The Determination of Diagnostic Reference Range (DRR) Based on Clinical Indications in Head Computed Tomography (CT) Imaging

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Abstract

Diagnostic reference range (DRR) were introduced to help manage image quality as well as patient dose by providing minimum estimated dose that covers 25–75% range of dose distribution. The International Commission on Radiological Protection (ICRP) (2017) recommended 75th percentile as upper boundary and 25th percentile as lower boundary of DRR [1]. Dose below the lower range should compromised accurate interpretation of the image and dose above the upper range may be in excess and need to be reviewed. Meanwhile, Diagnostic Reference Levels (DRLs) also recommended by ICRP as a guidance to identify any uncommon high dose delivered by computed tomography (CT) scanner. DRLs are established at 75th percentile of dose distribution and should be implemented at international, regional, or local level for dose management.

This study aims to establish a local DRR based on five most common clinical indications for adult head CT scanning at Department of Radiology, Hospital Universiti Sains Malaysia (HUSM), Kelantan. This study involved a retrospective survey on adult patient data undergone head CT scan with two CT scanners, Toshiba CT scanner at Trauma Department and Siemens CT scanner at Radiology Department, HUSM. The related data regarding the scanning protocols and dose descriptor (dose length product, DLP) were recorded for the most common clinical indication in head CT scans.

Results showed the five most common clinical indication related to head CT scans were abscess, bleeding, stroke, trauma, and tumour. The DLP values were varied based on their clinical indications and CT scanner types. Figure 1 shows boxplots representing the DRRs of dose length product (DLP) based on the five most common clinical indications in head CT scans for Toshiba and Siemens CT scanners. From the figure, the DLP ranges for Toshiba CT scanner were slightly higher than Siemens CT scanners. The lowest DLP value was observed for tumour indication and the highest DLP was bleeding and trauma indications. Clinical indication that requires higher image resolution and details and longer scan length, recorded higher DLP distribution.
This study demonstrates that the dose descriptor values, CTDI_{vol} and DLP were varied for similar anatomical region based on different image quality requirement for each clinical indication. Therefore, DRR and DRL should be established based on specific clinical indication and routine dose audit is essential to ensure patients safety.

**Keywords**
Clinical indication, Computed tomography, Diagnostic reference range

**Reference**