



## CT-Scan Patient Dose Monitoring on Thorax Examination in General Hospital Sanjiwani Gianyar



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### Abstract

Currently, in the world of medicine, the use of medical devices is very important. Along with the development of technology, the need for imaging in radio diagnostics is getting higher. This can be seen from the increasing trend of using medical devices by experts that are tailored to the needs of patients. The progress of radiological examination is growing rapidly with the use of radiation sources, one of which is by using a CT-Scan (Computed Tomography Scanning). The use of CT-Scans must be monitored to ensure the protection and safety of workers, patients, and the public. Protection requirements that must be met in the use of radiation are optimization of radiation protection and safety. The optimization of radiation protection is determined from the diagnostic guide level or the Indonesian Diagnostic Reference Level (I-DRL). The data used in this study is a chest contrast examination with the category of adults (15 years and over). From the CT-Scan irradiation, the  $CTDI_{Vol}$  and DLP values were determined in the 3rd quartile ( $Q3=75$  percentile). The results showed that the  $CTDI_{Vol}$  value of 15.79 mGy and DLP of 805.80 mGy.cm was the dose value that was still following the national I-DRL value that had been determined based on BAPETEN Regulation No. 1211/K/V/2021.

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## 1 Introduction

Currently, in the world of medicine, the use of medical devices is very important. Along with the development of technology, the need for imaging in radiodiagnostics is getting higher. This can be seen from the increasing trend of using medical devices by experts that are tailored to the needs of patients. The progress of radiological examination is growing rapidly along with the progress of other sciences which is influenced by the development of technology, physics, chemistry, biology, electronics, computers, and so on. As for some of these examinations is the use of radiation sources, one of which is by using a CT-Scan (Lundstedt et al., 1998; Marini & Walczak, 2015).

Almost all hospitals in the world use CT-Scan tools to diagnose patients who have injuries to their organs by emitting X-rays of the patient's body parts to be diagnosed (Sofiana, 2012). X-ray radiation gives rise to radiation called ionizing radiation, which can form ions by removing orbital electrons from atoms and interacting with them. Due to this ionization process, the material through which the radiation passes will form pairs of positive and negative ions. Some of the detrimental effects that appear on the human body due to exposure to X-rays are somatic effects in the form of damage to body tissue cells and genetic damage in the form of mutations of reproductive cells, stochastic effects, and deterministic effects (Rusmanto, 2016). In this study, to determine and analyze the radiation dose received by CT-Scan Thoracic (chest contrast) patients with the category of adults (15 years and over) with male and female gender at the Sanjiwani General Hospital, Gianyar.

## 2 Materials and Methods

The research used secondary data from the results of the examination of patients with chest contrast CT-Scan consisting of 2 categories, namely female and male patients with an adult age range ( $\geq 15$  years). Patient identification information that is needed other than age group is gender and weight (Peloquin, 1997; Weitschies et al., 2010). Each type of examination requires data of at least 10 patients for each type of examination that is infrequent or infrequent and 20 patients for each type of examination that is frequent or multiple (Ibrahim et al., 2018). If the facility can estimate the patient's workload per type of examination for each modality, then the number of patient samples required is at least 30% of the workload.

For a chest contrast CT scan, the estimated patient dose can be identified using  $CTDI_{Vol}$  and DLP.  $CTDI_{Vol}$  and DLP values can generally be seen on the CT Scan console monitor screen or integrated with the DICOM data system for each patient such as dose protocol reports or other features depending on the manufacturer (Klink et al., 2014; Hill et al., 2008). The research scheme carried out to facilitate the research process starts from patient medical records, patient age classification, patient weight,  $CTDI_{Vol}$  value, DLP value to determining local DLP or local DRL values which are then adjusted to the national I-DRL value as shown in Figure 1,

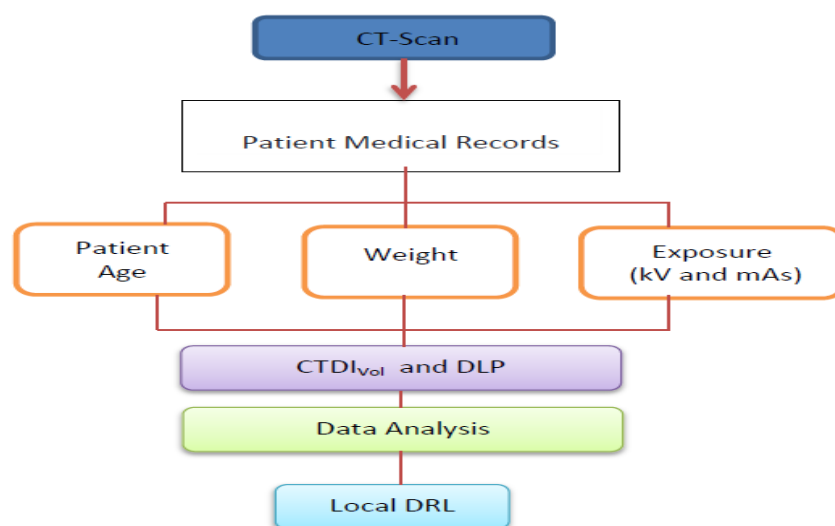


Figure 1. Research schematic

After the dose data was obtained, an analysis was carried out using the distribution of the data with the 3rd quartile value ( $Q_3=75$  percentile). The value obtained in the 3rd quartile is then called the DRL value. This DRL value can be used as a reference or reference (baseline) in diagnostic and interventional radiology examinations, including CT-Scan examinations (Suryatika et al., 2020). To find the  $Q_3$  position of the patient dose distribution using the formula:

$$n_{q_3} = \frac{3(n+1)}{4} \quad (1)$$

While the value of  $Q_3$  is calculated using the formula:

$$X_{q_3} = X_{a,3} + \frac{1}{4}(X_{b,3} - X_{a,3}) \quad (2)$$

Where:

- $n(q_3)$  : 3rd quartile position
- $n$  : the amount of data
- $X(q_3)$  : 3rd quartile value
- $X(a,3)$  : observations before the 3rd quartile position
- $X(b,3)$  : observations after the 3rd quartile position

### 3 Results and Discussions

The results of the examination of patients with chest contrast CT Scan in the category of female and male patients aged over 15 years, for  $CTDI_{Vol}$  and DLP data taken from the DICOM data system for each patient such as the dose protocol report (Suandayani et al., 2020; Putra et al., 2020). Furthermore, the patient's  $CTDI_{Vol}$  and DLP data were sorted from the smallest data to the largest data, then analyzed using the data distribution with the 3rd quartile value ( $Q_3=75$  percentile), using equations 1 and 2 as follows:

$$n_{q_3} = \frac{3(n+1)}{4}$$

$$n_{q_3} = \frac{3(20+1)}{4} = 15,75$$

The position of the 3rd quartile is in the data sequence 16, for  $CTDI_{Vol}$  15.87 mGy and DLP 816.66 mGy.cm. So that the value of the 3rd quartile can be determined as follows:

$$\begin{aligned} X_{q_3} &= X_{a,3} + \frac{1}{4}(X_{b,3} - X_{a,3}) \\ CTDI_{Vol_{q_3}} &= 15,28 + \frac{1}{4}(17,32 - 15,28) \\ &= 15,28 + \frac{1}{4}(2,04) \\ &= 15,79 \text{ mGy} \end{aligned}$$

and

$$\begin{aligned} DLP_{q_3} &= 796,80 + \frac{1}{4}(832,62 - 796,80) \\ &= 796,80 + \frac{1}{4}(35,82) \\ &= 805,80 \text{ mGy} \end{aligned}$$

The results of the analysis that have been carried out on the 3rd quartile values for  $CTDI_{Vol}$  and DLP can be expressed as the value of local DRL at Sanjiwani General Hospital Gianyar for chest contrast CT Scan examination in adult patients (Kadry et al., 2019; Xing et al., 2020; Suryatika et al., 2019). This value can be used as a baseline for diagnostic and interventional radiology examinations. This means that after the DRL value is set, the value is used as a comparison with the estimated dose received by the patient (Rusmanto, 2016).

Following BAPETEN Regulation no. 1211/K/V/2021, the Indonesian Diagnostic Reference Level has been set, hereinafter referred to as I-DRL, for the modalities of X-ray CT Scan and General Radiography (Silvia et al., 2013; Strauss & Rae, 2012). For chest contrast, CT Scan examination, the I-DRL value at  $CTDI_{Vol}$  was 16.00 mGy and DLP was 810.00 mGy.cm. The results of the research conducted indicate that the local DRL value is following the

national I-DRL value. Thus, monitoring of the amount of dose received by patients at the Sanjiwani General Hospital, Gianyar, is well monitored in the next 1-2 years (Fukuda et al., 2017; Tomic et al., 2019).

#### 4 Conclusion

Examination of adult patients ( $\geq 15$  years) for a chest contrast CT scan, the results showed a  $CTDI_{Vol}$  value of 15.79 mGy and a DLP of 805.80 mGy.cm which was the local DRL value of the Sanjiwani General Hospital, Gianyar. Where the local DRL value is following the national I-DRL value, based on BAPETEN Regulation No. 1211/K/V/2021.

##### *Conflict of interest statement*

The author declared that they have no competing interests.

##### *Statement of authorship*

The author has a responsibility for the conception and design of the study. The author has approved the final article.

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