ESTABLISHMENT OF DIAGNOSTIC REFERENCE LEVELS (DRLs) FOR CT OF THE HEAD AND NECK IN RADIATION THERAPY AND COMPARISON WITH A EUROPEAN SAMPLE

Celine Clerkin1, Laura Mullaney1 and Sinead Brennan2

1 Applied Radiation Therapy Trinity, Discipline of Radiation Therapy, School of Medicine, Trinity College Dublin, Ireland.
2 Department of Radiation Oncology, St Luke’s Radiation Oncology Network at St Luke’s Hospital, Dublin 6.

Introduction
Computed tomography (CT) has become an indispensable tool in the radiation therapy (RT) treatment planning process. Ionising radiation is cumulative and carries a stochastic risk of malignancy. (1) It is a requirement of EU legislation that doses of ionising radiation for medical exposures be kept ‘As Low As Reasonably Achievable’. The International Commission on Radiological Protection (ICRP) defined diagnostic reference levels (DRLs) in 1990 as “a level intended for use as a simple test for identifying situations where the level of patient dose or administered activity is unusually high”. (2) The objective of a DRL is to help avoid excessive radiation dose to the patient that does not contribute additional clinical information to the medical imaging task. Currently diagnostic DRLs exist in Ireland (3), but no attempts have been made to introduce dose audit in the RT setting.

Methods and Materials
An anonymised dose audit survey (collecting data on CT dose index volume (CTDIvol); dose length product (DLP); mAs; tube voltage; number of scan phases and scan length) of 10 head and neck patients was distributed to all Irish RT centres and a sample of European centres.
Diagnostic DRLs are proposed based on two primary dosimetry metrics: CTDIvol and DLP. CTDIvol specifies the radiation intensity used to perform a specific CT examination. The CTDIvol is fixed and independent of patient size and scan length. DLP combines the CTDIvol and the scan length to quantify the total radiation dose received by a patient. The accepted convention for calculating DRL is using the 75th percentile of the mean CTDIvol and DLP.

Results
Survey - Surveys were returned by five Irish centres, representing 42% of the national average, and one European centre.

Proposed DRL - The proposed Irish DRL is 1025 mGy cm for DLP and 21 mGy for CTDIvol. Based on the European survey the DRLs for DLP and CTDIvol were 680 mGy cm and 22 mGy respectively.

Variations - Significant variation was found between participating centres in the mean DLP, p<0.002 (Table 1), CTDIvol, p<0.049 (Table 2) and scan lengths, p<0.0001. Slopes of the linear regression lines for DLP vs. CTDIvol and DLP vs. scan length showed a positive correlation with m values of 5.51 and 1.72 respectively.

<table>
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<th>Centre ID</th>
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<th>Range (mGy cm)</th>
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<td>20</td>
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</table>

Table 1. Mean Dose Length Product (DLP) for head and neck CT scanning in surveyed radiation therapy centres.

Discussion
• The results of this study support the hypothesis that variation exists in doses used for head and neck CT planning in RT, giving that the purpose of the procedure is the same for this may be surprising.
• This variation supports the establishment of therapeutic DRLs for head and neck CT scanning.
• The results of the DLP in this study are in line with a RT CT breast audit, with diagnostic DRLs being approximately half of those proposed by the therapeutic survey. (4)
• Constant revision of DRLs is necessary as technology changes and facilitates lower patient dose.

Conclusions
Variation exists in doses used for head and neck CT in radiation therapy. Irish DRLs have been proposed (DLP 1025 mGy cm and CTDIvol 21 mGy) with the aim of dose optimisation. Results of this study provide a platform for dose comparison and optimisation of planning CT protocols in head and neck cancer.

References
4. O’Connor S, McGlade C, Rainford LA. An audit of breast cancer CT protocols in radiation planning in RT, giving that the purpose of the procedure is the same for this may be surprising.