Radiation Worker Protection Policy Against Radiation Exposure in Carrying

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Abstract. Policy of radiation use procedures carried out by medical personnel or radiation workers has a potential risk, namely exposure to radiation when carrying out their work. The increase in medical measures in the use of radiation will of course have an impact or implications for radiation workers. The impact of the policy on increasing radiation use cannot be viewed only in terms of the workload problem for radiation workers but also related to the impact of the challenge of ensuring an appropriate radiation worker protection policy. This review literature study aims to determine how the radiation worker protection policies include radiation worker protection regulations and radiation worker protection forms. The method used is literature review, namely by examining data sources in the form of articles in research journal databases both from within and outside the country through searching for e-journals, government regulations, and reliable sources of internet articles. The results showed that there was an enlargement of the thyroid in radiation workers in the radiology unit, the patient died due to an overdose in radiation therapy, many of the equipment did not meet safety requirements. In carrying out their work, health workers in the radiation sector are protected as regulated in policy, namely a set of regulations in the form of laws, government regulations, ministerial decrees and regulations as well as Bapeten decrees and regulations. Forms of protection for radiation workers include monitoring and examination of dose limit values (NBD) for radiation safety, requirements for the provision of radiology services according to specified regulations, compliance with radiation workers must use personal protective equipment, and radiology units in health facilities must meet maximum protection standards. The government's attention is needed in order to guarantee the safety protection policy for radiation workers that are scattered throughout the country.

Keyword: Radiation Worker Protection, Radiation Exposure

1 Introduction

Management radiology services in general and diagnostic radiology in particular have been carried out in various health service facilities. With the development of science and technology that has occurred today, it has enabled various diseases to be detected using diagnostic radiology facilities, namely services that use ionizing and non-ionizing radiation. With the development of time, diagnostic radiology has also progressed quite rapidly, both in terms of equipment and methods [1].

The use of radiation in medical procedures continues and is increasing worldwide. UNSCEAR (United Nations Scientific Committee on the Effects of Atomic Radiation) estimates indicate that there are about 4 billion X-ray examinations per year, worldwide [2].

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All radiation use procedures performed by medical personnel or radiation workers have a potential risk, namely exposure to radiation when carrying out their work. The increase in medical measures in the use of radiation will of course have an impact or implications for radiation workers. The impact of increased radiation use cannot be viewed only in terms of workload problems for radiation workers but also related to the impact of the challenge of ensuring appropriate radiation protection [3]. Within the hospital, radiologists, radiology and nuclear medicine technicians, and others involved in performing X-ray examinations and computed tomography (CT), have an increased risk of exposure to radiation than other hospital healthcare professionals [4].

2 Method

Research with literature review is research with the same preparation with other research but the sources and methods of collecting data by taking data from the library, reading, taking notes, and processing research materials. The method used is literature review, namely by examining data sources in the form of articles in research journal databases both from within and outside the country through searching for e-journals, government regulations, and reliable sources of internet articles. The keywords used in the search for articles were Radiation Worker Protection, radiation protection regulations, due to radiation exposure, forms of radiation worker protection. Data obtained from various references as well as from primary sources of journals obtained were subjected to in-depth review by the author. The data obtained is used to answer the problems of this research.

3 Result and Discussion

3.1 Radiation Worker Protection Policy

One of the applications of nuclear technology in the health or medical sector is radiology services. The Radiology Service Unit is one of the medical support installations, using ionizing radiation sources (X-rays) to diagnose the presence of a disease in the form of an anatomical picture of the body that is displayed on a radiographic film [5]. Risk assessments need to be carried out in hospitals that have ionizing radiation facilities considering that this will have the potential to produce considerable radiation exposure if not properly managed [6].

The challenges faced in the health sector are the increase in Ionizing Radiation Sources (SRP), technological developments and SRP safety standards which must be anticipated by updating policies in the form of regulations, radiation safety permit requirements that cannot be met by health facilities, increasing patient demands for the quality of health services radiology, as well as the number of radiotherapy facilities that are aging but still in use considering the long queues and waiting lists for radiation therapy for cancer patients, as well as the inadequate national infrastructure for compliance with radiation safety regulations in the health sector. The facts show that there is an enlarged thyroid in radiation workers in the radiology unit, patients die of overdose in radiation therapy, many of the equipment does not meet safety requirements. The government's attention is needed in order to guarantee the protection of radiology patient safety which is spread throughout the country. In accordance with the provisions of international radiation safety, BAPETEN has imposed radiation safety provisions through the X-ray aircraft suitability test for licensing requirements. The accuracy

of the operation of the X-ray aircraft is very important for the protection of patients, to get the accuracy required a conformance test. Data from the conformity test results showed that 42% of the X-ray aircraft tested were unreliable, meaning they were not suitable for use and were not allowed to operate. In addition, the lengthy process of obtaining a certificate of conformity test results is not smooth enough so that SRP supervision is less effective due to: Increased use of X-ray aircraft in the field of health facilities, lack of experts, lack of qualified testing institutes / testers conducting tests for testing. the suitability of X-ray aircraft, the lack of training institutions for the suitability test of X-ray aircraft; and the conformity test implementation scheme is less effective [7].

Health examination is an important thing to do to monitor the health condition of radiation workers, health examination / monitoring of radiation workers at the RSK Lung radiology installation has not been carried out optimally. Radiation workers already have civil servant health cards and have had check-ups, but the hospital has never conducted special examinations for radiation workers, so health monitoring has not been optimal [8]. In the research of Nabilah et al. [9], there were hospitals that had no initial examination before carrying out activities as radiation workers organized by the hospital but radiation workers had carried out individual health checks, then periodic medical check-ups were carried out routinely once a year. Examinations carried out include blood laboratory tests, clinical chemistry, complete urine and physical tests. The main tests are blood and urine tests, for blood tests, blood tests including hemoglobin, red blood cell count, white blood cell count, differential count and platelet count. Any abnormality or excess number of young (immature) blood cells should be noted. Leukemia may begin with anemia, neutropenia and thrombocytopenia. It should also be noted that blood cell counts vary greatly either by physiological conditions, presence of disease or by laboratory processes [9].

The components of implementing optimization of radiation protection and safety (2 points) of 2 points (100%) are not fulfilled by the radiology installation according to BAPETEN Regulation Number 8 of 2011 Article 36 paragraph 3a and 3b, namely (1) Implementation of optimization of radiation protection and safety for workers and members of the public has not been implemented so that it is not possible to know the dose received by radiation workers from radiation exposure whether it has exceeded the set dose limit, which is 20 mSv per year or 0.2 mSv per week and for community members it is 0.5 mSv per year or 0.01 mSv per week; and (2) The implementation of optimization of radiation protection and safety for patients has not been carried out so that they cannot know the radiation dose received by the patient, whether it has exceeded the set dose limit, but using the ALARA principle (As Low As Reasonably Achieve), namely with the shortest time possible to obtain a radiograph that is qualified and patients received the lowest possible radiation exposure [10].

From the results of calculations carried out at Hospital X1, the greatest result of environmental radiation exposure was 5.06 × 10-5 mSv / year and Hospital X2 obtained 1.45 × 10-4 mSv / year. Judging from these results, the environmental radiation exposure of the two hospitals is still below 0.5 mSv / year so it is declared safe. From the results of the analysis of environmental radiation exposure in the X1 Hospital Radiography Room and X2 Hospital Radiography Room, the radiology room of the two hospitals is safe because it is still below 0.5 mSv / year. The structural radiation barriers of the two hospitals are also safe because the existing wall thickness in Hospital Radiography Room X1 and Hospital Radiography Room X2 has exceeded theoretical calculations [11]. Based on the results of the study, the availability of facilities at Type B Hospital in Central Jakarta, the frequency was adequate and inadequate, on an average as much as 50%. The results of the analysis of the relationship between the availability of facilities and work behavior showed that there were 11 (55%)

radiation workers with adequate facilities that had unsafe work behavior, while 12 (60%) of radiation workers with inadequate facilities had unsafe work behavior. The results of statistical tests, it was found that the value of p>0.05, this proved that there was no significant relationship between the availability of facilities and the work behavior of the radiographer. According to the assumptions of researchers, there are still many radiation workers who do not use radiation protection equipment due to the lack of supervisory roles to supervise radiation workers in Type B Hospital [12].

Based on the results of observations, interviews and documentation studies that have been carried out by researchers regarding the components of management requirements in terms of health monitoring, 2 points of health monitoring components (4 points) are fulfilled and according to standards (Government Regulation Number 33 of 2007 article 9) namely initial health checks and periodic health checks during work. A total of 1 point (25%) is fulfilled but not in accordance with the standard (Perka BAPETEN Number 6 of 2010 article 4), namely the health monitoring component which includes: health checks, counseling and health management of workers who have received excessive radiation exposure for medical examinations in the form of counseling has not been carried out . a number of 1 point (25%) is not fulfilled by the installation according to Government Regulation Number 33 Year 2007 article 9, namely medical examinations for radiation workers who will terminate work relations because no personnel have retired or have terminated employment ties [13]. In the study of Suryawati et al. [14] the effect of radiation in the Radiotherapy Installation at the Hospital was determined from the value of the radiation dose rate obtained with TLD-100. The radiation dose rate outside the irradiation room ranged from 0.21 to 1.20 mSv per year. The radiation dose rate obtained is still below the deterministic effect threshold, namely 3000 mSv - 6000 mSv and NBD set by Perka BAPETEN No. 3 of 2013. So it can be estimated that the radiation effect received by radiation workers and the community is a stochastic effect [14].

3.2 Radiation Worker Protection Regulations

Radiation workers in carrying out their duties as health workers in the field of diagnostic radiology are protected by a set of legal rules consisting of: Law Number 36 of 2009 concerning Health, Law Number 44 of 2009 concerning Hospitals, Law of the Republic of Indonesia Number 10 years 1997 concerning Nuclear Energy, Law Number 36 of 2014 concerning Health Workers, Government Regulation of the Republic of Indonesia Number 33 of 2007 concerning Safety of Ionizing Radiation and Security of Radioactive Sources, Government Regulation of the Republic of Indonesia Number 29 of 2008 concerning Licensing for Utilization of Ionizing Radiation Sources and Nuclear Materials, Regulation of the Minister of Health of the Republic of Indonesia Number 363 of 1998 concerning Testing and Calibration of Medical Devices at Health Service Facilities, Regulation of the Minister of Health of the Republic of Indonesia Number 780 of 2008 concerning Implementation of Radiology Services, Decree of the Minister of Health of the Republic of Indonesia number 1014 of 2008 concerning ng standard diagnostic radiology services in health care facilities. Based on Article 1 Number (1) PP No. 29 of 2008 concerning Licensing and Utilization of Ionizing Radiation Sources and Nuclear Materials (hereinafter referred to as PP Permit and Utilization of Radiation), what is meant by utilization is activities related to nuclear power which include research, development, mining, manufacturing, production, transportation. , storage, transfer, export, import, use, decommissioning and management of radioactive waste to improve people's welfare.

Based on Article 4 of the Regulation of the Minister of Health Number 780 of 2008 concerning the Implementation of Radiological Services, it is determined that one of the requirements for obtaining a license for the provision of diagnostic radiology services is if it meets the equipment requirements in accordance with the classification of health service facilities, which consists of: a. Plan data, size, construction and room protection; b. Diagnostic radiology equipment data and technical specifications; c. Minutes of tool function test; and D. Equipment importer license from BAPETEN (for tools using ionizing radiation / X-rays). Regulation of the Minister of Health of the Republic of Indonesia Number 363 of 1998 concerning Testing and Calibration of Medical Devices, requires that every medical device used in Health Service Facilities be tested and calibrated periodically at least 1 (once) a year by the Testing institution, to ensure accuracy and accuracy. as well as the safety of using medical devices.

Based on the Regulation of the Head of BAPETEN Number 15 of 2014 concerning Radiation Safety in the Production of Diagnostic and Interventional Radiology X-Ray Aircraft, the hospital is obliged to ensure that the Dose Limit Value (NBD) is not exceeded in two ways, namely monitoring radiation exposure and monitoring the dose received. by radiation workers. As for the maintenance and maintenance of the radiological equipment, it must refer to the manufacturer's guidelines which are carried out periodically and continuously by radiographers, medical physicists, electromedical technicians and manufacturing technicians to ensure the quality of the equipment used so that health services to the public are not disturbed. This is as stipulated in the Regulation of the Minister of Health Number 780 of 2008 concerning the Implementation of Radiology Services and the Decree of the Minister of Health Number 1014 of 2008 concerning Diagnostic Radiology Service Standards in Health Service Facilities. The use of nuclear energy must be carried out by taking into account the safety and security aspects to protect workers, community members and the environment. Regulations regarding the Safety of Ionizing Radiation are stipulated by Government Regulation Number 33 of 2007 concerning Safety of Ionizing Radiation and Security of Radioactive Sources. This provision stipulates several safety requirements which include: (1) Radiation Protection requirements; (2) Dosage limitation; (3) verification of safety and technical requirements; (4) more detailed monitoring of worker health; and (5) intervention in chronic and emergency situations.

3.3 Form of Radiation Worker Protection

Radiology Installation is a health service provider that utilizes ionizing and non-ionizing radiation in an effort to improve the degree of public health towards a healthy community. In radiology installations, both those that have simple and modern facilities are organizations that meet science and technology, fulfill the profession, meet quality and are full of risks, so it is not surprising that Unwanted Events (KTD) may occur, ranging from mild to fatal consequences for officers. . Unwanted events can occur starting from pre-radiation, during radiation exposure and after radiation exposure. The Nuclear Energy Regulatory Agency (Bapeten) has set a dose limit value (NBD) for radiation safety. NBD is stipulated in the Regulation of the Head of BAPETEN Number 8 of 2011 concerning Radiation Safety in the Use of Diagnostic and Interventional Radiology X-ray Aircraft. The NBD for the effective dose of radiation workers should not exceed 20 mSv in 1 year, the NBD for the effective dose of community members should not exceed 1 mSv in 1 year. One of the efforts that can be made to ensure the safety and health of radiation workers and the public is to control the receiving of external radiation doses on a regular basis. Methods that can be done to control the external radiation dose received by radiation workers and the public include monitoring

radiation doses with individual dosimeters, monitoring radiation in the work area, and mapping radiation in the work area [15].

The percentage of radiation workers who have unsafe work behavior is more than those who behave safely. This is in accordance with the results of research conducted by Ilham (2013) that there are 52.2% of workers who behave unsafe when using radiation protection devices while working compared to workers who behave safely when using radiation protection devices while working, there are 47.8%. Thus, it can be seen that there are more radiographers who do not have safe behavior in their work. Based on the results of the study, the number of radiation workers who had attended training was 19 (47.5%) and those who had never attended training were used to train certain knowledge and skills. According to Geller [16] about 50 safety principles, one of which focuses on training. The training is intended to increase workers' understanding of hazards and risks. According to the assumptions of researchers, the lack of radiation workers who attended radiation protection training held by BAPETEN (Nuclear Energy Supervisory Agency) was due to the high cost of training so that the hospital only included a few radiographers so that many radiographers behaved unsafe [12].

It is recommended for the Radiology Installation to increase the provision of radiation protection training for radiation workers, increase safety verification reporting for radiation exposure monitoring and identification of potential exposures and procurement of surveillance equipment to measure radiation exposure, the results of TLD are collected by radiation workers to radiation protection officers and sent on time so that the dose acceptable readability, improve the maintenance of medical examination records of workers who will terminate employment for approximately 30 years because of the possibility that over long periods of time there will be radiation effects on radiation workers [13]. Radiation workers are required to use personal protective equipment when the radiation exposure conditions generated by X-ray aircraft are high enough. One of the checks that requires radiation workers to use personal protective equipment is a special examination, in which radiation workers are close to the radiation source [17].

According to the Government Regulation of the Republic of Indonesia Number 33 of 2007 concerning safety of ionizing radiation and safety of radioactive sources article 31 states that license holders are required to provide radiation protection equipment and every worker, patient, patient companion and / or other person related to radiation is required to wear radiation protection equipment. While the examination room is in accordance with the standard, namely the wall of the examination room must be 20 cm thick concrete or 25 cm red brick with a density of 2.2 gr / cm3 or equivalent to 2 mm Pb so that it is safe from radiation hazards (BAPETEN, 2005). Radiation barriers, aprons, Pb glasses, shielding, gonad shields are in accordance with the standard, namely the protective apron has a thickness equivalent to 0.25 mm Pb and the size / design must cover parts of the body that are exposed to direct radiation, protective gloves must have a thickness equivalent to 0.25 mm Pb and its design should provide adequate protection from direct radiation hitting the hands and wrists and facilitate movement, the gonad shield must have a minimum thickness equivalent to 0.5 mm Pb (BAPETEN, 2005). In the Radiology Laboratory of 'Aisyiyah University, Yogyakarta, there is only 1 radiation sign with a new symbol and a red light above the entrance to the X-ray aircraft room as a sign of radiation hazards in the room. The Radiology Unit in the hospital requires several main rooms, namely the radiation room, operator's room, dark room, sanitation room, film reading room and dose planning room. In addition to the main room, an administrative room is also needed which includes, among others, an administration room, a patient's waiting room, a doctor's office, and so on [18].

Decree of the Minister of Health Number 1014 of 2008 concerning Diagnostic Radiology Service Standards in Health Service Facilities explains that diagnostic radiology services are an integral part of medical services that need special attention because besides being useful in establishing diagnoses, they are also very dangerous for patients, officers and the surrounding environment. if not properly organized. In an effort to achieve quality and safe radiology services, excellent management and technical management are needed, supported by good facilities / infrastructure, human resources and equipment.

4 Conclusion

1) Of Radiation Worker Protection Policy must be of concern to the Government and Health Service Providers because radiation has a huge potential risk to the health and survival of radiation workers.
2) Policies in the form of regulations on the protection of radiation workers are regulated by a set of legal rules consisting of laws, government regulations, regulations of the minister of health, decree of the minister of health, Regulation of the Head of Bapeten which regulates the use and operation of radiation services.
3) The form of a radiation worker protection policy can be carried out through a Health Monitoring policy and examination of the dose limit value (NBD) for radiation safety, requirements for Radiology Service Implementation according to specified regulations, compliance with radiation workers must use personal protective equipment, and the Radiology Unit in the hospital must meet the maximum protection standards.

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