Paediatric diagnostic reference levels in computed tomography: a systematic review

D M Satharasinghe[1,2], J Jeyasugiththan[1], W M N M B Wanninayake[2] and A S Pallewatte[3]

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Abstract

This study aims to review the existing literature on diagnostic reference levels (DRLs) in paediatric computed tomography (CT) procedures and the methodologies for establishing them. A comprehensive literature search was done in the popular databases such as PubMed and Google Scholar under the key words 'p(a)ediatric DRL', 'dose reference level', 'diagnostic reference level' and 'DRL'. Twenty-three articles originating from 15 countries were included. Differences were found in the methods used to establish paediatric CT DRLs across the world, including test subjects, reference phantom size, anatomical regions, modes of data collection and stratification techniques. The majority of the studies were based on retrospective patient surveys. The head, chest and abdomen were the common regions. The volume computed tomography dose index ($CTDI_{vol}$) and dose–length product (DLP) were the dosimetric quantities chosen in the majority of publications. However, the size-specific dose estimate was a growing trend in the DRL concept of CT. A 16 cm diameter phantom was used by most of the publications when defining DRLs for head, chest and abdomen. The majority of the DRLs were given based on patient age, and the common age categories for head, chest and abdomen regions were 0–1, 1–5, 5–10 and 10–15 years. The DRL ranges for the head region were 18–68 mGy ($CTDI_{vol}$) and 260–1608 mGy cm (DLP). For chest and abdomen regions the variations were 1.0–15.6 mGy, 10–496 mGy cm and 1.8–23 mGy, 65–807 mGy cm, respectively. All these DRLs were established for children aged 0–18 years. The wide range of DRL distributions in chest and abdomen regions can be attributed to the use of two different reference phantom sizes (16 and 32 cm), failure to follow a common methodology and inadequate dose optimisation actions. Therefore, an internationally accepted protocol should be followed when establishing DRLs. Moreover, these DRL variations suggest the importance of establish a national DRL for each country considering advanced techniques and dose reduction methodologies.