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Assessment the Awareness and Knowledge Level about Radiation Protection: An Empirical Study on the Radiology Professionals of the Radiology Departments, East Java Indonesia

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Abstract:-
Rationale and Objective: first of all, as long as there are ways and foundations to protect ourselves from radiation then it must be pointedly taken into account and do the best for that. Second, since radiation protection is as important as radiation exposure and also CT scanner emits an extremely large amount of radiation comparing to the conventional x-ray and radiation has negative biological effects on living organisms which may lead to cancerous cells. Therefore, this study comes to shed a light on radiation protection and aims to assess the awareness & knowledge of radiology professionals and how they influence on the protection at radiology departments in CT units.
Materials and Methods: questionnaire was applied to radiology professionals who work at radiology department in CT unit. In this study target groups were "technologists, physicists and radiologists who had been asked to fill in the questionnaire consisting of their actual assessment and knowledge on ionizing radiation and its protection. All questions were in multiple choice formats using Likert scale ranging from 1 to 4. Then, the obtained data were analyzed with Statistical Package for Social Sciences (SPSS) and Partial Least Square (PLS) softwares.
Results: in this study 102 participants had taken part. Their level of awareness and knowledge about radiation protection and radiation doses and side effects were found to be between fairly good and good overall. However, the high effect was evidently appeared between Awareness & knowledge and Protection in present study. The respondents sample included technologist "radiographer", physicist and radiologist with percentages 69.6%, 2.0% and 28.4% respectively. However, the percentage of physicist was too low, which can understand that the hospitals lack these important people and the majority of covered hospitals do not have such as at all. In addition, based on their main Career as one of the most notable classifications in the questionnaire the results have shown whether it impact on the Awareness and Knowledge of radiation protection in general or not. So, the majority of categories were in fact either good or fairly good within all level degree too. The statistical methods analyzing show that all hypotheses were supported with value of t-statistics greater than 1.96 with error level α = 5%. Generally, analyzing the present study in details, it is surprising that the knowledge and awareness on radiation protection and safety among the participants were between a moderate and excellent level. On the other hand, strangely there were few of them who did not know that ionizing radiation is not used in MRI and US.
Conclusion: the present study has illustrated that general assessment and knowledge related to ionizing radiation, its protection, radiation doses and side effects are sufficient among target groups CT units. The results highlight the majority of participants have had courses and studied in curriculum during their study about radiation protection and they comply with radiation protection protocol in hospitals. Finally, from findings it can be noted that protection is in a linear relationship with general awareness & knowledge, knowledge about radiation doses and knowledge about side effects.

Keywords:-Assessment & knowledge, radiation protection, radiology department, radiology professionals, CT scan unit.

I. INTRODUCTION

Since Ionizing radiation has been increasingly used during the past decades for diagnosing and treating different medical conditions. However, besides its diagnostic and therapeutic effects, ionizing radiation is also associated with different bad side effects[1]. Whereas radiology departments have potential to present hazardous effects due of ionizing radiations. Awareness and knowledge of application protection guidelines and instruments among radiology professionals has an important role to safe working in these places [2]. In short, radiation protection for all professionals, patients and public must be applied properly as respectively as priority.

X-ray is the most ionizing radiation that has been using in the hospitals which were discovered in 1895 by Wilhelm Conrad Roentgen who was working with a cathode-ray tube as shown in figure (1) treating by using a variety of imaging techniques such as X-ray, ultrasound, computed tomography (CT), nuclear medicine, positron emission tomography (PET), and magnetic resonance imaging (MRI) [3].

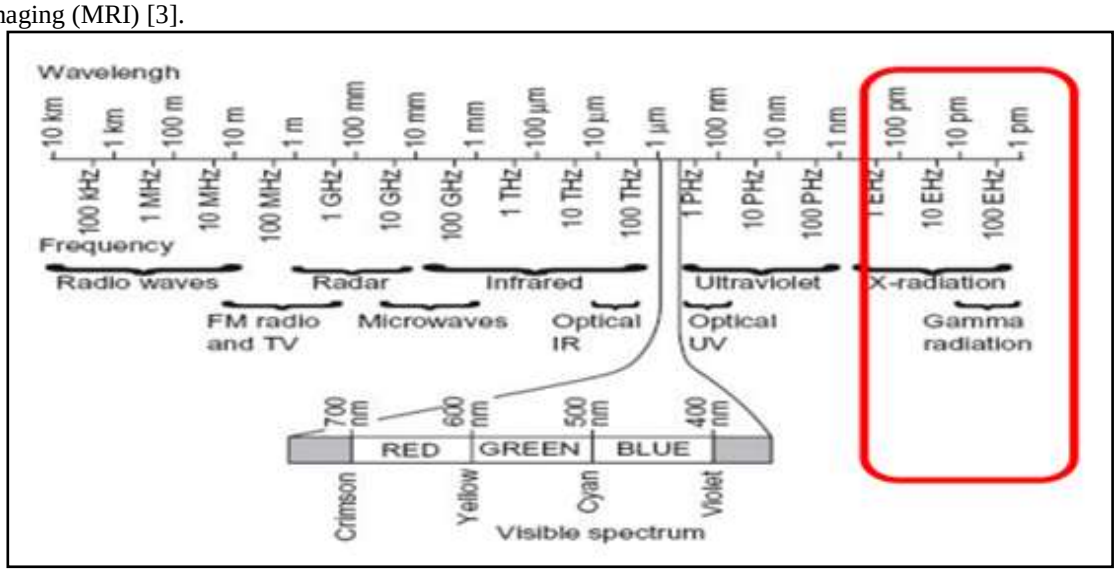

Figure (1) spectrum range in the red box is ionizing radiation that consist of x-ray and gamma ray[4]

Indeed, the acquisition of medical images is usually carried out by the radiographer, often known as a radiologic technologist. Depending on location, the diagnostic radiologist, or reporting radiographer, the images and produces a report of their findings and impression or diagnosis. This report is then transmitted to the physician who ordered the imaging, either routinely or emergently [5]. However they may require knowledge and safety precautions of professionals [1]. Hence, the main aim of radiation protection protocol should focus on prevention of the deterministic effects occurrence and to reduce the probability of stochastic effects, that is why personnel should be restricted to the "As Low As Reasonably Achievable" ALARA principle concept. In order to achieve the goals must do proper radiation protection protocols [6].

The International Commission on Radiological Protection (ICRP) is the primary body in protection against ionizing radiation. ICRP is a registered charity and is thus an independent non-governmental organization created by the 1928 International Congress of Radiology to advance for the public benefit the science of radiological protection [7] and began to develop the risk/benefit concept since 1977. This concept recommended that all patient exposures must be justified and kept as low as possible. So it is a mandatory issue to follow the ALARA principle "As Low as Reasonably Achievable" during any examination [6]. The ICRP provides recommendations (some new recommendations take account of the latest biological and physical information and consolidate the additional guidance since 1990 [8] and guidance on protection against the risks associated with ionizing radiation, from artificial sources widely used in medicine, general industry and nuclear enterprises, and from naturally occurring sources. These reports and recommendations are published four times each year on behalf of the ICRP as the journal Annals of the ICRP. Each issue provides in-depth coverage of a specific subject area [7]. Whereas, the BadanPengawas Tenaga Nuklir (BAPETEN) is the Nuclear Energy Regulatory Agency of Indonesia which has the local standards for radiation. BAPETEN is a non-Department Government Institution which is under and responsible to the President. It has the tasks of implementing the surveillance of all activities of the use of nuclear energy in Indonesia through regulation, licensing and inspection in accordance with applicable laws and regulations. BAPETEN was founded on May 8, 1998 and began actively working on January 4, 1999 [9]. Finally, the reason for choosing this problem is to optimize awareness and knowledge of professionals and for other two point. First, protection objective to prevent the occurrence of deterministic effects in individuals by keeping

the doses below the relevant threshold and to ensure that all reasonable steps are taken to reduce the occurrence of stochastic effects in the radiation workers at present and in the future. Second, safety objective to protect individuals, society and the environment from harm by establishing and maintaining effective defenses against radiological hazards from sources [10]. Therefore, this study is focusing on a narrow topic which discusses the evident issues that has not been cared as required for many years ago especially for radiation personnel.

The main problems underline in this research can be made such the following questions: Do the professionals have enough awareness and knowledge about radiation protection and safety? And how do the professionals comply with the regulations of quality standards. Next, the purpose of the present study can be divided in two points; 1) General purpose: that to assess the radiation protection awareness and knowledge level of medical radiation workers in some hospitals of East Java in Indonesia. 2) Specific Purpose: to know the extent of awareness of radiation safety among radiology workers (Personnel) in emergency department. In addition, to enhance the compliance to radiation protection protocol and reduce (curb) the radiation risks as much as possible among the employees and patients. Moreover, the Benefits of the Research were,

- Improve the awareness and knowledge of health care professionals.
- Minimize radiation hazard for workers and patients in hospitals.
- Curbing exceed the regulations of the quality standards in the department.
- Make employees aware on ways to prevent the risks of radiology.

Finally, the research limitations were as following; the study was carried out in the radiology department that employ CT scan. The survey was targeting the professionals of radiology department who works in emergency department. The study has covered seven (7) general hospitals in East Java.

II. MATERIALS AND METHODS

This research uses questionnaire which has already applied to the groups of radiology departments' professionals in several hospitals in east Java in Indonesia that can mention as following; Dr. Saiful Anwar Hospital (RSSA) Malang, PantiWaluyaSawahan Hospital (RKZ) Malang, Persada Hospital Malang, NgudiWaluyoWlingi Hospital (RSUD) Blitar, Dr. Soedono Hospital (RSUD) Madiun, AisyiyahPonorogo Hospital (RSU) Madiun and Dr. AbdoerRahem Hospital (RSUD) Situbondo. However, the sample for the study was the specific category of CT units personnel in radiology departments which include only three categories "technologists, physicists, radiologists" for assess the radiation protection awareness of these groups. Then, the data has collected in almost three months from May to July 2016. After that, the data was analyzed by using two softwares called Statistical Package for the Social Sciences "SPSS" with P-value level >0.05, and Partial Least Squares (PLS) with t-statistic value levels of 1.96 was considered statistically significant. In this study we have 4 variables as shown in conceptual framework figure (2). Then, in each variable we gave minimum 4 questions. Totally, 100 samples to fulfil the requirement and however the amount of sample that were gotten is 102 in this research.

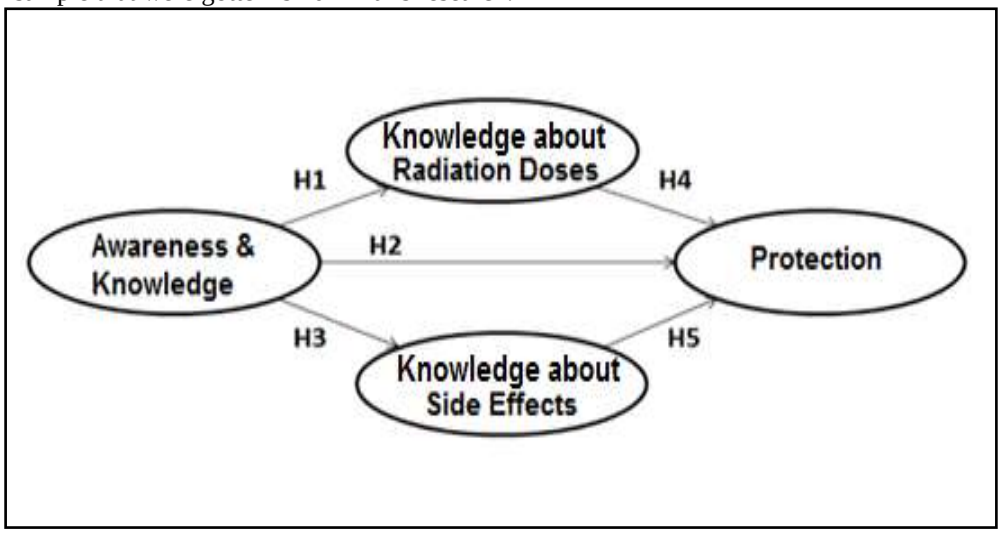

Figure (2) Conceptual framework

The numbers of questions that has been written down for each variable were as following: 15 questions about general awareness & knowledge, 4 questions about radiation doses knowledge, 4 questions about side effects knowledge and 14 questions about protection. Then, how they affect one another.

Operational Definitions:

Radiology employees: they are the people who work at radiology department in the hospital. However, the study is going to focus on these sample; technologist (radiographer), physicist and radiologist.

Radiation doses: it rather means absorbed dose which is a physical dose quantity representing the mean energy imparted to matter per unit mass by ionizing radiation. In the SI system of units, the unit of measure is joules per kilogram that named Gray (Gy) as has already mentioned. Also, doses should not be exceeded during worktime.

Radiation side effects: as a result of getting high dose of x-ray that let to get bad effects of the exposure. Moreover, those effects may lead to cause disease and cancer cells.

Protection: it is the rules and protocols that was formulated by some organizations and authorities such as International commission on radiological radiation (ICRP) and nuclear energy regulatory agency (BAPETEN) in Indonesia besides to some recommendations which must be followed by personnel.

III. RESULTS & DISCUSSION

Out of the 105 questionnaires had been distributed, 102 questionnaires were returned with completed answers. The response rate has passed (97%). And they were divided as in table 1, 2.

Table 1 participant's specialty

	Frequency	Percent
Technologist "Radiographer"	71	69.6%
Physicist	2	2.0%
Radiologist	29	28.4%
Total	102	100%

Table 2 participant's degree

	Frequency	Percent
Diploma	69	67.6%
Under graduated	14	13.7%
Post graduated / specialist	19	18.6%
Total	102	100%

The results of a survey on the protection and safety issues related to the use of radiation for medical procedures which is designed to assess the awareness & knowledge of healthcare professionals who are radiation professionals obviously revealed that even though there is a disparity of ages, degrees, experiences and specialties (career); they have a good awareness overall and knowledgeable with most of questions for each variable; figure (3) and they follow the own protocols unlike the previous studies. That because tutorials and workshops are their best choice for the participants to keep their level as high as they can. Additionally, it was appeared by some professionals that there are excessive number of requested images which unnecessary, and the question is who is responsible of that?

Table 3 Classifications of Participants' Categories by Degree

Degree "Education Qualification"	General Knowledge & Awareness				TOTAL
	Not good	Poorly	Fairly good	Good	
Diploma	-	1	25	43	69
Undergraduate	-	1	3	10	14
Post graduate/specialist	-	-	7	12	19
TOTAL	-	2	35	65	102
	Knowledge about Radiation Doses				
	Not good	Poorly	Fairly good	Good	
Diploma	-	3	34	32	69
Undergraduate	1	-	8	5	14
Post graduate/specialist	-	1	11	7	19
TOTAL	1	4	53	44	102
	Knowledge about Side Effects				
	Not good	Poorly	Fairly good	Good	
Diploma	3	1	28	37	69
Undergraduate	1	1	6	6	14
Post graduate/specialist	-	1	7	11	19
TOTAL	4	3	41	54	102
	Protection				
	Not good	Poorly	Fairly good	Good	
Diploma	-	3	20	46	69
Undergraduate	-	2	2	10	14
Post graduate/specialist	-	-	8	11	19
TOTAL	-	5	30	67	102

Table 4 Classifications of Participants' Categories by Best Describing

Which one describes you best	General Knowledge & Awareness				TOTAL
	Not good	Poorly	Fairly good	Good	
Technologist/Radiographer	-	2	27	42	71
Physicist	-	-	-	2	2
Radiologist	-	-	8	21	29
TOTAL	-	2	35	65	102
	Knowledge about Radiation Doses				
	Not good	Poorly	Fairly good	Good	
Technologist/Radiographer	1	3	35	32	71
Physicist	-	-	2	-	2
Radiologist	-	1	16	12	29
TOTAL	1	4	53	44	102
	Knowledge about Side Effects				
	Not good	Poorly	Fairly good	Good	
Technologist/Radiographer	4	1	30	36	71
Physicist	-	1	1	0	2
Radiologist	-	1	10	18	29
TOTAL	4	3	41	54	102
	Protection				
	Not good	Poorly	Fairly good	Good	
Technologist/Radiographer	-	4	21	46	71
Physicist	-	1	-	1	2
Radiologist	-	-	9	20	29
TOTAL	-	5	30	67	102

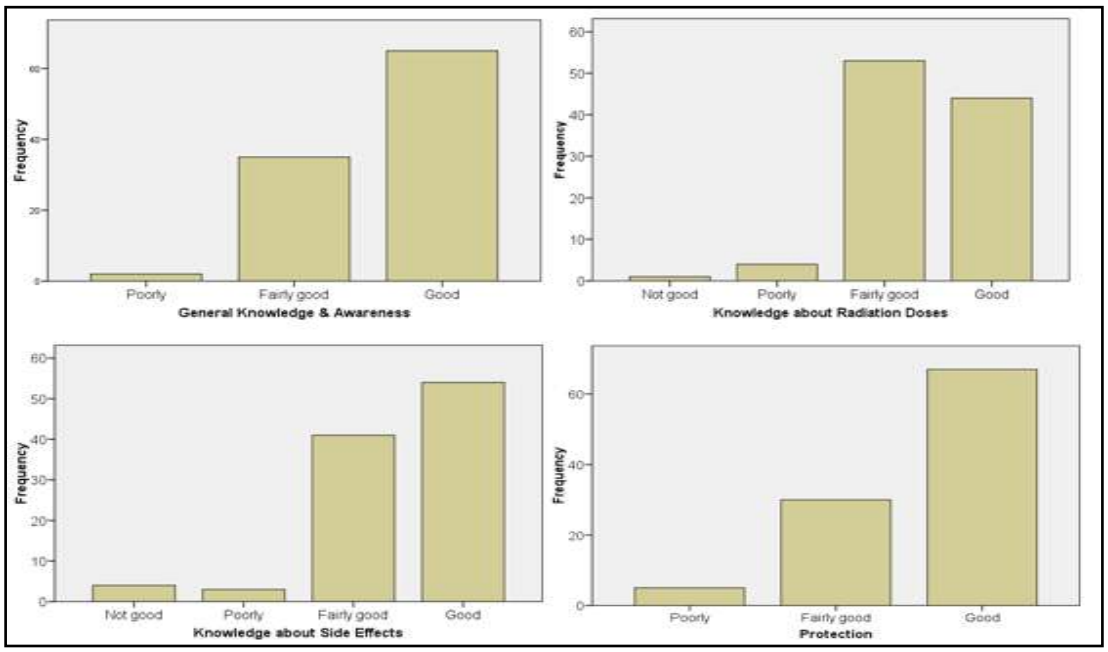

Figure (3) The numbers of participants categories

Analysis using PLS

This research used PLS to analyze data according to conceptual framework, and to do the estimates in the measurement model. The PLS methodology had also achieved an increasingly popular mission in practical research, which may represent an appreciation of distinctive methodological features of PLS.

- ***Inner Model (Structural Model)***

Inner models describes the relationship between latent variables based on substantive theory. Also will test the Hypothesis to measure if accepted or accept (Ho). The limit to accept the Hypothesis is clear with (α) =5% or 0.05. It is resulted t table value of 1.96. Therefore:

If t-statistic value is more than t-table value [> 1.96] then Ho is rejected while Ha accepted.

If t-statistic value is less than t-table value [< 1.96] then Ho is accepted while Ha rejected.

- ***Outer Model (Measurement Model)***

This model will used to know validity and reliability which bridge indicator and its latent variable. It need to be measured by Convergent and Discriminant [11].

Hypothesis Testing

Hypotheses testing is done by the bootstrap resampling method developed by Geisser and Stone [12]. When the results of testing hypothesis on models outer significantly, it indicates that the indicator is viewed can be used as a measuring instrument latent variables. Meanwhile, when the test results in inner models is significant, it means that there is a significant effect of latent variables to other latent variables. To test the hypothesis, we can see the value of t-statistics. Limits to reject and accept the hypothesis put forward is 1.96 (t table). Where if the value of t is in the range of tables and values-t table then the hypothesis will be rejected or, in other words accept the null hypothesis (H0) as demonstrated in path coefficient table 5.

Table III Path Coefficients

Hypothesis		Original Sample (O)	t- Statistics	Description
H1	**Awareness & Knowledge -> Knowledge about Radiation Doses**	0.499	5.876	Significant
H2	**Awareness & Knowledge -> Knowledge about Side Effects**	0.551	6.757	Significant
H3	**Awareness & Knowledge -> Protection**	0.300	3.069	Significant
H4	**Knowledge about Radiation Doses -> Protection**	0.317	3.369	Significant
H5	**Knowledge about Side Effects -> Protection**	0.278	2.971	Significant

According to the findings of some previous studies there was actually limited awareness and knowledge about radiation protection of health care professionals. However, we find from this survey show an accurate awareness and knowledge of the target groups. However, professionals' awareness is the particular

concern as that category plays a fundamental role in the radiation protection chain.In addition, through this study the results have successfully demonstrated that the impact of general awareness& knowledge on protection are significant compared to other variables as shown in table 5. Although there are different generations, degrees and main career, there however was a concern by the all professionals to protection and safety of radiation and continuously follow ALARA principle.Moreover, the study findings reveal that the positive influence between general awareness & knowledge on side effects can be interpreted that the wider knowledge about ionizing radiation will be followed by an increase in their protection. As long as the improving their knowledge, the protection will be in high applied to keep people as safe as possible and this leads to reduce an expected side effects. Furthermore, the results of this survey indicate the positive influence between general awareness & knowledge against to radiation doses can be interpreted that the better knowledge will be followed by minimizing in their received doses. Indeed, there are some additional notes that received from participants that there is some hospitals suffer from a lack of number of healthcare professionals who working with ionizing radiation especially the physicist who almost was about disappeared at all in targeted hospitals. At the same time in this survey the researcher noted that overtime of work hours which must not be exceeded according to international and local organizations, as a result that leads to get many negative effects. Additionally, it was appeared by some professionals that there are excessive number of requested images which unnecessary, and the question is who is responsible of that?

IV. CONCLUSION

Firstly, Based on the current results of a survey on the protection and safety issues of radiation related to the use of radiation for medical procedures which is designed to assess the awareness & knowledge of healthcare professionals who are surely radiation professionals and particularly in computer tomography (CT) units in radiology departments. The findings demonstrated that the level of awareness and knowledge of healthcare professionals who deal with ionizing radiation in CT scan units are adequate overall and that the approved radiation safety program efficient at both awareness and protection. There however the protection is in a linear relationship with general awareness & knowledge, knowledge about radiation doses and knowledge about side effects. Additionally, there is influence between the three factors on protection which means as good as the personnel are knowledgeable the protection goes perfectly. On the other hand, in versus there a number of previous studies and reports are in disagreement with present study [13], [14], [15], [16]. Moreover, the workers always follow the protocol that has been recommended in the hospital. Also professionals took into account that radiation protection as important as radiation exposure and quantities of unnecessary radiological imaging leads to exposed to potentially harmful ionizing radiation. Furthermore, the results of a survey on the protection and safety issues related to the use of radiation for medical procedures which is designed to assess the awareness & knowledge of healthcare professionals who are radiation professionals obviously revealed that even though there is a disparity of ages, degrees, experiences and specialties (career); they have a good awareness overall and they follow the own protocols unlike the previous studies. That because tutorials and workshops are their best choice for the participants to keep their level as high as they can. Finally, besides to the majority of participants who have a good awareness & knowledge, there are some of them do not have enough knowledge.

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