

Implementation of a Radiation Safety Management System in Conventional Spaces in the Radiology Installation

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ABSTRACT

Klungkung Regional General Hospital is one of the health services owned by the Klungkung district government in the form of a hospital, managed by the Klungkung district government and recorded as a type B hospital. At the Klungkung Regional General Hospital, there are several things that are not in accordance with the radiation safety management system determined by BAPETEN. Some of these things that are not suitable such as the lack of compliance of radiation workers with the standard operating procedures (SOPs) of radiation work in conventional rooms which are often found things outside the provisions, the use of equipment such as aprons and there are doors in the radiological examination room that have leaks, because environmental exposure measurements have been made in the area and leaks were found, and also monitoring the health of radiation workers who have not been optimal. This type of research uses descriptive qualitative research methods with an observational approach from the routine activities of radiation workers at the Radiology Installation of the Klungkung Regional General Hospital. The Radiology Installation of the Klungkung Regional General Hospital has met the BAPETEN Perka standard No.4 of 2020 but there are still some that have not met the standards for the Implementation of the Radiation Safety Management System in the Conventional Room at the Radiology Installation of the Klungkung Regional General Hospital, including the conventional room inspection door to the operator room experiencing a leak, it has been reported to the relevant party in this case for follow-up so that the detected radiation leak can be dealt with immediately.

Keywords: Safety Management Systems, Radiation, Conventional Rooms, Radiology Installations, Hospitals

ABSTRAK

Rumah Sakit Umum Daerah Klungkung merupakan salah satu pelayanan kesehatan yang dimiliki oleh pemerintah kabupaten Klungkung yang berbentuk RSUD, diurus oleh pemerintah kabupaten Klungkung dan tercatat merupakan Rumah Sakit bertipe B. di Rumah Sakit Umum Daerah Klungkung terdapat beberapa hal yang tidak sesuai dengan sistem manajemen keselamatan radiasi yang telah ditentukan oleh BAPETEN. Beberapa hal yang tidak sesuai tersebut seperti kurangnya ketaatan pekerja radiasi terhadap standar operasional prosedur (SOP) kerja radiasi di ruang konvensional yang sering ditemukan hal-hal diluar ketentuan, tidak optimalnya penggunaan

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peralatan seperti apron dan terdapat pintu di ruang pemeriksaan radiologi yang mengalami kebocoran, karena telah dilakukan pengukuran paparan lingkungan di area itu dan ditemukan adanya kebocoran, dan juga pemantauan kesehatan pekerja radiasi yang belum optimal (Hamidy et al., 2021). Jenis penelitian ini menggunakan metode penelitian kualitatif deskriptif dengan pendekatan observasional dari aktivitas rutin pekerja radiasi di Instalasi Radiologi Rumah Sakit Umum Daerah Klungkung. Instalasi Radiologi Rumah Sakit Umum Daerah Klungkung sudah memenuhi standar perka BAPETEN No.4 Tahun 2020 tetapi masih ada beberapa yang belum memenuhi standar Implementasi Sistem Manajemen Keselamatan Radiasi Pada Ruang Konvensional di Instalasi Radiologi Rumah Sakit Umum Daerah Klungkung diantaranya pintu pemeriksaan ruang konvensional menuju ruang operator mengalami kebocoran, sudah dilapor ke pihak terkait dalam hal ini untuk ditindaklanjuti agar kebocoran radiasi yang terdeteksi bisa segera ditangani.

Kata kunci: Sistem Manajemen Keselamatan, Radiasi, Ruang Konvensional, Instalasi Radiologi, Rumah Sakit

INTRODUCTION

A hospital is a place that provides health services, such as a radiology unit. The radiology unit uses radiation to assist in the process of diagnosing disease by making radiograph images. Even though this radiation is useful, it can also cause health problems for radiation workers and the surrounding community. Therefore, efforts are needed to protect occupational health and safety for radiation workers, and also minimize radiation exposure by following Standard Operating Procedures (SOP) for work (Eliwa et al., 2018; Goula et al., 2021). Occupational Safety and Health (*Keselamatan dan Kesehatan Kerja/K3*) is an instrument that protects workers, companies, the environment and the surrounding community from dangers resulting from work accidents (Ridwan & Kamariah, 2019; Batista et al., 2019). This protection is in an K3 system in the workplace involving elements of management, workforce, working conditions and environment which are integrated to prevent and reduce Occupational Accidents (*Kecelakaan Akibat Kerja/KAK*) and Occupational Diseases (*Penyakit Akibat Kerja/PAK*) so as to create a safe, efficient and efficient workplace. productive. Therefore, a system is implemented which is a human right that must be fulfilled by Occupational Safety and Health which is an instrument that protects workers, companies, the environment and the surrounding community from dangers resulting from work accidents (Fairusiyyah et al., 2016; Ogenyi et al., 2018).

In developing countries, the use of radiation for medical purposes has seen a significant increase. However, the growth in the number of hospital workers has not been able to keep up with the increased workload due to the development of radiation technology. Therefore, monitoring of radiation doses in the medical field needs to be emphasized, although efforts to monitor radiation doses resulting from work in the medical field still receive relatively less attention compared to other places (Monita et al., 2021). Government Regulation of the Republic of Indonesia Number 33 of 2007 concerning the safety of ionizing radiation and the security of radioactive sources regulates radiation safety for workers, the public, and the environment, as well as the security of radioactive sources and inspections in the use of nuclear energy. The aim of this regulation is to ensure the safety, security, tranquillity, and health of workers and members of the public as well as the protection of the environment (Yunisca et al., 2022).

The Head of the Indonesian Nuclear Energy Regulatory Agency Number 4 of 2020 concerning radiation safety in the use of diagnostic and interventional X-ray radiology, states that Ionizing Radiation Safety in the Medical Field hereinafter referred to as Radiation Safety is the action taken to protect patients, workers, members of the public, and the environment from the dangers of radiation. Radiation Protection is the action taken to reduce the damaging effects of radiation exposure (Mayani & Adi, 2021; Dari et al., 2023). According to the regulation from the Head of BAPETEN Number 8 of 2011

Article 35 paragraph 1, protection against radiation can be done by providing all radiation protection equipment such as film badges or Thermoluminescent Dosimeter (TLD) badges, aprons, lead-lined shields and equipped with lead glass, thyroid protectors, ovarian protectors, lead glasses, and lead gloves. All of this radiation protection equipment must be worn by all radiation workers (Yani et al., 2021; Damayanti et al., 2022).

METHOD

This research utilized a descriptive qualitative research method with an observational approach to the routine activities of radiation workers in the Radiology Department of Klungkung Regional General Hospital. The location of this research in the preparation of scientific papers is in the Radiology Department of Klungkung Regional General Hospital. The study sample consisted of 6 respondents, with the criteria of radiographers who have been working for more than 2 years, comprising 5 radiographers and 1 radiation protection officer working in the Radiology Department of Klungkung Regional General Hospital. In analyzing this data, the author employed a descriptive qualitative analysis technique, wherein the author describes and elaborates on the qualitative data obtained from the data collection methods. Data analysis began by collecting data to support this scientific paper, including through observation and direct interviews regarding the implementation of radiation safety systems in conventional rooms at Klungkung Regional General Hospital. The author also conducted direct interviews with the 6 respondents to gather data. Additionally, the author collected data by documenting the necessary data for this research. In this study, the author will process the data using an open coding system to draw conclusions.

RESULTS

Based on the Decision of the Minister of Health of the Republic of Indonesia regarding the Standards of Diagnostic Radiology Services in Healthcare Facilities, the requirements for radiology examination rooms include the type, completeness, and size/space needed. This includes a room wall thickness of 25 cm (brick) with a density of 2.2 g/cm³ and 20 cm (concrete) with 2 mm of Lead (Pb) so that the radiation level around the room does not exceed 1 mSv/year. The door should have a thickness of 2 mm Lead (Pb), and ventilation should be at a height of 2 m from the floor with a room temperature of 20-24°C. Additionally, a red light should be on when the machine is turned on as a warning sign of radiation danger.

Meanwhile, from the researcher's observation based on interview results at the entrance of the conventional room examination towards the operator at the Radiology Department of Klungkung Regional General Hospital, there is indeed a leakage which has been tested by a medical physicist. The next step has been reported to the IPSRS for follow-up action so that the detected radiation leakage can be promptly addressed. While working in the examination room, radiation personnel always take refuge in the operator room because the examination room and operator room are separate. The X-ray machine used in the Conventional Room at the Radiology Department of Klungkung Regional General Hospital already has a Nuclear Energy Utilization Permit from Nuclear Energy Regulatory Agency (*Badan Pengawas Tenaga Nuklir/BAPETEN*), as one of the requirements for radiology service. The latest permit is still in process.

Table 1. Results of Observations

Employment	Information	Amount
Radiology Specialist Doctor	Available	1
Medical Physicist	Available	1
Radiation Protection Officer	Available	1
Radiographer	Available	16

Based on Table 1, it is known that the Radiology Installation at the Klungkung Regional General Hospital already has health workers who are competent in their respective fields.

Table 2. Interview results regarding the implementation of radiation protection training

Radiation protection training		Information
Radiation protection training has been carried out for each personnel	Not Available	Because there is already a Radiation Protection Officer (<i>Petugas Proteksi Radiasi/PPR</i>)
Has conducted training for protection officers organized by BAPETEN	Available	Radiation Protection Officer (<i>Petugas Proteksi Radiasi/PPR</i>)

The Radiology Installation at the Klungkung Regional General Hospital has never held radiation protection training for all its workers. Meanwhile, Radiation Protection Officers take part in training and implementation every four years which is organized by BAPETEN, there are documents or recordings in the form of certificates, membership cards as proof that radiation protection training activities have been carried out for radiation workers (Monita et al., 2020). This is not in accordance with BAPETEN Perka No.4 of 2020 which states that permit holders are required to carry out radiation protection training as a requirement in the Radiation Safety Management System (Syahda et al., 2020; Diniati et al., 2021).

Table 3. Results of health monitoring interviews

Health Monitoring Indicators	Information
Conducted once a year routine health checks during work	Available
Laboratory examination	Available
Chest x-ray examination	Available

The Radiology Installation at the Klungkung Regional General Hospital has carried out health checks on radiation workers during work, periodic health checks or medical check-ups are carried out once a year, namely in May. Examinations carried out include laboratory examinations which include DL, UL checks, chest photos. The results of the health examination will be informed to each radiographer and the results of the health examination of workers who have resigned will be kept for a minimum of 5 years.

Table 4. Observation results of radiation protection equipment

Worker	No Personal TLD	Dose received (mSv) (October-December 2022)
Worker 1	00486	0.22 (± 0.05)
Worker 2	00487	0.2 (± 0.05)
Worker 3	00488	0.22 (± 0.05)
Worker 4	02752	0.21 (± 0.05)
Worker 5	00490	0.21 (± 0.05)
Worker 6	04193	0.44 (± 0.11)
Worker 7	03476	0.22 (± 0.05)
Worker 8	00493	0.2 (± 0.05)
Worker 9	00494	0.23 (± 0.06)
Worker 10	00495	0.22 (± 0.05)

The radiation protection equipment in the Radiology Department of Klungkung Regional General Hospital includes several radiation protections tools such as aprons, thyroid shields, lead glasses, lead gloves, and gonad aprons. This is in accordance with the Head of the BAPETEN Regulation No. 4 of 2020 Article 35 paragraph 1, which mentions that radiation protection can be carried out by providing all radiation protection equipment (Dianasari & Koesyanto, 2017; Akhadi, 2019).

Individual radiation dose monitoring for radiation workers is done using personal dosimeters such as Thermoluminescent Dosimeter (TLD), which is a device for recording radiation doses capable of recording the accumulated dose received by each individual

radiation worker. In the Radiology Department of Klungkung Regional General Hospital, every radiation worker uses TLD with different serial numbers, which are sent to the Health Facility Security Agency (Badan Pengamanan Fasilitas Kesehatan/BPFK) for processing every 3 months. The dose test results TLD report will then be sent to the radiology department.

Table 5. Radiation dose test results

No	Radiation protection equipment indicators	Information	Amount
1.	Aprons	Available	12
2.	Gonad Apron	Available	6
3.	Thyroid Protector	Available	6
4.	Pb glasses	Available	7
5.	Gloves	Available	2

Based on the monitoring results of the radiation doses received by workers in the Radiology Department of Klungkung Regional General Hospital, it has been found that the received doses are still below the specified radiation dose limits. This is in accordance with Government Regulation No. 33 of 2007, which stipulates that every license holder is required to conduct radiation dose monitoring for workers, and the dose exposure results for resigned workers should be kept for a minimum of 5 years.

The recording or storage of radiation worker health documents and radiation dose monitoring results documents in the workplace area are well-organized in the archive room of the Radiology Department of Klungkung Regional General Hospital. There are also several standard procedures related to the radiology department, namely:

Table 6. Fixed procedures in the radiology department

No	Recording	Information
1.	Standard operating procedures for operating x-ray aircraft	Available
2.	Standard operational procedures for radiological examinations	Available
3.	Standard operational procedures for special examinations using contrast media	Available
4.	Standard operational procedures for equipment maintenance and repairs	Available
5.	Standard operating procedures for permitting and storing radiation exposure	Available

Based on the research findings, standard procedures in the radiology department at the Klungkung Regional General Hospital Radiology Installation are well-documented. Table 3 shows the five standard procedures that have been established, including the operational standards for the use of X-ray machines, general radiology examinations, special examinations using contrast media, equipment maintenance, as well as licensing and storage of radiation exposure. From Table 3, it can be seen that all of these standard procedures have been documented with a check mark (√), indicating that the implementation of these procedures has been carried out effectively. The research also found that document storage, both for worker health monitoring results and workplace monitoring, is sufficiently organized. This indicates that the Radiology Department of Klungkung Regional General Hospital adheres to established procedures and maintains necessary documentation well to ensure the safety and quality of radiology services provided.

CONCLUSION

The Radiology Department of Klungkung Regional General Hospital has met the standards set by BAPETEN Regulation No. 4 of 2020, but there are still areas that do not fully comply with the Implementation Standard of Radiation Safety Management System in the Conventional Room. For instance, there is a leakage detected from the conventional room examination door towards the operator room, which has been reported for necessary follow-up action to promptly address the radiation leakage.

Therefore, it's imperative that the radiation protection personnel periodically conduct monitoring and evaluation. The management of Klungkung Regional General Hospital is advised to promptly address the detected leakage in the conventional room door. During examinations, radiation workers always seek refuge in the operator room to avoid radiation exposure. In conclusion, while the radiology department largely complies with regulations, ongoing vigilance and improvement efforts are essential to maintain high standards of radiation safety and ensure the well-being of both workers and patients. Addressing the identified issues promptly will enhance the overall safety and quality of radiology services provided by Klungkung Regional General Hospital.

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