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RADIATION SAFETY CULTURE COMPLIANCE AMONG RADIOLOGY PRACTITIONERS IN KANO METROPOLIS USING INTERNATIONAL ATOMIC ENERGY AGENCY TRAITS AS CRITERION.

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ABSTRACT

Introduction: Radiation safety culture is pivotal in dose optimization and effective radiological practice in the clinical setting.

Aim: To assess radiation safety culture compliance among radiology practitioners in Kano metropolis

Materials and Method: A structured questionnaires were distributed among one hundred radiation workers from Aminu Kano Teaching Hospital, National Orthopedic Hospital Dala, Muhammad Abdullahi Wase Specialist Hospital, and Muhammed Buhari Specialist Hospital. A prospective cross-sectional study designed was used and Non-probability (purposive) technique was employed to conduct the study. Data were analyzed using statistical package for social sciences version 20. A descriptive statistic was used to compute percentages and frequencies.

Result and Discussion: Out 100 questionnaires 85 were returned, and out of the 85 respondents, ages in year ranges from 20-30 years ,43.5%(n=37), 30-40 years,29.4%(n=25), 40-50 years,20.0%(n=17), >50 years, 7.1%(n=6),those age ranges from 20-30 years constitute the largest proportion which is 43.5%.the respondents consist of 60%(n=51) males and 38.8%(n=33) females in which one respondent 1.2%(n=1)does not respond to the question. 22.4 %(n=19) of the respondent are Radiologist, 35.3 %(n=30) are Radiographers, and 41.2 %(n=36) were x-ray technicians, while the remaining 1.2 %(n=1) no response.

Conclusion: Radiology practitioners in Kano metropolis have good attitudes toward the radiation safety culture and shows strong adherence to the radiation safety culture traits. The study highlights weaknesses in terms of engagement of management, regular audit of radiation safety and appropriate management of staff's radiation doses.

Introduction

Radiation Safety Culture as defined by the health physics society is the core values and behaviors resulting from a collective commitment by leaders and individuals to emphasize safety over competing goals to ensure protection of people and the environment[1]. Radiation Safety Culture is the assembly of characteristics and attitudes in organizations and individuals that work with sources of ionizing radiation, which establishes that, as an overriding priority, protection and safety issues receive the attention warranted by their significance[1]. Radiation Safety Culture is the assembly of characteristics and attitudes in organizations and individuals that work with sources of ionizing radiation, which establishes that, as an overriding priority, protection and safety issues receive the attention warranted, it is important that the health care community become familiar with the terminology, common equipment, and standard practices used in radiation safety and monitoring [2].

Radiation safety culture in health care considers the radiation protection of patients, health workers, and the general public. It is embedded in the broader concept of patient safety and is included in the concept of good medical practice. Therefore, it uses the same approaches that are used to implement safety culture in health-care settings (no blame, no shame, willingness, teamwork, transparent communication, error reporting for learning[3].

Radiation safety culture in medical imaging enables health-care providers to deliver safer and more effective health care tailored to patients' needs. It is mainly addressed to ensuring the justification/appropriateness of the procedure and the optimization of the protection, keeping in mind that primary prevention of adverse events will always be a major objective[3].

The ultimate goal of radiation protection in health care is the safety of patients and others, by minimizing the risks associated with the use of radiation while maximizing benefits for patients' care. Health-care delivery contains a certain degree of inherent risk. As health-care systems and processes become more complex and fragmented the risk at each point of care and the number of points of care may increase. The success of treatment and the quality of care do not depend on the competence of individual health-care providers alone. A variety of other factors are important. These include organizational design, culture, and governance as well as the policies and procedures intended to minimize or mitigate the risks. [3]

Health-care institutions are increasingly aware of the importance of transforming their organizational culture to improve the protection of patients and health-care workers. European data consistently show that medical errors and health-care related adverse events occur in 8% to 12% of hospitalizations. Health-care facilities should be accountable for continually improving patient safety and service quality. Organizational culture is typically described as a set of shared beliefs among a group of individuals in an organization. Safety culture is a part of the organizational culture that can be defined as the product of individual and group values, attitudes, perceptions, competencies, and patterns of behavior that determine the commitment to, and the style and proficiency of an organization's safety management.[4]

A safety culture shall be fostered and maintained to encourage a questioning and learning attitude to protection and safety and to discourage complacency, which shall ensure that policies and procedures be established that identify protection and safety as being of the highest priority, problems affecting protection and safety be promptly identified and corrected in a manner commensurate with their importance, the responsibilities of each individual, including those at senior management levels, for protection and safety be clearly identified and each individual be suitably trained and qualified, clear lines of authority for decisions on protection and safety be defined and organizational arrangements and lines of communications be effected that result in an appropriate flow of information on protection and safety at and between the various levels in the Organization of the registrant or licensee [3].

To ensure the safety of patients, providers, and staff members, it is important that the health care community become familiar with the terminology, common equipment, and standard practices used in radiation safety and monitoring [2]. The protection of people against exposure to ionizing radiation or radioactive substances and the safety of radiation sources, including the means for achieving such protection and safety, such as the various procedures and devices for keeping people's doses and risks as low as reasonably achievable and below prescribed dose constraints, as well as the means for preventing accidents and for mitigating the consequences of accidents should they occur [5]. The principles of radiation protection and safety on

which the safety standards are based are those developed by the International Commission on Radiological Protection (ICRP). These principles are reflected in the requirements of the Basic safety standard. Occupational radiation protection is achieved by application of the three ICRP principles of justification, optimization and dose limitation [6].

Diagnostic imaging and interventional radiological techniques are increasingly used to diagnose a wide range of injuries and diseases, and to give life-saving treatment for many diseases. The use of radiation in medical practices has evolved since its beginning and 30% to 50% of medical decisions are based on radiological examinations, however, it is still limited by its relevant hazards to patients and healthcare providers [2]

It has been recognized since early studies on x-rays and radioactive minerals that exposure to high levels of radiation can cause clinical damage to the tissues of the human body[3]
Biological molecules are primarily made up of atoms of carbon, hydrogen, oxygen, and nitrogen. Electrons can be removed from these molecules when they are irradiated, producing ions, which is called ionizing radiation[4] . The energy released by radiation can also put the atoms in excited state, break molecules and, as a consequence, can form highly reactive ions and free radicals, which can attack very important molecules (like DNA) in the cell nucleus, causing damage [4].
From epidemiological data, the lowest dose of x-radiation for which there is good evidence of carcinogenicity is around 10–50mSv for an acute exposure and around 50–100mSv for a pro-tracted exposure. The typical exposure dose for one chest radiograph taken is 0.02mSv and that for an abdominal CT is 9mSv [5].

The average radiation dose received annually by the public is 2.5 mSv, and 15% of them are related to medical exposures. Among all radiological examinations, the doses of computed tomography (CT) are the highest[2] . The biological effects of ionizing radiation fall into two broad categories. Deterministic effects predictably occur above certain thresholds of absorbed dose to a specific tissue and include skin erythema, epilation, and possibly even direct cardiac toxicity. Stochastic effects are those in which radiation causes damage that may result in a malignancy, usually at a much later time.The risk and frequency of malignancies caused by the levels of radiation used in medical imaging remains undetermined and controversial[6].

The measurement of safety culture in health care is generally regarded as the first step toward improvement in healthcare delivery An understanding of radiation safety principles and their application in practice are critical for all radiation workers as that will enlighten them about the effect of ionizing radiation as well as increase their understanding of the importance of radiation protection. Hence, the research intends to embark on the study to assess the radiation safety culture among radiology practitioners that are involved in the use of ionizing radiation.

Materials and Methods

A prospective cross-sectional study to assess the radiation safety culture among radiology practitioner in Kano metropolis using international atomic energy agency traits as criterion. The study was conducted from April to October 2019. Using purposive sampling method in which one hundred structured questionnaires were distributed to the participants. The questionnaire consisted of eleven sections (A, B to K) with A consisting the demographic information of the participants, B on engagement of hospital management. C about appropriate training. D about regular audit of radiation protection. E about appropriate use of diagnostic imaging. F on appropriate management of radiation equipment and radioactive materials. G on appropriate appointment and use of accredited experts and officers. H on optimization of patient dose. I on management of staff dose. J on appropriate incident handling. K on effective communication. Consent forms were attached to every questionnaire in order to obtained informed consent from the participants. the data collected were analyzed using SPSS version 23.0. Chicago.

Results and Discussion

Demographic information of the participants

Out of the 100 administered questionnaire 85 were returned and filled, the result shows that 22.4 % (n=19) of the respondent are Radiologist, 35.3 % (n=30) are Radiographers, and 41.2 % (n=36) were X-ray technicians, while the remaining 1.2 %(n=1) gives no response. The result shows that 55.3 % (n=47) of the respondents takes the radiation safety training, and also shows that only 23.5% (n=20) of the respondents checks their personal dosimeter regularly. It Shows that 58.8 % (n=50) of the respondent shows that they have quality assurance and regular preventive measures in their workplace. 67.1% (n=57) of the respondents have assurance that the have suitable condition for

storage of radioactive materials in their workplace. 54.1 % (n=46) of the respondents answered that they have radiation protection or radiation safety officer in their department.it shows that 67.1 % (n=57) of the respondents knows the ALARA principle.it also shows that only 20.0 % (n=17) of the participants respond that the personal occupational dose report is regularly tracked in their workplace. And also 65.9 % (n=56) of the respondents agreed that the management always focus attention on incidents and problems solving in their workplace. 89.4 % (n=78) of the participants feel that they can clearly explain the radiation precautions needed to patient and his visitors. The result also shows that only 23.5 % (n=20) of the participants responded that the management regularly engage in developing radiation safety program, while 52.9 % (n=45) responded that the management occasionally engage, and 23.5 % (n=20) of the participants responded that the management never engage in developing any radiation safety program in their department.

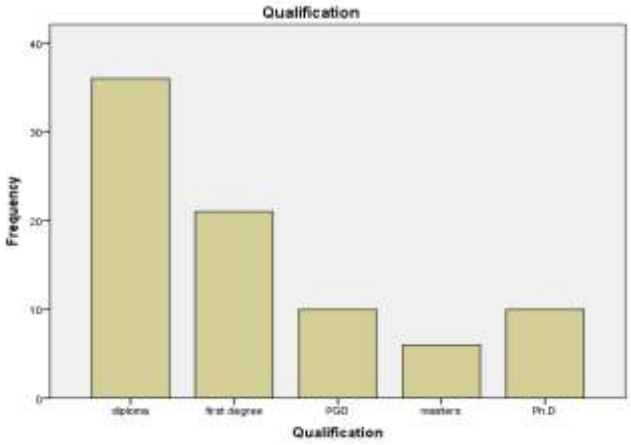

Fig:1 Participants Distribution based on qualification

Figure 2: Participants Distribution based on years of experience

Discussion

Radiation safety culture in health care considers radiation protection of patients, health workers and the general members of the public. Therefore, more consideration has to be given to the field of radiation protection and safety which will allow the radiation workers to prevent themselves, patients, and members of the public from deleterious effect of ionizing radiation. And this could be achieved by given more consideration to the principal aspects of radiation protection and proper adherence to the radiation safety traits. The finding of this study shows that 22.4 % (n=19) of the respondent are Radiologist, 35.3 % (n=30) are Radiographers, and 41.2 % (n=36) were x-ray technicians, therefore the current study was design to study the response of the practitioners base on ten trends of international atomic energy agency.

Regarding the questions on appropriate training the current study shows that 55.3 % (n=47) of the respondents takes the radiation safety training which is in line with the finding of Mohamed *et al.*,(2019)[7] which show that 74.7%(n=65) of the participants takes radiation safety training. [7] And also the current study shows that 52.3 %(n= 47) received training in their vocational or undergraduate course on individual and collective radiation protection therefore the finding of this study is in contrary to the finding of Batista *et al.*,(2017) in which only 37% of the respondent had the training in radiation protection.[4] And also the finding of this study shows that 22.9 %(n=19) of the participants read only 1article on radiation safety, and 32.9%(n=28) read 1-5 articles while 29.4%(n=25) read more than 5 articles on radiation safety which is in contrary to the finding of Abdellah *et al.,* (2015) in which 80% of them didn't use to read about radiation safety.[2] The implication of having appropriate training is that it will allow the radiation workers to work safely and to know the fundamental aspects of radiation safety culture. Regarding to the questions on regular audit of radiation safety 50.6 % (n=43) agreed that the institution is carefully monitoring their radiation exposure which is in contrary to finding of Abdellah *et al.,* (2015) in which only 15%(n=12) of the respondents agreed.[2] And also the finding of the current study shows that only 23.5% (n=20) of the respondents checks their personal dosimeter regularly while 50.6 % (n=43) checks their dosimeter occasionally. And also the finding of the current study shows that 37.6%(n=32) of the participants responded that the professionals used to receive the result of their dosimeter reading and

the clinical examination that has been done which is in line with the finding of Batista *et al.,* (2017) in which 39% of the participants responded that the professionals used to receive the result of the dosimeter reading and the clinical examinations.[4] And regarding to the questions on appropriate use of diagnostic imaging the current study shows that 58.8 %(n=50) of the respondent shows that the have quality assurance and regular preventive measures in their workplace, this finding is similar to the finding of Batista *et al*.,(2017) in which 80% of the respondent answer similarly.[4] And also the finding of the current study shows that 85.9 %(n=73) of the respondents knows that the computed tomography use higher dose of radiation which is contrary to the finding of Mawya *et al.,* (2012) in which only 25% of the respondent knows that CT uses ionizing radiation.[8] Appropriate use of diagnostic imaging is vital in any radiological unit because it will lead to production of good quality images and reduction of patient exposure. Also regarding the questions on appropriate management of radiation equipment and radioactive materials 67.1 % (n=57) of the respondents have assurance that the have suitable condition for storage of radioactive materials, and also 34.1 % (n=29) know how to handle radiation equipment and radioactive materials and 51.8% (n=44) partially know. The current study also reveals that 45.9 %(n=39) of the respondents answered that there are writing guidelines about disposal of waste generated by radiology services in their departments which is contrary to the finding of Batista *et al.,* (2017) were by 81% of the respondents state that they have writing guidelines about disposal waste generated by radiology services in their departments.[4] Therefore the appropriate system of management of radiation equipment and radioactive materials is very important because it will prevent the personals and environment from being contaminated by radioactive waste. Base on the response to the questions under appropriate appointment and use of accredited experts and officers 81 % (n=69) of the responded agreed that the management always employed well qualified staffs in their department, and 65.9 %(n=56) reveals that they have assurance that all the staffs in their working environment meat the required specification. And also based on the data collected the current study shows that 54.1%(n=46) answered that they have radiation protection or radiation safety officer in their department, which shows that the finding is in contrary to the finding of Batista *et al.,* (2017) in which only 14% of the respondent shows that they have radiation supervisor in their work environment.[4] The appropriate appointment and use of accredited expert is very important in radiology department because it will lead to good and accurate practice which will contribute to the development of good radiation safety culture. Regarding the questions on optimization of patient dose the current responses made by the participants shows that 67.1 %(n=57) know the ALARA principle, this finding is happen to be similar to the finding of Mohamed M. et al., (2019) in which 79%(n=69) of respondent knows the ALARA principle[7] and also this finding is in contrary to the finding of Tanzila *et al.,* (2019) in which only 13% of the respondent have knowledge regarding ALARA principle.[9] And also base on the response to the question which says that "is there any sign in a visible place requesting the women to in inform the doctor or technician about pregnancy or suspicion of pregnancy, 61.2%(n=52) of the participants respond to yes, therefore this finding is similar to the finding of Batista, et, al., (2017) were by 65% of the participants responded to yes.[4] And also the current study finds out that 89.4 %(n=76) of the participants knows the steps to take for patient needing radiation precaution, this is also similar to the finding of Abdellah *et al.,* (2015) in which 61.3 %(n=49) of the respondents agreed that they feel confident about the steps to take when caring for patient needing radiation precautions.[2] Therefor optimization of patient dose is vital in radiological procedures to minimize the high risk of damage due to radiation exposure, is one of the major approach of radiation safety. And also base on the responses made by the participants on management of staff's dose the finding of the current study shows that 49.4% (n=42) of the participants assured that all the staffs in their working environment were provided with dosimeter. And also the finding of the current study indicated that 49.4 %(n=42) of the respondents were always asked to use TLD and lead apron during procedure, this shows that this finding is in contrary to the finding of Mohamed *et al.,* (2019) were by 88.5% (n=77) of the respondents are using TLD during procedure and 87.4%(n=76) are using lead apron during procedure.[7] And also base on the data collected the current study shows that only 20.0%(n=17) of the participants respond that the personal occupational dose report is regularly tracked in their work place, this implies that the finding is in contrary to the finding of Mohamed *et al.,* (2019) in which 81.6%(n=71) responded that

the personal occupational dose reports is being tracking in their work place.[7] Also base on the data collected on appropriate incident handling, the current study indicate that 69.4% of the respondent agreed that they appreciate the way management handles any issue that arise within the department. And the current study shows that 65.9 % (n=56) of the respondents agreed that the management always focus attention on incidents and problems solving in the department. 58, 8 %(n=50) of the participants respond that there are protocol/flowchart regarding procedure to be adopted in the case of accident and emergency which is in contrary to the finding of Batista *et al.,* (2017) were by only 30% of the participant responded that they have in there working environment.[4] According to the data collected on effective communication the current study shows that 69.4 %(n=59) of the participants appreciate the way and manner the staffs and management communicate with each other, and also the current study implies that 77.7% (n=66) of the respondents agreed that they feel confident to communicate with all the staffs in their departments when there is any issue. And also the current study shows that 89.4 % (n=78) of the participants feel that they can clearly explain the radiation precautions needed to patient and his visitors, this finding is found to be in close relation to finding of Abdellah *et al.,* (2015) in which 50.0%(n=40) of the respondent feels that the can clearly explain the radiation needed to their patient and visitors[2] but the current finding is more significant. Effective communication between radiology practitioners is vital because good communication system will ensure good practice that will lead development of different ideologies which will finally result in development of high level of radiation safety culture. Regarding the questions on engagement of management the current study shows that 23.5 %(n=20) of the participants responded that the management regularly engage in developing radiation safety program, while 52.9 % (n=45) responded that the management occasionally engage, and 23.5 % (n=20) of the participants responded that the management never engage. And the current study also shows that 21.2 %(n=18) of the respondents reveals that it's only one time they received an articles or manuals on radiation safety, while 28.2 %(n=43) of the participants received more than one times, and 50.8 %(n=43) of the participants respond that the management never provide the articles or manuals on radiation safety to their work place, and Based on current study 32.9%(n=28) of the respondents shows that the management regularly motivate the staffs in carrying quality control and quality assurance measures, while 54.1%(n=46) shows that the management only motivate when there is problems, in which 12.9%(n=11) shows that the management never motivate the department and staffs in carrying quality control and quality assurance measures. This finding is contrary to the finding of Berris *et al.,* (2017) in which 77.3% of the respondents shows that the quality control checks is performed regularly in their working environment.[10] Appropriate engagement of management plays vital role to the radiological procedure, and is the major factor which lead to development of good radiation safety culture within the radiology department in a hospital.

Conclusion

The concluded that the radiology practitioners in Kano metropolis have good attitudes toward the radiation safety culture, and there was good adherence of radiology practitioners on radiation safety traits . Though the study reveals the weaknesses in three points, study highlights that there is poor engagement of the hospitals management, regular audit of radiation safety and appropriate management of staffs involvement in Radiation safety policies.

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