Quality control and patient doses in computed tomography

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Introduction and Purpose

- Quality control of computed tomography scanners is a legal requirement in Poland. Polish regulations also specify diagnostic reference levels for CT (adopted from European Guidelines EUR 16262).

- The aim of the work was to analyse results of quality control tests and patient doses for several computed tomography units in our centre.
Materials and Methods

- **Monthly tests**
  - Artefacts
  - CT numbers
  - Noise
  - Uniformity
  - Slice width
  - Couch movement
  - Positioning lights

- **Yearly tests**
  - Dose indices
  - Beam collimation
  - kVp
  - HVL
  - Image quality

- **Doses**
  - CTDI and DLP data collected for typical protocols and for groups of patients
  - Results compared with diagnostic reference levels published by the European Commission\(^1\),\(^2\) and by the NRPB\(^3\)

1) EUR 16262, cited in Polish law
2) European Guidelines for Multislice Computed Tomography
3) NRPB-W67
Materials and Methods

CT scanners included in the study:
- GE HiSpeed DX/i – single slice CT used for planning of radiotherapy (RT) (left)
- Siemens Somatom Emotion Duo – CT on rails used for planning of brachytherapy (BT) and for intraoperative imaging (right)
- GE LightSpeed Pro 32 – used for diagnostics
- Philips Gemini TF 16 (PET-CT)
The results of all tests were generally within limits for all examined scanners.
## Results: doses

<table>
<thead>
<tr>
<th>CT scanner</th>
<th>Examination</th>
<th>CTDI&lt;br&gt;_{vol} [mGy]</th>
<th></th>
<th></th>
<th>DLP [mGy x cm]</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>average</td>
<td>min</td>
<td>max</td>
<td>DRL EU</td>
<td>DRL NRPB</td>
<td>average</td>
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<tr>
<td>GE HiSpeed DX/i</td>
<td>Head</td>
<td>16.4</td>
<td>6.9</td>
<td>28.5</td>
<td>60</td>
<td>65/55</td>
<td>294</td>
</tr>
<tr>
<td></td>
<td>Chest</td>
<td>10.7</td>
<td>4.4</td>
<td>14.4</td>
<td>35</td>
<td>10/11</td>
<td>323</td>
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<tr>
<td></td>
<td>Breast (for RT)</td>
<td>6.9</td>
<td>4.1</td>
<td>9.1</td>
<td>35</td>
<td>10/11</td>
<td>162</td>
</tr>
<tr>
<td></td>
<td>Abdomen</td>
<td>8.8</td>
<td>5.9</td>
<td>11.0</td>
<td>35</td>
<td>13</td>
<td>336</td>
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<tr>
<td></td>
<td>Pelvis</td>
<td>9.1</td>
<td>6.8</td>
<td>17.8</td>
<td>35</td>
<td>12</td>
<td>239</td>
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<tr>
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<td>Prostate (for RT)</td>
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<td>7.1</td>
<td>9.5</td>
<td>35</td>
<td>12</td>
<td>157</td>
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<tr>
<td>GE LightSpeed Pro 32</td>
<td>Head</td>
<td>61.0</td>
<td>52.0</td>
<td>72.5</td>
<td>60</td>
<td>100/65</td>
<td>1288</td>
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<tr>
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<td>Chest</td>
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<td>6.9</td>
<td>30.9</td>
<td>10</td>
<td>13/14</td>
<td>653</td>
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<tr>
<td></td>
<td>Abdomen&amp;Pelvis</td>
<td>24.5</td>
<td>9.7</td>
<td>43.7</td>
<td>15</td>
<td>14</td>
<td>1266</td>
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<tr>
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<td>Abdomen</td>
<td>16.6</td>
<td>6.8</td>
<td>45.8</td>
<td>25</td>
<td>14</td>
<td>1181</td>
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<tr>
<td>Siemens Somatom Emotion Duo</td>
<td>Head (for BT)</td>
<td>27.4</td>
<td>27.4</td>
<td>27.4</td>
<td>60</td>
<td>65/55</td>
<td>341</td>
</tr>
<tr>
<td></td>
<td>Breast (for BT)</td>
<td>8.6</td>
<td>5.1</td>
<td>10.9</td>
<td>35</td>
<td>10/11</td>
<td>327</td>
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<td>Pelvis (for BT)</td>
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<tr>
<td>Philips Gemini TF 16</td>
<td>Whole body (PET-CT)</td>
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<td>3.5</td>
<td>3.5</td>
<td>-</td>
<td>-</td>
<td>39.4</td>
</tr>
</tbody>
</table>
Results: doses

- Patient doses for examinations of the same parts of the body differed between scanners. In some cases they exceeded the diagnostic reference levels.
- Highest doses were observed for applications that require highest image quality (diagnosis), lowest for those in which CT only provides supplementary data (PET-CT).
- CT examinations performed in our centre do not match examinations for which the levels were defined.
Conclusions

- Results of the quality control tests are satisfactory. They shall be continued as required by current Polish regulations to monitor performance of the scanners.
- The scope of examinations, for which diagnostic reference levels are published in national or international recommendations, does not match the scope of examinations performed in our centre.