

# Determination of an Institutional Diagnostic Reference Level (DRL) for 16-slice and 128-slice Computed Tomography (CT) Scanner in a Tertiary Hospital in the Philippines

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## I) Introduction

Currently, the Philippines is still on the process of finalizing the guidelines in the establishment of National Diagnostic Reference Level (NDRL)<sup>5</sup>. Consequently, medical institutions in the country have no national reference yet for comparison with their current practice. In the absence of NDRL, healthcare institution consisting of several X-ray rooms or a single facility linked to a new technique may also derive typical values set as the median value of the distribution from a patient survey according to the International Commission on Radiological Protection (ICRP) Publication 135<sup>1</sup>. Among the imaging modalities utilized in diagnostic radiology, Computed Tomography (CT) scan has the potential to impart higher radiation dose to the patient.<sup>6</sup> Therefore, this study aims to determine separately the typical values of Volume Computed Tomography Dose Index (CTDI<sub>vol</sub>) in units of mGy and the Dose-Length Product (DLP) in units of mGy-cm for the Head, Chest, and Abdomen-Pelvis CT scan using the 16-slice and 128-slice CT scanner installed in the hospital.

## II) Methodology

A retrospective patient survey for adults who undergone CT scan examination from September to December 2021 was done in order to collect the CTDI<sub>vol</sub> and DLP values displayed in the CT console for each examination. A total of 391 examinations were included in the survey consisting of 296 for Head, 34 for Chest, and 61 for Abdomen-Pelvis. The typical values of CTDI<sub>vol</sub> and DLP for each CT scanner were selected as the median value of the collected data.<sup>1</sup> Comparison of the typical values of the CT dose metrics between scanners and international DRLs as well as NDRLs of neighboring countries was subsequently completed.<sup>6,8</sup>

Table 1. CT scanners Used

CT scanner	Manufacturer	Model	Number of Detector Rows	Number of Slice	Year of Installation
1	Philips	Brilliance 16	16	16	2012
2	Hitachi	Scenaria View	64	128	2021

Table 2. Patient Profile

CT Examination	Female	Male	Total	Age Range	Mean Age
Head	122	174	296	21-94	54
Chest	22	12	34	21-80	51
Abdomen-Pelvis	22	39	61	23-77	54
Overall	166	225	391	21-94	53

## III) Results

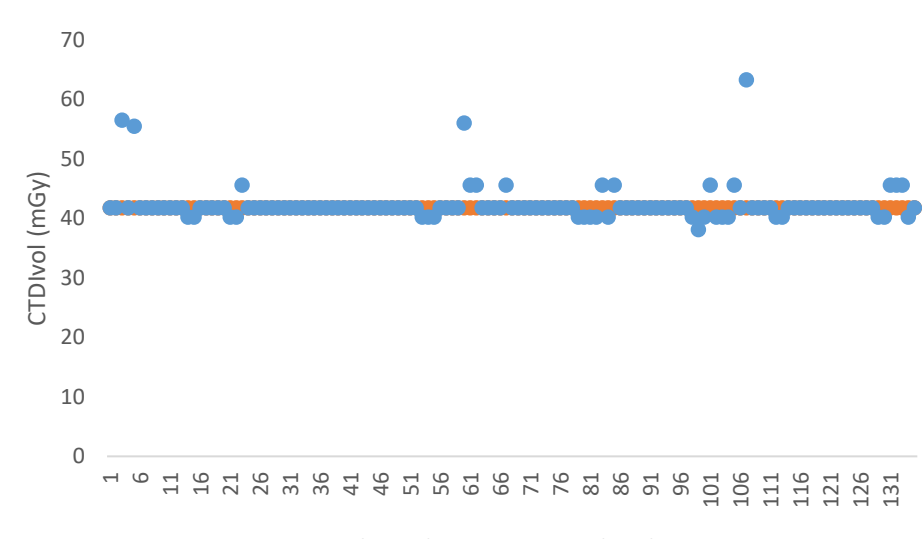


Figure 1. CTDI<sub>vol</sub> for Head CT scan using the 16-slice CT scanner

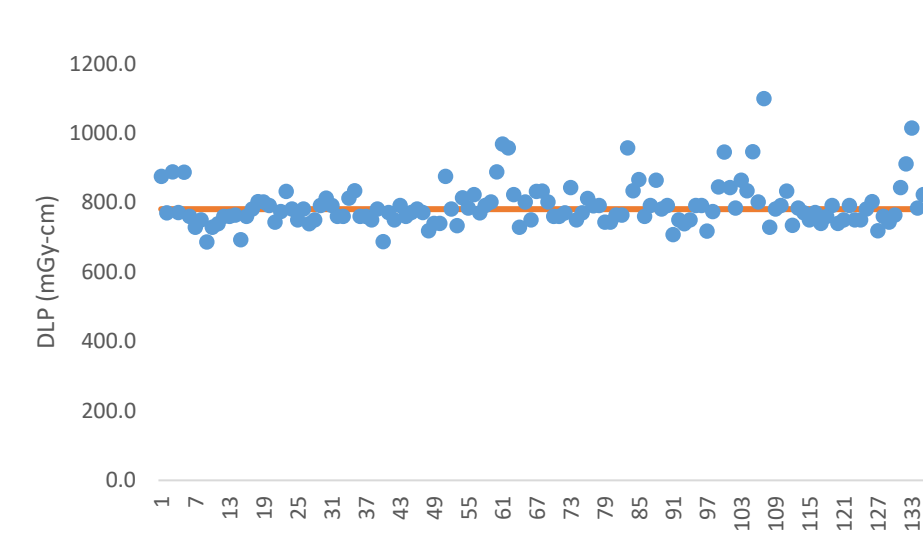


Figure 2. DLP for Head CT scan using the 16-slice CT scanner

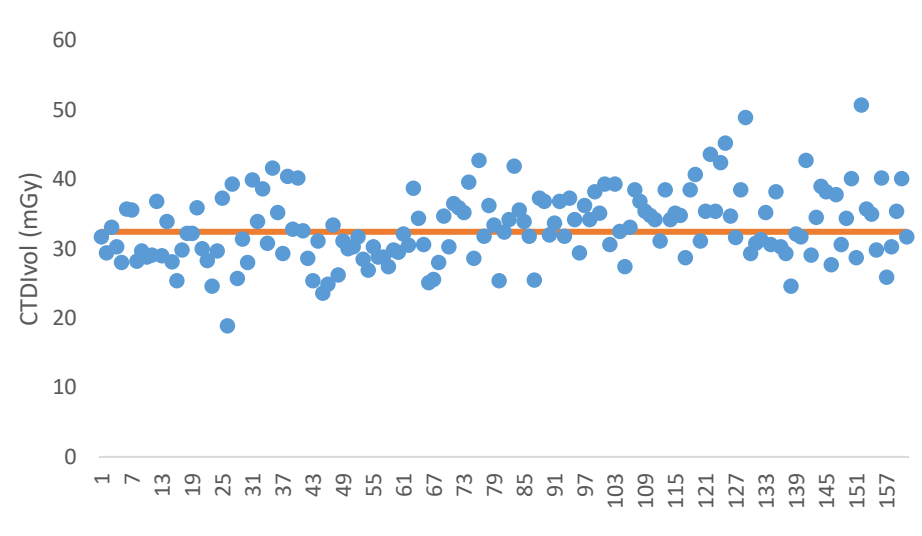


Figure 3. CTDI<sub>vol</sub> for Head CT scan using the 128-slice CT scanner

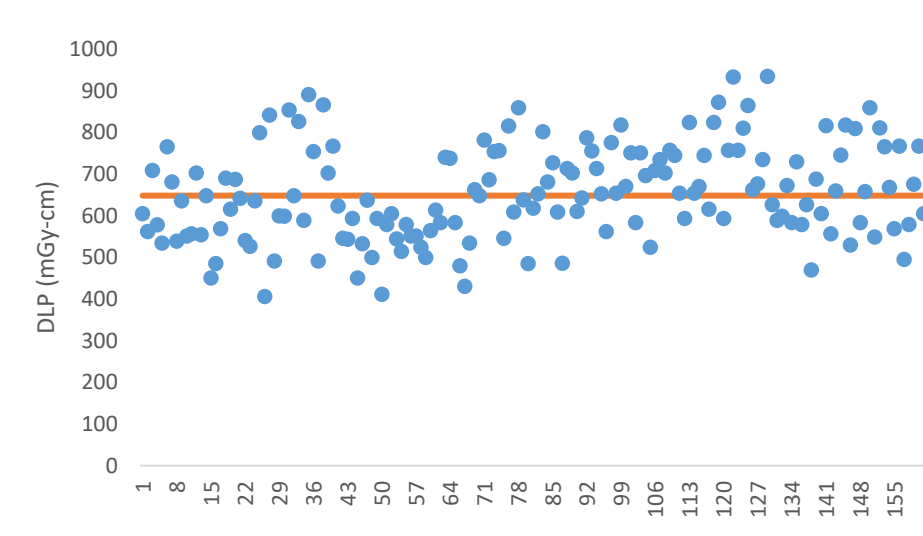


Figure 4. DLP for Head CT scan using the 128-slice CT scanner

Similar graphs were obtained for Chest and Abdomen-Pelvis CT using the two scanners. Summary of results are presented in the following table.

Table 3. Comparison of Typical Values of Institutional DRL per CT Scanner

CT Examination	Median CTDI <sub>vol</sub> (mGy)			Median DLP (mGy-cm)		
	16-slice	128-slice	% Difference	16-slice	128-slice	% Difference
Head	42	32	25.3	781	648	18.6
Chest	11	6	56.5	416	222	60.9
Abdomen-Pelvis	15	11	31.3	814	558	37.4

Typical values of both CTDI<sub>vol</sub> and DLP obtained from the 128-slice CT scanner are lower than that of the 16-slice CT scanner for all anatomical regions included in the study. These results are then compared to published international DRLs and NDRLs of neighboring countries.

## III) Results (continued...)

Table 4. Comparison of Typical Values of Institutional CTDI<sub>vol</sub> with International DRLs

CT Examination	Median CTDI <sub>vol</sub> (mGy)		CTDI <sub>vol</sub> (mGy)					
	16-slice	128-slice	ACR-AAPM <sup>2</sup> DRL (2018)	EC <sup>3</sup> Most Common DRL (2014)	Malaysia <sup>4</sup> DRL (2013)	Thailand <sup>5</sup> DRL (2018)	Indonesia <sup>6</sup> DRL (2020)	Japan <sup>7</sup> DRL (2021)
Head	42	32	56	60	46.8	62	65	77
Chest	11	6	13	10	19.9	18	14	13
Abdomen-Pelvis	15	11	15	25	12.8	20	17	18

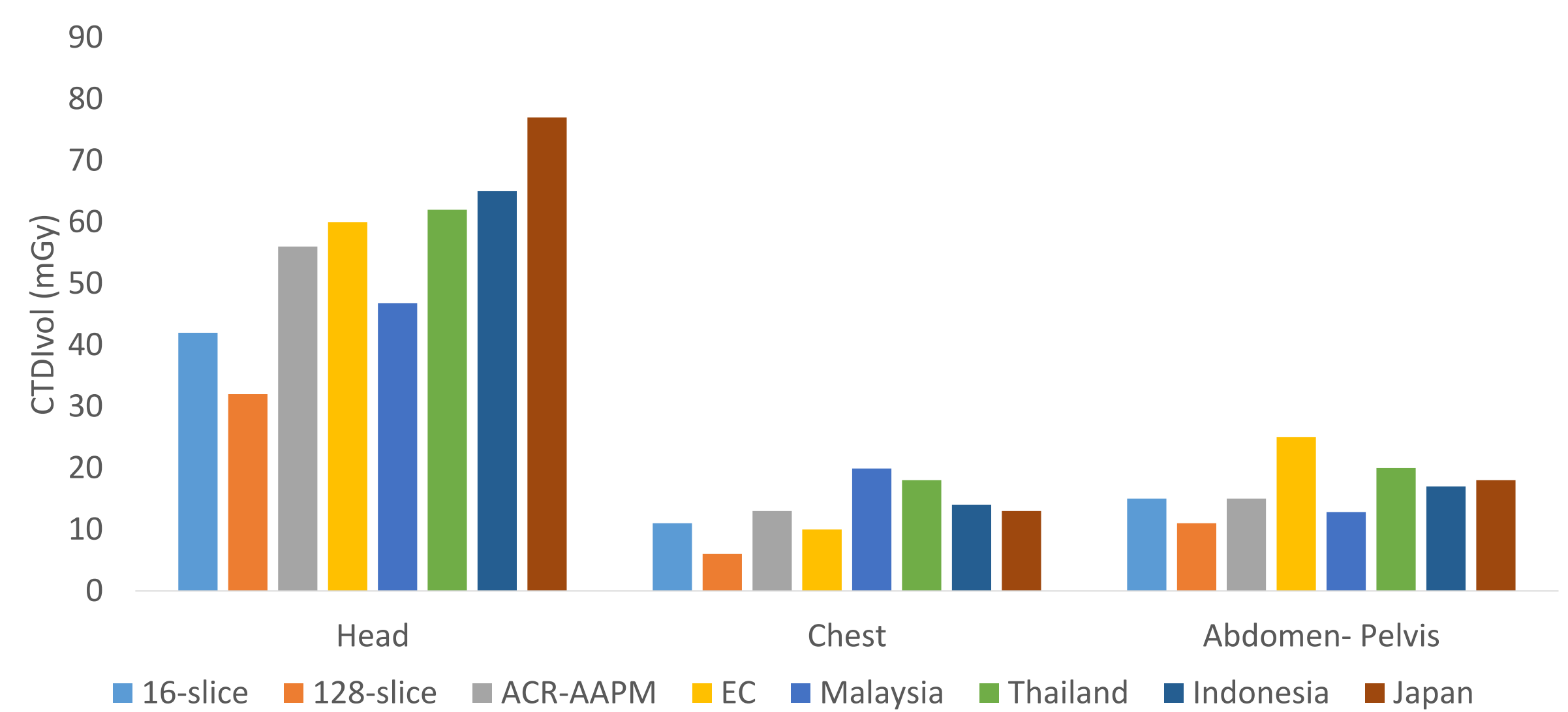


Figure 5. Comparison of the Institutional CTDI<sub>vol</sub> to published international and national DRLs

Table 5. Comparison of Typical Values of Institutional DLP with International DRLs

CT Examination	Median DLP (mGy-cm)		DLP (mGy-cm)					
	16-slice	128-slice	ACR-AAPM <sup>2</sup> DRL (2018)	EC <sup>3</sup> Most Common DRL (2014)	Malaysia <sup>4</sup> DRL (2013)	Thailand <sup>5</sup> DRL (2018)	Indonesia <sup>6</sup> DRL (2020)	Japan <sup>7</sup> DRL (2021)
Head	781	648	962	1,000	1,050	1,028	1,400	1,350
Chest	416	222	469	400	600	665	759	510
Abdomen-Pelvis	814	558	755	800	450	717	1,350	880

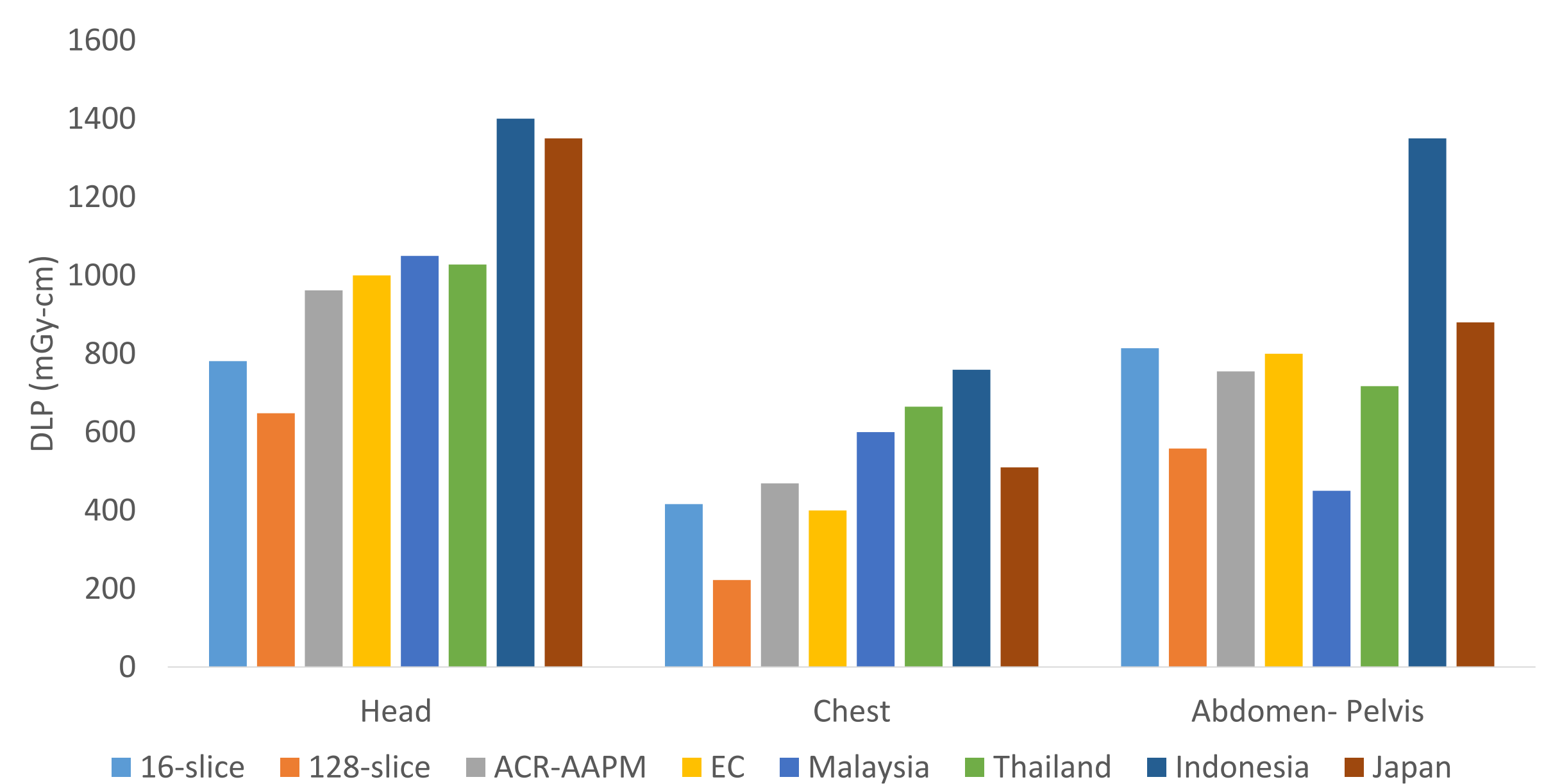


Figure 6. Comparison of the Institutional DLP to published international and national DRLs

## IV) CONCLUSION

Comparing the typical values of CTDI<sub>vol</sub> and DLP for both CT scanners to international DRLs as well as NDRLs of neighboring countries revealed that they are within reasonable range and even lower for the Head and the Chest CT dose metrics. This implies that the current CT protocols for both scanners are within the acceptable standards of practice in terms of the typical values of CTDI<sub>vol</sub> and DLP obtained in this study. The recent dose reduction technologies employed in the newly-installed 128-slice CT scanner possibly contributed to the lower values compared with those obtained using the older 16-slice scanner. Higher typical values could be an indicator that an optimization of protection is necessary to reduce the CTDI<sub>vol</sub> and DLP without compromising adequate image quality. Findings of this study can be used by other institutions in comparing their typical values of CT dose metrics in a Philippine setting while the NDRL of the country is still on process. Multiple studies of this nature or a much broader scope can be a good starting point in data collection for the establishment of the Philippines' NDRL.

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