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Analysis of *CTDIvol* and *DLP* Measurements Using the *Wilcoxon Signed-Rank Test* in Non-Contrast *MSCT Urography* Examinations at Tidar Hospital Magelang City

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ABSTRACT

This study aimed to assess and compare the amount of radiation received during non-contrast MSCT urography examinations at the Radiology Department of Tidar Hospital, Magelang City. The radiation measurements included CTDIvol and DLP, which were then compared with the Indonesian diagnostic reference values (I-DRL) determined by BAPETEN. The method used in this study was a quantitative descriptive approach involving 30 patients. Data analysis was performed using SPSS software and the Wilcoxon Signed-Ranks Test. The results showed an average CTDIvol dose of 6.1 mGy for men and 5.8 mGy for women, and a DLP dose of 294.5 mGy cm (men) and 300.6 mGy cm (women). Based on age, the 22–59 year old group had an average CTDIvol of 6.2 mGy and a DLP of 315.8 mGy•cm, while the 60–75 year old group had a CTDIvol of 5.3 mGy and a DLP of 249.4 mGy•cm. All values were lower than the I-DRL (17 mGy and 830 mGy•cm). Statistical test results showed a significant difference ($p < 0.001$), indicating that the protocol used was standard and safe.

1. INTRODUCTION

Patients are the subjects of medical procedures involving ionizing radiation sources. Unlike radiation workers and members of the public, patients are not subject to Dose Limit Values (NBD); therefore, to prevent unnecessary radiation exposure, the dose received by the patient must be justified and optimized to ensure it is commensurate with the medical objective (Efendi & Diartama, 2023).

According to BAPETEN (2013), radiation dose is the amount of radiation present in a radiation field or the amount of radiation energy absorbed or received by the material through which it passes. The Dose Limit Value abbreviated as NBD is the maximum dose permitted by BAPETEN that may be received by radiation workers and members of the public within a specific period without causing significant genetic or somatic effects resulting from the utilization of nuclear energy.

The Diagnostic Reference Level (DRL) is one of the measures for optimizing radiation protection and safety for patients; however, the primary consideration when using ionizing radiation modalities is

justification. DRLs serve as a tool for optimizing patient radiation protection and safety and for preventing unnecessary radiation exposure (Masuku, 2023).

The I-DRL (Indonesian Diagnostic Reference Level) is a guidance value for medical exposure in diagnostic and interventional radiology, as well as nuclear medicine.

The I-DRL (Diagnostic Reference Level) value is established by the Head of BAPETEN and must be used by medical practitioners as a measure to optimize radiation protection for patients (Sari, Aryanto, Mardikaningrum, Widarno, & Wisnusaputra, 2023).

The Diagnostic Reference Level (DRL) for computed tomography scanning is expressed in terms of CTDIvol (Computed Tomography Dose Index Volume) and DLP (Dose Length Product); CTDIvol serves as an indicator of the output dose from the scan, while DLP represents the total dose delivered during the examination. CTDIvol and DLP values are displayed on the computed tomography scanning workstation. CTDIvol depends on exposure parameters such as tube voltage, tube current, scan length, rotation time, and pitch (Pratiwi, Diartama, & Arieidiastutu, 2022).

SPSS (Statistical Package for the Social Sciences) is a software application specifically used for statistical data calculation and processing.

SPSS is used for quantitative data processing and analysis, as these processes are interrelated and fall within the scope of statistics (Matdoan, Jariyah, & Walli, 2021).

Based on the Decree of the Head of the Nuclear Energy Regulatory Agency No. 1221/K/V (2021) regarding the establishment of Indonesian diagnostic reference levels for X-ray computed tomography (CT) scanning modalities, the dose received by patients over the age of 15 during non-contrast CT urography examinations is 17 mGy for CTDIvol and 830 mGy·cm for DLP.

The objective of this study is to describe the results of a radiation dose analysis for non-contrast MSCT urography examinations at Tidar Hospital, Magelang City, to determine whether the administered doses comply with the Indonesian Diagnostic Reference Level (I-DRL) values established by BAPETEN.

2. MATERIALS AND METHODS

This study employs a quantitative descriptive design, utilizing secondary data from references related to non-contrast MSCT urography to determine the mean, median, mode, third quartile, maximum, and minimum values of CTDIvol and DLP, and to compare them with patient I-DRL values.

2.1. Research Design

Data collection was conducted from September to November 2025; the study population consisted of all Multislice Computed Tomography examinations.

The sample for this study consists of non-contrast multislice computed tomography (MSCT) urography examinations performed between September and November 2025.

2.2. Subjects or Objects and Instruments

The sample consisted of 30 patients undergoing non-contrast Multislice Computed Tomography (MSCT) Urography at the Radiology Department of Tidar Hospital, Magelang City, who met the criterion of being adults (aged 15 years and older).

2.3. Research Procedure

Data processing was conducted by calculating the average values of CTDIvol and DLP for non-contrast MSCT urography scans—specifically by calculating the aggregate CTDIvol and DLP figures—to determine the mean, median, mode, maximum value, minimum value, and third quartile; this was followed by an analysis of the research results and processed data using statistical calculations performed with SPSS (Statistical Package for the Social Sciences) version 27.

2.4. Data Analysis Techniques

A test is conducted to determine whether the data are normally distributed. If the data are normally distributed, a one-sample test (at a 95% confidence level) and an independent samples t-test are performed to assess whether there is a significant difference in means between two independent groups (such as gender or age groups); if the data are not normally distributed, a non-parametric test is performed, followed by a comparison with the I-DRL value established by BAPETEN. If the significance value is less than 0.05, the null hypothesis (H_0) is rejected; if the significance value is greater than 0.05, the null hypothesis (H_0) is accepted.

3. RESULTS AND DISCUSSION

Data were obtained from 30 patients undergoing non-contrast MSCT urography examinations. Dose values—specifically CTDIvol and DLP—were retrieved from the existing computer's Dose Report System and are presented in Tables 1 through 10.

3.1. Results

Table 1 CTDIvol Calculation Results By Gender Category

	Gender	Mean	Median	Modus	Min	Max	Q3
CTDIvol	Man	6,1	5,2	4,2	4,2	15,9	6,1
	Woman	5,8	5,2	4,4	4,2	12	6,9

Based on Table 1, the overall CTDIvol calculation results by gender show a mean value of 4.5 mGy for males and 4.7 mGy for females; a median value of 4.5 mGy for males and 4.6 mGy for females; a mode of 4.2 mGy for males and 4.4 mGy for females; a minimum value of 4.2 mGy for both males and females; a maximum value of 5 mGy for males and 5.3 mGy for females; and a third quartile value of 4.7 mGy for males and 5 mGy for females.

Table 2 CTDIvol Calculation Results By Age Category

	Age	Mean	Median	Modus	Min	Max	Q3
CTDIvol	22-59 years	4,6	4,5	4,2	4,2	5,3	4,8
	60-75 years	4,6	4,6	4,4	4,2	5,3	4,9

Based on Table 2, the overall CTDIvol calculation results by age category show the following values: a mean of 4.6 mGy for the 22–59 age group and 4.6 mGy for the 60–75 age group; a median of 4.5 mGy for the 22–59 age group and 4.6 mGy for the 60–75 age group; a mode of 4.2 mGy for the 22–59 age group and 4.4 mGy for the 60–75 age group; a minimum of 4.2 mGy for the 22–59 age group and 4.2 mGy for the 60–75 age group; a maximum of 5.3 mGy for the 22–59 age group and 5.3 mGy for the 60–75 age group; and a third quartile value of 4.8 mGy for the 22–59 age group and 4.9 mGy for the 60–75 age group.

Table 3 DLP Calculation Results By Gender Category

	Age	Mean	Median	Modus	Min	Max	Q3
DLP	Man	294,5	243	200,7	159,5	702,3	319,6
	Woman	300,6	216,8	181,5	181,5	810,6	322,5

Based on Table 3, the overall DLP calculation results by gender show a mean value of 212.9 mGy·cm for males and 206.7 mGy·cm for females; a median value of 211.2 mGy·cm for males and 202 mGy·cm for females; a mode value of 200.7 mGy·cm for males and 181.5 mGy·cm for females; a minimum value of 199 mGy·cm for males and 181.5 mGy·cm for females; a maximum value of 243 mGy·cm for males and 244.4 mGy·cm for females; and a third quartile value of 220.3 mGy·cm for males and 214.4 mGy·cm for females.

Table 4 DLP Calculation Results By Age Category

	Age	Mean	Median	Modus	Min	Max	Q3
DLP	22-59 years	315,8	242,5	200,7	185	810,6	347
	60-75 years	249,4	218,1	159,5	159,5	430,9	304,8

Based on Table 4, the overall DLP calculation results by age category show the following values: for the 22–59 age group, the mean was 212.5 mGy·cm, the median was 210 mGy·cm, the mode was 200.7 mGy·cm, the minimum was 185 mGy·cm, the maximum was 244.4 mGy·cm, and the third quartile was 221.3 mGy·cm; for the 60–75 age group, the mean was 203.2 mGy·cm, the median was 200 mGy·cm, the mode was 181.5 mGy·cm, the minimum was 181.5 mGy·cm, the maximum was 218.1 mGy·cm, and the third quartile was 216 mGy·cm.

Table 5 Independent Sample T-Test results for CTDIvol and DLP values based on gender.

Variabel	Group	N	Mean ± SD	p-value	Keterangan
CTDIvol	Man	16	4.53 ± 0.26	0.089	Tidak signifikan
	Woman	14	4.73 ± 0.37		
DLP	Man	16	212.94 ± 11.74	0.243	Tidak Signifikan
	Woman	14	206.74 ± 16.62		

Based on the independent sample t-test conducted on CTDIvol and DLP data comparing male and female patient groups, p-values (Sig. 2-tailed) of 0.089 for CTDIvol and 0.243 for DLP were obtained. Both values exceed the significance threshold of 0.05; therefore, it is concluded that there is no significant difference between genders regarding CTDIvol or DLP values. Thus, gender does not influence the radiation dose received by patients undergoing non-contrast multislice computed tomography (MSCT) urography.

Table 6 Results of Independent Sample T-Test For CTDIvol and DLP Values Based on Age

Variabel	Group	N	Mean ± SD	p-value	Keterangan
CTDIvol	22-59 years	22	4.61 ± 0.32	0.676	Tidak signifikan
	60-75 years	8	4.66 ± 0.36		
DLP	22-59 years	22	212.52 ± 14.42	0.118	Tidak signifikan
	60-75 years	8	203.24 ± 12.39		

Based on the independent sample t-test results regarding differences in CTDIvol and DLP values across age groups, no statistically significant differences were found. The p-values (Sig. 2-tailed) were 0.676 for CTDIvol and 0.118 for DLP; both values exceed the significance threshold of 0.05.

Although the mean DLP value in the 22–59 age group was slightly higher than in the 60–75 age group, the difference was not statistically significant.

Table 7 Results of the One-Sample Statistics Test for CTDIvol at Tidar Hospital, Magelang City

Variabel	N	Mean	Std. Deviation	Std. Error mean
CTDIvol	30	4.620	.3274	.0598

Table 7 presents the results of a one-sample statistical test on CTDIvol data obtained from 30 samples, with a mean CTDIvol of 4.620.

The recorded standard deviation of 0.3274 indicates relatively low data variability, while the standard error of the mean of 0.0598 suggests a low level of error in the mean estimate. These data provide an overview of the CTDIvol distribution within the studied sample, which can be used for further analysis of the measured variable's characteristics.

Table 8 Results of One-Sample Statistics Test for CTDIvol at Tidar Hospital, Magelang City, against BAPETEN Standards

Variabel	t	df	Sig. (2-tailed)	Mean difference	Test Value
CTDIvol	-207.128	29	< 0,01	12.3800	17 mGy

Based on the results of the One-Sample T-Test, it can be concluded that there is a significant difference between the obtained CTDIvol value and the value established by BAPETEN.

This is evident from the t-value of -207.128, with 29 degrees of freedom (df) and a significance level (p-value) of less than 0.001, indicating that the test result is highly significant.

Furthermore, the mean difference of -12.3800 mGy indicates that the CTDIvol value at the hospital is lower than the limit established by BAPETEN.

Therefore, with a p-value of less than 0.05, the null hypothesis (H0) which states that there is no difference between the CTDIvol at the hospital and the BAPETEN standards is rejected, indicating a significant difference between the two.

Table 9 One-Sample Statistics Results for DLP at Tidar Hospital

Variabel	N	Mean	Std. Deviation	Std. Error mean
DLP	30	210.043	14.3180	2.6141

Based on the table, the mean value is 210.043. The data dispersion, or standard deviation, is recorded at 14.3180, illustrating the extent of variation in DLP values among the samples.

Furthermore, the standard error value of 2.6141 indicates how accurately the sample mean estimate represents the population mean.

This data provides an overview of the distribution and consistency of DLP values at Tidar Hospital, Magelang City.

Table 10 Results of the One-Sample t-Test for DLP at Tidar Hospital, Magelang City, against BAPETEN Standards

Variabel	t	df	Sig. (2-tailed)	Mean difference	Test Value
DLP	-237.160	29	< ,001	-619.9567	830 mGy

Based on the One-Sample T-Test results comparing the DLP at Tidar Hospital, Magelang City, with BAPETEN regulations, it can be concluded that the obtained t-value is -237.160, with 29 degrees of freedom (df). A significance value (Sig.) of less than 0.001 indicates a highly significant difference between the average DLP value at the hospital and the BAPETEN standard. The mean difference of -619.9567 indicates that the DLP value at Tidar Hospital, Magelang City, is lower than the standard established by BAPETEN.

Therefore, with a p-value of less than 0.05, the null hypothesis (H₀)—which states that there is no difference between the CTDIvol at Tidar Hospital in Magelang City and BAPETEN regulations—is rejected, indicating a significant difference between the two.

An evaluation of CTDIvol measurements during non-contrast MSCT urography examinations at the Radiology Department of Tidar Hospital, Magelang City, based on gender, revealed that the average CTDIvol values obtained were 4.5 mGy for males and 4.7 mGy for females.

This value is lower than the I-DRL of 17 mGy established by BAPETEN, indicating that the dose delivered by the MSCT scanner during this examination is safe and within regulatory limits.

Based on the results of this evaluation, it can be concluded that the examination meets the radiation safety standards established by BAPETEN, and the use of appropriate protocols is crucial to minimizing the risk of excessive radiation exposure.

An evaluation of CTDIvol measurements for non-contrast MSCT urography examinations revealed an average patient CTDIvol of 4.6 mGy for the 22–59 age group and 4.6 mGy for the 60–75 age group. Both values fall well below the I-DRL threshold established by BAPETEN, demonstrating that the use of appropriate examination protocols can minimize unnecessary radiation exposure.

These results indicate that, although age does not influence the radiation dose received, the dose remains within safe limits. Therefore, it is important to continuously update and monitor examination protocols to ensure patient safety regarding radiation exposure.

An evaluation of DLP values from non-contrast MSCT urography examinations based on gender revealed average DLP values of 212.9 mGy·cm for males and 206.7 mGy·cm for females. Both values are well below the I-DRL of 830 mGy·cm established by BAPETEN, indicating that the total radiation dose delivered by the scanner during these examinations remains within established safety limits. Although there is a slight difference between the doses received by males and females, both remain within a safe range. This demonstrates that the implemented procedures are effective in keeping radiation doses low, and that the use of appropriate equipment and protocols plays a crucial role in achieving safe dose levels.

An evaluation of DLP values for non-contrast MSCT urography examinations revealed average DLP values of 212.5 mGy·cm for the 22–59 age group and 203.2 mGy·cm for the 60–75 age group. Both values are lower than the I-DRL of 830 mGy·cm established by BAPETEN, indicating that the total radiation dose delivered by the MSCT scanner during these examinations remains within established safety limits. The difference in DLP values between these age groups reflects appropriate adjustments to the examination protocols, tailored to the specific needs and characteristics of each age group.

Therefore, it is crucial to continuously conduct evaluations and improvements to optimize patient safety in every radiological examination.

4. CONCLUSION

Based on data analysis, the CTDIvol and DLP values were evaluated using the Wilcoxon Signed-Ranks Test to compare the obtained results with the I-DRL standards established by BAPETEN.

It is demonstrated that the radiation dose for non-contrast MSCT urography examinations is lower than the I-DRL established by BAPETEN, with I-DRL values of 17 mGy for CTDIvol and 830 mGy·cm for DLP.

Statistical test results show a significant difference between the measured values and the I-DRL, indicating that the implemented protocol is effective in reducing the radiation dose received by patients without compromising image quality.

Overall, Tidar Hospital in Magelang City has successfully optimized radiation doses in accordance with applicable guidelines.

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REFERENCES

- [1] Ahadiyah, N.N., Setiawan, E., Arifin, Z., & Anam, C. 2020. Pengukuran computed tomography dose index (CTDI) pada phantom kepala dengan menggunakan CT Dose profiler, Berkala fisika:120.
- [2] A.J. Lubis, 2020. "Pemanfaatan Ct-Scan (Computer Tomography dalam dunia medis, pp. :393-398
- [3] AR, B. M., Hidayanto, E., & Richardina, V. 2018. Analisis Pengaruh Dosis Radiasi Eksternal Akumulasi Dosis yang Diterima Petugas Radiasi di Ruang Penyinaran Radioterapi RSUP dr. Hasan Sadikin Bandung. Youngster Physics Journal, :110.
- [4] BAPETEN. 2019. Buku Panduan Perizinan Radiologi Diagnostik dan Intervensional. Jakarta: Badan Pengawas Tenaga Nuklir.
- [5] BAPETEN. 2020. Peraturan badan Pengawas Tenaga Nuklir Republik Indonesia No. 3 Tahun 2020 tentang keselamatan radiasi dalam penggunaan irradiator untuk iradiasi. Jakarta: Badan Tenaga nuklir.
- [6] BAPETEN. 2021. Keputusan Kepala Badan Pengawas Tenaga Nuklir Nomor: 1211/K/V/2021 Tentang Penetapan Nilai Tingkat Panduan Diagnostik Indonesia (Indonesian Diagnostic Reference Level) Untuk Modalitas Sinar-X Ct Scan Dan Radiografi Umum. Jakarta: Kepala Badan Pengawas Tenaga Nuklir .
- [7] Dewilza, N., & Yudha, S. 2023. Dasar-Dasar CT Scan. Sleman: Deepublish.
- [8] D. N. Demaio, 2018. "Mosby's Exam Review for Computed Tomography," Elsevier Inc, vol. 3.
- [9] Efendi, I. R., & Diartama, A. A. 2023. Evaluasi Nilai Ctdivol Dan Dlp Pada Pemeriksaan Msct Thorax Dewasa Selama Periode Februari 2022 Sampai Dengan Juli 2022 Di Rs Tk.I Pelamonia Makassar. Jurnal Ilmiah Multi Disiplin Indonesia : 421.
- [10] Feranita, 2017. Penentuan Dosis Radiasi pada Pemeriksaan Computer Tomography Angiography.
- [11] Lampignano, J. P., & Kendrick, L. E. 2018. Bontrager's Textbook of Radiographic Positioning and Related Anatomy, Ninth Edition. USA: Elseiver.
- [12] Latifah, R., Jannah, N. Z., Nurdin, D. Z., & Budi.p. 2019. Determination Of Local Diagnostic Reference Level (Ldl) Pediatric Patients On Ct Head Examination Based On Size-Specific Dose Estimates (Ssde) Values. Journal of Vocational Health Studies :128.

- [13] L. E. Romans, 2018 “Computed tomography for technologists: A comprehensive text, second edition,” *Computed Tomography for Technologists: A Comprehensive Text*. pp. :1–440
- [14] Masuku, R. S. 2023. Analisis nilai Computer Tomography Dose Index (CTDI) dan Dose Length Product (DLP) pada pemeriksaan Multislice Computed Tomography (MSCT) trauma kepala dewasa diinstalasi radiologi Rumah Sakit Balimed Denpasar, Bali. *Jurnal Ilmiah Multidisiplin*, 2.
- [15] Sari, N. E., Aryanto, B., Mardikaningrum, E. L., Widarno, I. S., & Wisnusaputra, A. 2023. Implementasi Indonesian Diagnostic Reference Level (Idrl) Pada Pelayanan Diagnostik In Vivo Kedokteran Nuklir Di Rsup Dr. Sardjito Tahun 2022-2023. *Prosiding Seminar Si-INTAN*: 46.
- [16] Sieroslawaska, A. 2023. Regions of the abdomen. Retrieved from kenhub.com: <https://www.kenhub.com/en/library/anatomy/regions-of-the-abdomen>

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