



Radiology Patient Dosage Monitoring for Local Diagnostic Reference Level



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Abstract

The utilization of radiation for health in Indonesia shows a significant increase, it can be seen from the increasing number of modalities of ionizing radiation sources used and the types of medical actions carried out with the help of radiation. The use of radiation must be monitored to ensure the protection and safety of workers, patients, and the community. In Government Regulation No. 33/2007 which regulates radiation safety for workers, the community and the environment, it can be seen that one of the protection requirements that must be met in the utilization of radiation is the optimization of radiation protection and safety. In diagnostic and interventional radiology, optimization can be interpreted as an attempt to make the dose received by patients as low as possible while maintaining optimum image quality. In this study, the effort to optimize patient dose is carried out on general radiography with the application of Si-INTAN (*National Patient Dose Data Information System*). The Si-INTAN portal is used as a means for monitoring patient dosages and the preparation of local and national Diagnostic Reference Level (DRL). The results showed that DRL is one of the patient's dose monitoring instruments. Local DRL value of Kasih Ibu Kedonganan Hospital for PA (*Postero Anterior*) projection in babies 0,381mGy, children 0,412 mGy and adults 0,418 mGy. This DRL value is a reference to determine the value of the National DRL.

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1 Introduction

The utilization of ionizing radiation for health in Indonesia shows a significant increase, it can be seen from the increasing number of ionizing radiation modalities used and the type of medical action carried out with the help of radiation (Compagnone *et al.*, 2005). The utilization of ionizing radiation must be monitored to ensure the protection and safety of workers, patients, and the community. Government Regulation No. 33 of 2007 concerning Safety of Ionizing Radiation and Security of Radioactive Sources states that every utilization of nuclear power must have a utilization permit and meet radiation safety requirements. One of the radiation safety requirements that must be met is the radiation protection requirements which include (Rusmanto *et al.*, 2016):

- a) The justification for the use of nuclear power must be based on the benefits outweighed the risks.
- b) Dosage limitation must be applied for occupational exposure and public exposure through the application of the Dose Limit Value (DLV). Dosage limitation does not apply to medical exposure.
- c) Optimization of radiation protection and safety must be endeavored to ensure that the lowest possible dose is achieved by considering social and economic factors.

Implementation of optimization is carried out through (Suryanti, 2018):

- 1) Considerations for choosing the modality to be used;
- 2) Consideration of selected procedures/operations;
- 3) Calibration;
- 4) Patient dosimetry (calculation or measurement of patient dose);
- 5) Diagnostic reference level (DRL) level; and
- 6) Quality assurance program for medical exposure.

On medical exposure, the patient is part of the object of investigation or treatment of medical measures using a source of ionizing radiation. That is, the patient receives greater direct benefits from the presence of medical measures with a source of ionizing radiation so that it can be understood that the patient does not need dosage restrictions as DLV (Begun *et al.*, 2011). Even so, the dose received by the patient must be justified and optimized to prevent the receipt of unnecessary exposure or unintended exposure (Dabukke, 2018; Sutapa *et al.*, 2018).

The level of diagnostic guidance for medical exposure or DRL is highly recommended to be used as a guide for medical practitioners in carrying out any type of diagnostic and interventional radiological examination and is used to prevent excessive radiation exposure in patients. Head of BAPETEN Regulation No. 8 of 2011 concerning Radiation Safety in the Use of Diagnostic and Interventional X-ray Radiology, states that the application of optimization of protection and radiation safety must-have endeavored so that patients receive radiation doses following the dose required to achieve the diagnostic purpose (Nur *et al.*, 2013). The intended diagnostic goal is to obtain an optimal radiographic image so that the diagnostic information needed by the doctor is always obtained by always seeking the lowest possible radiation dose of the patient that can be achieved by following the principle of As Low As Reasonably Achievable (ALARA) (Sikumbang, 2018; Aliff & Fowsar, 2016). In diagnostic and interventional radiology, optimization of protection is interpreted as an attempt to make the dose received by the patient as low as possible while maintaining optimum image quality. Following the 2014 IAEA recommendations, the government must ensure that DRLs are set for each type of diagnostic and interventional radiological examination including nuclear medicine diagnostics. DRL values are based on survey results on a broad scale or determined values with suitable local conditions.

2 Materials and Methods

Determination of the level of acceptance of patient doses is done using patient data (secondary data) on general radiographic examinations with PA projections. All research activities were carried out at the Radiology unit of Rs. Kasih Ibu Kedongan with variables observed included exposure factors or radiation conditions such as kV, mA / mAs, the distance of the patient with focus, effective dose (K) and RDL value.

To obtain identification of the amount of dose received by the patient for piston examination, the diagnostic and interventional radiological patients are grouped into 3 categories based on age, namely (Hastuti *et al.*, 2009):

- a) Babies (0-4 years old)
- b) Children (5-14 years old)
- c) Adult (15 years and above)

Patient identification information needed in addition to the age group is gender and weight. Each type of examination requires a minimum of 20 patients for each type of examination contributed to the national level. Make adjustments using variable exposition factors ranging from 50, 60, 70, 80, 90, 100 and 110 kV, at 15 mAs with FFD still at 100cm. Radiation dose measurements were carried out 5 times, then the process was carried out with SiINTAN application and statistically analyzed using ANOVA (Analysis of Variance). ANOVA test results were significantly different ($P \leq 0.05$) followed by LSD test so that differences can be seen between treatments.

3 Results and Discussions

The results of monitoring patients' doses with Si-INTAN application on thoracic examination with PA projections can be shown in Figure 1 as follows,

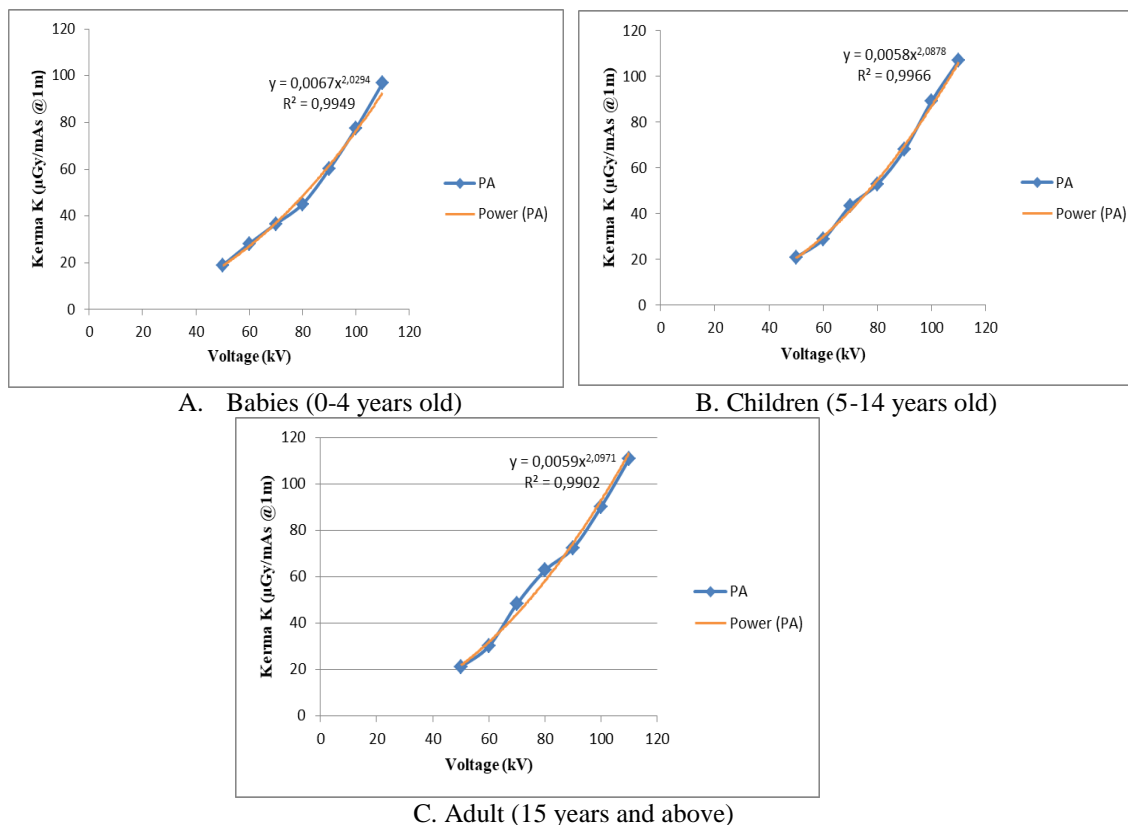


Figure 1. Data Radiation Out of X-Ray Devices for PA Projection

Thoracic (PA) examination with a condition of irradiation of 50 kV, 15 mAs, and distance of the patient to the focus of 100 cm. By using the data in Figure 1A, the kerma value (K) obtained at the inspection is $K = (0.0067 \times (50)^{2,0294} \times 15 \text{ mAs} \times (100/100)^2 = 281.87 \mu\text{Gy}$. The kerma value multiplied by the backscattering factor (BSF) around 1.35 so that it becomes ESD or DRL = $K \times \text{BSF} = 281.87 \mu\text{Gy} \times 1.35 = 380, 524 \mu\text{Gy} = 0.381 \text{ mGy}$, also occurs in Figure 1B and 1C DRL values can be determined in the same way, 0.412 mGy and 0.418 mGy, Figure 1 shows that the average dose received by babies, children, and adults for PA thoracic examination when compared with the DRL recommended value of BAPETEN of 0.4 mGy, the dose value received by the patient appeared to be relatively the same as the recommended value.

In general, the surface dose entered at the diagnostic radiological examination measured at the Radiology unit Kasih Ibu Kedonganan Hospital is still in the range of DRL values prevailing in Indonesia. Thus, the results of this study also indicate that the X-ray devices used are also quite optimum and is capable of producing good image quality. Similar studies can be carried out for patients with more types of diagnostic radiological examinations

measured at various other referral hospitals in Indonesia (Hiswara & Kartikasari, 2015). The collected data will then be used to determine DRL in various types of diagnostic radiological examinations that are nationally applicable.

The results of this study specifically show that the radiation dose received by babies and children is smaller than that received by adult patients. Comparison of patient dose values obtained in this study with results obtained from several other countries also shows that patient doses in Indonesia and Malaysia as developing countries are relatively not different from patient doses in developed countries (Hiswara & Kartikasari, 2015).

4 Conclusion

In general, the local DRL value is Kasih Ibu Kedonganan Hospital shows a value that does not exceed the value of the diagnostic reference level applicable in Indonesia. The results also showed that the radiation dose received by babies and children was smaller than the radiation dose received by adult patients. This local DRL value is used as a reference to determine the national DRL.

Conflict of interest statement

The authors declared that they have no competing interests.

Statement of authorship

The authors have a responsibility for the conception and design of the study. The authors have approved the final article.




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