A Patient Centric Initiative to Reduce Radiation Dose to Pediatric Patients in Computer Tomography Chest and Abdomen procedures

Fatima Mubarak & Mohammad Yusuf

Department of Radiology
The Aga Khan University Hospital Karachi, Pakistan
Objective

An initiative to reduce radiation dose to pediatric patients during Computer Tomography’s chest and abdomen related procedures based on international best practices.
Methods

• The need for radiation dose management is critical in the light of JCI Sentinel Event (Issue 47) as well as Advisory Board’s document “Managing Radiation Risk”. An assessment was carried out to determine the level of radiation dose being employed for pediatric patients for CT chest and abdomen examinations and was also compared to the international recommendations. The assessment showed that the radiation dose was typically higher than the recommended standards.

• The initiative by the Healthcare Informatics team spanned from educational to technical aspects to address the higher radiation dose. Internationally defined best practices and radiation dose reference levels were identified. CT modalities were configured for appropriate reduced dose protocols, technologists were educated, radiologists were consulted on the image quality and reduced radiation dosage, an in-house system was developed to extract process and archive the radiation dose results of each procedure and finally produce meaningful reports.
Results

The initiative managed to reduce the pediatric Chest and Abdomen procedure’s average CT radiation doses by 43% and 62% respectively compared to the average radiation dose that was delivered in procedures prior to the initiative. This also resulted in bringing the dose levels within the reference levels defined by international bodies. For comparison, ICRP publication 87 reference levels were utilized.
Dose Reduction Initiative at AKU Radiology

Results – Sample dose levels for Pediatric CT exams after dose reduction efforts.

<table>
<thead>
<tr>
<th>MR#</th>
<th>Age</th>
<th>Study</th>
<th>AKU CT DLP (DLP)</th>
<th>International Standard (DLP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>202-11-62</td>
<td>&lt;1</td>
<td>CT Angio</td>
<td>33</td>
<td>50</td>
</tr>
<tr>
<td>572-17-42</td>
<td>2Y</td>
<td>CT Angio</td>
<td>41</td>
<td>75</td>
</tr>
<tr>
<td>271-04-60</td>
<td>1.2Y</td>
<td>CT Angio</td>
<td>42</td>
<td>50</td>
</tr>
<tr>
<td>287-94-96</td>
<td>&lt;1</td>
<td>Chest w Contrast</td>
<td>36</td>
<td>200</td>
</tr>
<tr>
<td>291-92-06</td>
<td>&lt;1</td>
<td>Abdomen w contrast</td>
<td>153</td>
<td>330</td>
</tr>
<tr>
<td>291-51-75</td>
<td>1.2Y</td>
<td>Head w/o contrast</td>
<td>457</td>
<td>600</td>
</tr>
</tbody>
</table>
Dose Reduction Initiative at AKU Radiology

Effective Dose Trends (Aquilion ONE)
2014
Dose Reduction Initiative at AKU Radiology

Pediatric CT Radiation Dose - Head (0-1yr)

Pediatric CT Radiation Dose - Chest (0-1yr)

Pediatric CT Radiation Dose - Abdomen (0-1yr)

Pediatric CT Radiation Dose - Head (1-5yrs)

Pediatric CT Radiation Dose - Chest (1-5yrs)

Pediatric CT Radiation Dose - Abdomen (1-5yrs)

Pediatric CT Radiation Dose - Head (5-18yrs)

Pediatric CT Radiation Dose - Chest (5-18yrs)

Pediatric CT Radiation Dose - Abdomen (5-18yrs)
<table>
<thead>
<tr>
<th>Modality</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head - CT640</td>
<td>2.24</td>
<td>2.91</td>
<td>3.09</td>
<td>3.39</td>
<td>11.53</td>
</tr>
<tr>
<td>Abdomen - CT640</td>
<td>11.75</td>
<td>11.75</td>
<td>11.75</td>
<td>11.75</td>
<td>47.00</td>
</tr>
<tr>
<td>Chest - CT640</td>
<td>9.11</td>
<td>11.22</td>
<td>9.03</td>
<td>10.23</td>
<td>39.60</td>
</tr>
<tr>
<td>Head - CT64</td>
<td>1.59</td>
<td>4.67</td>
<td>4.63</td>
<td>4.32</td>
<td>14.13</td>
</tr>
<tr>
<td>Abdomen - CT64</td>
<td>14.81</td>
<td>14.81</td>
<td>14.81</td>
<td>14.81</td>
<td>58.14</td>
</tr>
<tr>
<td>Chest - CT64</td>
<td>9.01</td>
<td>9.01</td>
<td>9.01</td>
<td>9.01</td>
<td>36.03</td>
</tr>
</tbody>
</table>

Overall Average Effective Dose (mSv):
- Head: 2.88
- Abdomen: 17.49
- Chest: 11.24

# of patients with more than 1 scans:
- Head: 517
- Abdomen: 979
- Chest: 702

EFFECTIVE DOSE
Adult Radiation Dose Trend Comparison by Modality 2014

Comparison to Reference Levels:
- Head: 115.79
- Abdomen: 85.17
- Chest: 94.29
- Spine: 78.12
- KUB: 318.97
- Spine: 301.73
Future Direction

✓ Improve the image quality and reduce dose through technology and optimization

✓ **Awareness** among the medical community

✓ **Facilitate** other centres to optimize their clinical radiation dose

✓ Facilitate centres throughout Pakistan.
Conclusion

Adopting a patient centric approach in a proactive manner, the team was able to assess and identify an area that had a direct bearing on patient care and was able to plan and implement an environment that provided significant reduction in the radiation dose being administered to pediatric patients during CT chest and abdomen examinations.