Minimization Strategy of Radiation Impact on Radiation Workers: Columbia Asia Medan Hospital in 2018

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Abstract : The Radiology Services Unit is one of the supporting medical installations, using ionizing radiation sources to diagnose the presence of a disease in the form of anatomical features displayed in the radiographic film.This study aims to obtain in-depth information about the existence of a policy from Management that related to X-Ray Radiation Protection and compliance of workers in carrying out their tasks in accordance with the rules applicable in the use of Personal Protective Equipment and compliance with the system of justification, optimization and limitation for safety workers.Descriptive qualitative research is to obtain or describe the reality of the events studied so that objective data that will be obtained by way of in-depth interview and focus group discussion as well as direct observation in the field.Policy is a rule that must be executed properly and consistently in the field of radiation sources work, where the radiation has adverse effect to the workers, the policies concerning to the standards of equipment, procedures, referrals, use of Personal Protective Equipment and exercises. These policies must be obeyed by the workers for the safety from radiation and the impact can be minimized properly and effectively.

1 INTRODUCTION

The use of ionizing radiation, including X-rays in medicine, both for therapy and diagnostics is common. Since the discovery of X-rays by Wilhelm Conrad Roentgen in 1895 and the production of the first radiographic equipment for clinical diagnostic use, the basic principle of radiography has not changed at all, namely producing an image on a receptor film with a radiation source from an X-ray beam that is experiencing absorption and attenuation when passing through various organs or parts of the body. (Lukman, 1991 in The use of ionizing radiation, including X-rays in medicine, both for therapy and diagnostics is common. Since the discovery of X-rays by Wilhelm Conrad Roentgen in 1895 and the production of the first radiographic equipment for clinical diagnostic use, the basic principle of radiography has not changed at all, namely producing an image on a receptor film with a radiation source from an X-ray beam that is experiencing absorption and attenuation when passing through various organs or parts of the body. (Lukman, 1991 in Sugiratu, 2012).

Radiology services must pay attention to aspects of radiation safety. In addition to providing benefits, these activities can also cause dangers to radiation workers, the general public and the environment. The danger that can be caused by the use of ionizing radiation is the emergence of harmful radiation effects for patients, workers and the general public. Some of the effects of radiation on humans are:

a. Deterministic Effect
   This effect arises in unusual conditions, for example in conditions of radiation accidents (acute radiation exposure), so there will be a large number of cells that die, while the cell replacement process is not balanced, so it will greatly affect the body system.
b. Stochastic Effect
   The effect of radiation does not completely result in cell death, but can also change the cell. In general, these changes will not significantly affect the cell so that there will be no observable effect, but it is possible that the changed cell can affect the control system in the cell, which in turn will cause the cell to divide faster than

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normal cells. If these abnormal cells invade normal tissue, they are called malignant cells and the result of this is cancer. Cancer does not appear immediately after people are exposed to radiation but requires a long calm time. The quiet time depends on the type of cancer but can vary from two years (leukemia) to thirty years or more for other types of cancer. In other words, the smaller the radiation dose a person receives, the less likely the effect will appear.

c. Hereditary Effects (Heredity effect)
If one reproductive cell (either a sperm cell or an egg cell) is damaged by radiation, then there is a possibility that this damage affects the first offspring or offspring in the next generation. This type of effect is known as the Heredity effect and because it appears based on probability it is grouped into stochastic effects. The risk of this type of heredity effect is far less than the risk of getting cancer (Sugiratu, 2012).

Based on this background above, researchon *The Strategy of Minimizing radiation on radiation workers at Columbia Asia Medan Hospital in 2018*, was intended to be known. X-ray radiation protection for worker safety and related information will discuss protection in work that complies with applicable regulations regarding the use of personal protective equipment and is related to the justification, optimization, and limitations in radiation systems.

The demand for compliance to carry out Radiation Safety Management is carried out to protect patients, workers, community members, and the environment from the dangers of radiation, as stipulated in Perka BAPETEN No. 08 of 2011. The regulation is by the theory of compliance (compliance theory). According to Dr.Cialdini in the theory of compliance, there are six principles that affect compliance, one of which is closely related to the radiation safety management system is the principle *of Commitment and Consistency*, where in running a system a strong commitment is needed to achieve optimal results in minimizing the impact of radiation and carried out consistently and thoroughly.

2 LITERATURE

X-rays are produced from X-ray tubes, which are a tool to produce free electrons, accelerate and finally hit a target (Batan, 2011) where X-rays are emitted electromagnetic waves with very short wavelengths and are categorized as one of the radiation ionizing which can interact with biological cells and can cause adverse effects on these cells. Therefore as a radiation worker must comply with all forms of policy that have been determined in terms of radiation utilization.

The current radiation protection philosophy dopted by the *International Commission on Radiation Protection* (ICRP) in a statement governing radiation dose limitation, which essentially follows:

a. An activity will not be carried out unless it has a positive advantage compared to risk, known as the *justification principle*
b. Radiation exposure is sought at the lowest possible level *(as lowas reasonably achievable*, ALARA), taking into account economic and social factors, known as *optimization principles*.
c. Individual doses may not exceed the limits recommended by the ICRP for a particular environment, known as the *principle of limitation.*

3 RESEARCH METODHS

This research was conducted in a descriptive qualitative way to find out or describe the reality of the events under study making it easier for writers to obtain objective data using the *action research* approach. Where in the data collection by means of in-depth interviews (*Indepth Interview)* of key informants and focus group discussions as well as direct observation in the field of research related to the Minimization of the Impact of Radiation on Radiation Workers at Columbia Asia Medan Hospital in 2018.In collecting data collected from in-depth interviews with 3 informants as informants and 1 focus group discussion. In interviews and group discussions the key words taken (coding) related to the hazard factors of radiation so that the results of these keywords can be analyzed in the discussion so that the results obtained can create a strategy to minimize the impact of the radiation hazards.

4 RESULTS AND DISCUSSION

In the results of the study, researchers explained the interview process to all informants regarding the extent of the Strategy. Minimization of the impact of Radiation on radiation workers at Columbia Asia Medan hospital. When conducting interviews from sources of information, there are several key points

that are very dominant in taking steps - very influential in suppressing radiation so that it does not have a high impact on radiation workers including:Policy and Compliance.

In interviews that were found from all informants, field observations and data search, Columbia Asia Medan Hospital was also complemented by policies from the central level of Columbia Asia Indonesia in the form *of Central Policy CA-C / Rad / 01 / ID concerning the Scope of Radiology Services*, Central Policy CA -C / Rad / 04 / ID regarding *Inspection and Investigation Requests,* Central Policy CA-C / Rad / 09 / ID regarding *Equipment Maintenance*. Columbia Asia Medan Hospital is also equipped with several Standard Operating Procedures (SOPs) relating to the applicable Policy that have been established from the Columbia Asia Indonesia Center, which are SPO Radiology Services for Inpatients, SPO Radiology Services for Outpatients, SPO Radiology Services for Patients in the Emergency Unit, SPO Radiology Equipment Maintenance, SPO Radiation Protection in General, SPO CT Scan, SPO Mammography, SPO General X-Ray. All SPOs are related to the implementation of routine procedures in the Radiology Section. From the completeness of radiology facilities and infrastructure, the three informants explained that the radiological infrastructure facilities especially those related to personal protection from radiation exposure are very complete, but the compliance of the workers themselves will use the personal protective equipment and also when carrying out their duties in the utilization of radiation. But in practice in the field based on the focus group discussion, the informant revealed the existence of non-compliance of the officers in the use of Personal Protective Equipment, following excerpts from the discussion of the opinion group of Informant 4 implied that the officer was inconsistent in the use of personal protective equipment

... we should use it because we haven't used it all this time ...

Likewise, this was corroborated in the interview obtained from informant 2 about the use of personal protective equipment whose impression was very difficult to control the officer in terms of the use of personal protective equipment such as the interview informant 2

"If that is their negligence depends on each individual. But if we have recommended it like that, they don't want to use it, it might be individual individuals. We can't do anything. "

In addition, officers must also comply with the rules set by Bapeten No.8 of 2011 in terms of the principle of justification where the officer performs his duties if there is a radiological request referral from a doctor and also as determined by applicable regulations from the parent company of Columbia Asia contained in Columbia Asia Central Policy CA-C / Rad / 04 / ID regarding *"Request for Examination and Investigation / Ordering Tests and Investigations"* point 1 which contains *Radiology tests can only be ordered by a medical doctor / Radiology Examination can only be instructed by a medical doctor* . But in the recognition of Radiographers who carry out their duties in the fieldset forth in group discussions there are only those who examine without a referral from the sending doctor. By looking at the excerpts from the discussion results it can be concluded that the radiology service system has not yet run optimally in terms of the justification principle. And this is found in the field is a patient who came not from the outpatient and inpatient clinical services at Columbia Asia Hospital but came directly from outside with various reasons such as photo control that had previously been done. Fulfill this so as not to be bumped into regulations and authorized to enter examination services to all sections including radiological examinations, the radiology department requests the assistance of hospital doctors to conduct examinations to include radiology services for the smooth flow of radiology services at Columbia Asia Medan Hospital in accordance with Central Columbia Asia CA-C / Rad / 04 / ID Policy on "Request for Examination and Investigation / Ordering Tests and Investigations" point 3 whose contents are OTC *(over the counter) cases without an appropriate requisition shall be screened by an in-house doctor before the investigation is carried out / OTC (over the counter) cases without proper application will be screened by an in-house doctor before the examination is carried out.*

From the results obtained in the study, in terms of radiology equipment maintenance went well and consistently in carrying out regular and continuous calibrations. And the use of individual personnel measuring instruments is also consistent in their use and measured in the BPFK laboratory (Balai Safeguard Health Facilities) running well and the results obtained in measurements during 2017 the results are still in the safe zone and below 20 mSv /

year as the following table. The human body is exposed to large doses of nuclear radiation will experience acute radiation syndrome (ARS) or radiation poisoning that can lead to death. The severity and symptoms that arise depends on how much nuclear radiation is absorbed by the body. The amount of radiation absorption depends on the strength of the radiation energy and the distance of the body to the radiation source. Signs and symptoms of nuclear radiation poisoning may not appear immediately when the body is exposed to large amounts of nuclear radiation. Symptoms may only appear within a few hours, up to weeks after exposure to radiation. Nuclear radiation sickness cases have started to boom since the explosion of the Hiroshima and Nagasaki atomic bombs in Japan. Even more devastating was when the Chernobyl nuclear power plant in Ukraine exploded and devastated the city. The damaged nuclear reactor released radioactive iodine and cesum. The material is believed to have caused hundreds of thousands of Chernobyl nuclear power plant workers to die, either during the incident or due to nuclear radiation arising after the incident. Some types of radiation have enough energy to ionize the particles. In general, this involves an electron that is 'thrown' from the electron shell, which will give a (positive) charge. This is often disruptive in the biological system, and can cause mutations and cancer. This type of radiation generally occurs in radioactive waste and radioactive waste. The three main types of radiation are found by Ernest Rutherford, Alpha, Beta, and gamma rays. The radiation was discovered through a simple experiment, Rutherford used a radioactive source and found that the resulting beam hit three different regions. One of them is positive, one of them is neutral, and one of them is negative. With this data, Rutherford concluded that radiation consists of three rays. He gave names taken from the first three letters of the Greek alphabet namely alpha, beta, and gamma. t low doses, body cells exposed to radiation are still able to recover themselves in a short time. Damaged cells will only die and be replaced by new cells. However, at high doses, damaged cells will multiply to become cancer cells (especially if your lifestyle supports being exposed to cancer such as smoking, consumption of carcinogens-prone foods, and so). Exposure to radiation at high doses in one time or short term will also cause some symptoms (called acute radiation syndrome) on your body such as nausea, vomiting, diarrhea, fever, weakness until fainting, hair loss, skin flushing, itching, swelling until burning, pain to convulsions. These symptoms will certainly be different if you are exposed for a long time. Sometimes the sensitivity of one's body also affects the impact of radiation exposure on one's body. For example, gamma radiation as much as 400 brakes will cause death to someone if exposed to two different times, with a span of 30 days. However, the same dose will not even have any effect if we are exposed for one year in smaller evenly distributed doses. The radiation we receive at all times, including radiation for medical purposes, has positive and negative impacts on human safety and the environment. The positive effects of radiation on human safety include being used as a treatment and the negative effects are dependent on the large dose received including starting from nausea, vomiting, dizziness, hair loss, causing cancer, genetically inherited, and even more dangerous is cause death. Therefore we must be careful of the dangers it poses, both to radiation workers and the general public including patients. Protection against the dangers posed by radiation is known as radiation protection. So that the dose received annually by workers or the general public does not exceed the dose limit set by Bapeten. Various efforts have been made to minimize these hazards so that workers and patients feel safe doing and subjected to medical measures. Radiation is energy that is emitted in the form of particles or waves. Radiation is divided into two types, namely ionizing radiation (large dose radiation) and non-ionizing radiation (low dose radiation). The type of radiation that is at high risk of causing health problems is ionizing radiation. One can be exposed to this type of nuclear radiation from nuclear energy transmitting machines, such as on CT scans and X-rays, or through nuclear bomb explosions and nuclear reactor leaks. The impact of exposure to nuclear radiation in high doses is very deadly. But this rarely happens in regions or countries that do not use much nuclear power as a source of electricity. If exposed to nuclear radiation, be sure to remove all clothing attached to the body to prevent additional contamination, and immediately wash the affected body part or skin with soap and water.

Table 1: Limit Doses of Individual Radiology Officers Columbia Asia Hospital Medan in 2017

No	Name of the officer	Jan-Mar	Apr -Juni	Jul-Sept	Okt-Des	Dose Amount / Year 2017	Dose determined / year by BAPETEN mSv
01	Radiologist 1	0,0082	0,0100	0,01	0,01	0,0382	20
02	Radiologist 2	0,034	0,0100	0,0351	0,01	0,0891	20
03	Radiologist 3	0,0090	0,0065	0,01	0,01	0,0355	20
04	Radiografer 1	0,0582	0,0328	0,0358	0,0355	0,1623	20
05	Radiografer 2	0,0723	0,0495	0,0753	0,0501	0,2472	20
06	Radiografer 3	0,0611	0,0553	0,057	0,0771	0,2505	20
07	Radiografer 4	0,0946	0,0213	0,0637	0,0293	0,2089	20
08	Radiografer 5	0,0634	0,0659	0,0661	0,0455	0,2409	20
09	Radiografer 6	0,1835	0,2362	0,0839	0,0863	0,5899	20
10	Radiografer 7	0,0316	0,0300	0,0156	0,369	0,4463	20
11	Radiografer 8	0,0455	0,0560	0,0455	0,0432	0,1902	20
12	Radiografer 9	0,0786	0,0553	0,0668	0,0367	0,2374	20
13	Radiografer 10	0,0306	0,0293	0,0321	0,016	0,108	20
14	Radiografer 11	0,0703	0,0465	0,0585	0,0294	0,2047	20
15	Radiografer 12	0,030	0,0587	0,1825	0,1119	0,3831	20
16	Radiografer 13	0,0288	0,0296	0,0379	0,039	0,1353	20
17	Radiografer 14	0,0750	0,1052	0,063	0,0783	0,3215	20

5 CONCLUSION

Based on the results and discussion of the research that has been submitted, the conclusions can be drawn as follows:

1. All radiology measures must refer to the applicable policy, namely the existence of standardization of calibrated radiology equipment, the existence of Standard Procedures in conducting examinations, referral of sending doctors, use of Personal Protective Equipment and continuous training.

2. From compliance, Officers do not consistently use Personal Protective Equipment (PPE), which in principle every time implementing PPE procedures must be used as an effort to minimize radiation hazards.

3. The absence of a provision from theManagement or Radiology department willlimits of the number of procedures set for each radiation worker in carrying out his work.

This conclusion can be illustrated by the Schematic Relationship Between Components in the Strategy to Minimize the Impact of Radiation on Radiation Workers at Columbia Asia Medan Hospital in 2018.

6 SUGGESTION

Based on the conclusions drawn, it is recommended:

1. All Radiation Workers must better understand the importance of using Personal Protective Equipment / Radiation Protection, where radiation is invisible but has a biological effect on people exposed to radiation.

2. Management should send workers to a special radiation protection training to be more caring and responsible again.

3. With an individual NBD (Dose Limit Value) result below 20 mSv / year, the part should be able to make a quality achievement target in terms of establishing

NBD standards in the radiology section called the Dosing Constrain.

4. Hospital Management, in this case, the Radiology manager can make a limit on the number of procedures for workers for the creation of radiation safety and the achievement of minimization of the impact of radiation for workers

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APPENDIX

Radiation Unit