</tr>
<tr>
<td>Brightspeed 16</td>
<td>RPID953</td>
<td>4</td>
<td>6.5 Abdomen Pelvis (sem e tardo 4 series)</td>
<td>2</td>
<td>9.45</td>
<td>1226.98</td>
<td>17.00</td>
<td>2150.00</td>
<td>-44.41 %</td>
<td>-42.93 %</td>
</tr>
</tbody>
</table>

This table shows a DRL analysis for all protocols mapped with a standard NS (TNI). The P75 values (Max series CTDIvol or Total DLP) that are above the DRL threshold are displayed in red writing.
% DLP Reduction

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-29%</td>
</tr>
<tr>
<td>B</td>
<td>-19%</td>
</tr>
<tr>
<td>C</td>
<td>-34%</td>
</tr>
<tr>
<td>D</td>
<td>-36%</td>
</tr>
<tr>
<td>E</td>
<td>-16%</td>
</tr>
</tbody>
</table>
% Optimization

% PROTOCOL p75 (DLP AND CTDI) < DRL

- COUNTRY A: 60%
- COUNTRY B: 52%
- COUNTRY C: 51%
- COUNTRY D: 50%
- COUNTRY E: 46%
## Dose benchmarking

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>SYSTEM</th>
<th>75% CTDIvol (mGy)</th>
<th>75% DLP (mGy.cm)</th>
<th>DRL CTDIvol (mGy)</th>
<th>DRL DLP (mGy.cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>CT Scanner A – 64 slice</td>
<td>3,10</td>
<td>43,33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>CT scanner B – 64 slice with dose reduction option</td>
<td>4,29</td>
<td>75,75</td>
<td>13</td>
<td>190</td>
</tr>
<tr>
<td>E</td>
<td>CT scanner C – 64 slice with dose reduction option</td>
<td>7,06</td>
<td>108,02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>CT scanner D – 64 slice</td>
<td>10,96</td>
<td>176,51</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Challenges (1/2)

- Country legislation & NHS rules
- Differences in national mentalities & CT dose perception
- CT dose culture between radiologists of different generations
- Workload differences between private & public sector
Challenges (2/2)

- Team spirit and collaboration
- Agreement on standardized CT protocols & practices
- Clinical and technical assessment of protocols
- CT protocol parameters corrections to reduce dose
Participants feedback

“We would like to inform you that the latest changes we have applied in Head, Neck and Sino-nasal CT scans have a very good image quality, which is considered much better than the previous image protocols. We would like to thank you very much and we will keep in touch for any protocol regulations and changes we might need in the future.”

Sincerely yours,

Radiologist

“Standardizing CT protocols is key because it means that all centers across all countries will operate in the same way. That means I can work anywhere throughout the organization.”

Radiographer
Conclusion

With dedicated teams, continuing education, standardization and a clear dose management strategy,

dose tracking will lead to dose reduction