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# Establishment of Local Dose Reference Levels for Radiotherapy Planning CT Scans

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## 1. ***Background-Aim***

A fundamental principle of radiation protection is to maintain the doses As Low As Reasonably Achievable. Diagnostic Reference Levels (DRLs) and **Size Specific Dose Estimate (SSDE)** are both important tools in Computed Tomography (CT) optimization procedures. Although CT is typically used for simulation (CT-SIM) **in radiotherapy** (RT), DRLs are not widely established for these scans.

***The primary objective of this study was to establish local DRLs (LDRLs) and SSDE values for various adult RT/CT-SIM protocols.*** The ultimate goal was to identify potential improvements of the clinically used CT protocols in radiotherapy.

## 2. ***Materials & Methods***

- **The LDRLs were established** for Thorax, Brain, Abdomen, Pelvis and Head & Neck RT protocols using the 75th percentile approach.
- **The indices** included in the analysis were: **CTDI, DLPscan, DLPexam and SSDE.**
- The Effective diameter and SSDE were calculated using the **AAPM TG 204 methodology.**
- A total of **150 scans** (30 scans per protocol) of standard-size patients were included in the analysis.
- Since National DRLs have not been established, **a comparison was performed with the respective British DRLs**.

## 3. ***Results***

**CTDI, DLPscan, DLPexam and SSDE values are shown in the table.**

| RT_Thorax | | |
|---|---|---|
| | **Metaxa Hospital** | **UK DRLs** |
| **CTDI (mGy)** | 9 | Breast: 10<br>Lung 3D: 14 |
| **DLP (mGy*cm)** | 354 | - |
| **$DLP_{TOTAL}$(mGy*cm)** | 360 | Breast: 390<br>Lung 3D: 550 |
| **Effective Diameter (cm)** | 29 | - |
| **SSDE (mGy)** | 12 | - |

- The RT/CT-SIM scans concerning breast and lung are performed with the RT_Thorax protocol.

## 3. *Results*

**CTDI, DLPscan, DLPexam and SSDE values are shown in the table.**

| RT_Abdomen | | |
|---|---|---|
| | **Metaxa Hospital** | **UK DRLs** |
| **CTDI (mGy)** | 14 | Gynecological: 16<br>Prostate: 16 |
| **DLP (mGy*cm)** | 617 | - |
| **$DLP_{TOTAL}$ (mGy*cm)** | 623 | Gynecological: 610<br>Prostate: 1750 |
| **Effective Diameter (cm)** | 29 | - |
| **SSDE (mGy)** | 18 | - |

| RT_Pelvis | | |
|---|---|---|
| | **Metaxa Hospital** | **UK DRLs** |
| **CTDI (mGy)** | 14 | Gynecological: 16<br>Prostate: 16 |
| **DLP (mGy*cm)** | 597 | - |
| **$DLP_{TOTAL}$ (mGy*cm)** | 604 | Gynecological: 610<br>Prostate: 1750 |
| **Effective Diameter (cm)** | 29 | - |
| **SSDE (mGy)** | 18 | - |

- The RT/CT-SIMs concerning gynecological and prostate cases are performed with the RT_Pelvis and RT_Abdomen protocols depending on the scan length.

## 3. *Results*

**CTDI, DLPscan, DLPexam and SSDE values are shown in the table.**

| RT_Head | | |
|---|---|---|
| | **Metaxa Hospital** | **UK DRLs** |
| **CTDI (mGy)** | 55 | 50 |
| **DLP (mGy*cm)** | 1407 | - |
| **$DLP_{TOTAL}$(mGy*cm)** | 1416 | 1500 |
| **EFFECTIVE DIAMETER** | 17 | - |
| **SSDE (mGy)** | 54 | - |

| RT_Head^Neck | | |
|---|---|---|
| | **Metaxa Hospital** | **UK DRLs** |
| **CTDI (mGy)** | 5 | 49 |
| **DLP (mGy*cm)** | 205 | - |
| **$DLP_{TOTAL}$(mGy*cm)** | 208 | 2150 |
| **EFFECTIVE DIAMETER** | 24 | - |
| **SSDE (mGy)** | 8 | - |

- Our results were comparable with the British DRLs for all protocols except for the Head & Neck for which ours were significantly lower. This is because the UK doses for Head & Neck examinations refer to measurements in the 16cm standard CT dosimetry phantom, while our values refer to measurements in the 32cm standard CT dosimetry phantom.

## 4. Conclusions

- The LDRL values indicated that **acceptable radiation protection practices are followed**.

- Continuing monitoring and analysis of the LDRLs could potentially **lead to further dose reduction**, while maintaining image quality in the CT/SIM.

## ***5. References***


1. AAPM Report No. 204 “Size-Specific Dose Estimates (SSDE) in Pediatric and Adult Body CT Examinations” (2011).
2. Guidance “National Diagnostic Reference Levels (NDRLs) from 13 October 2022”