An Assessment Of The Knowledge Of Radiography Students About Quality Assurance And Quality Control Tests Of Diagnostic X-Ray Equipment

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ABSTRACT

Background: Quality assurance and quality control tests plays an important role and used to be assist imaging facility consistently and provide adequate diagnostic information with minimum of cost, least possible of radiation dose to the patients and operators. (¹)

Objective: To evaluate of the awareness about quality assurance and quality control tests of diagnostic x-ray equipment among radiography students.

Method and materials: This cross–sectional study was conducted at college of paramedical sciences, Teerthanker Mahaveer University, Moradabad (U.P.). The duration time of study was one (1) year. A validated questionnaire was distributed among radiography students. This questionnaire included thirty questions (MCQs and Short Answer Type Questions) and divided into two sections (A) related to demographic data (Academic qualification, Gender) of participants and (B) related to the knowledge about Q.A. And Q.C. tests of clinical x-equipment.

Results: This study was consisted 130 radiography students, we found that male students were 79(60.76%) and numbers of female students were 51(39.23%). On the basis of the results, it found that the knowledge level of BRIT third year’s students was very low (47.87%) and for MRIT final year’s students it also was average (56.19%) and finally the over-all knowledge level of all radiography students was (49.27%) low.

Conclusion: Finally, the over-all knowledge level of all radiography students was (49.27%)
low. Therefore, it should be needed to be organizing the classes, seminars, CME (continuous medical education) programs, Conferences about the quality assurance and control tests in the regular interval of times.

**Key words:** Quality Assurance (Q.A.), Quality Control (Q.C.), X-ray Equipment.

**INTRODUCTION**

Last few decades mostly in developing countries it has been noticed that the growth rate of diseases increased so demand of effective health care facility is very high. In the diagnostic Imaging department of any hospital or other diagnostic centers mainly for x-ray equipment, the quality assurance and quality control tests play an important role and used to be assist imaging facility consistently and provide adequate diagnostic information with minimum of cost, least possible of radiation dose to the patients and operators.\(^{(1)}\)

These tests are also providing the maximum adequate diagnostic information about service and quality of products.\(^{(15),(17)}\). The quality assurance and the quality control tests are both the parts of quality management system (QMS) which are used for improvement of the performance of any diagnostic equipment like x-ray equipment, fluoroscopy equipment, mammography, CT equipment, and MRI equipment etc.\(^{(8),(14)}\).

**Quality:** Quality may be expressed as the state of end product that fulfilled the requirements and expectations of the customers.\(^{(16),(18)}\) In radiology, the means of quality is the right exam to right patient at right time in the right way for right reason.\(^{(3),(11),(14)}\).

**Quality assurance (QA):** The World Health Organization (W.H.O.) describes quality assurance as a systematic effort by personnel working in a hospital to ensure that clinical photographs are of sufficient and high quality, allowing them to reliably provide consistent clinical investigative outcomes of patients while exposing them to the least amount of radiation possible.\(^{(2),(13)}\). The quality assurance is a program used for preventing errors and mistakes in final manufactured products for removing the problems when products and services are delivered.\(^{(4),(11)}\). The AERB (Atomic energy regulatory board India) has defined as, “Quality assurance (Q.A.) of clinical x-ray equipment means the systemic movements those are essential to providing appropriate self-confidence level for users that a clinical x-ray equipment will execute sufficiently compliant with the protection identified by the proficient consultant\(^{(3),(8),(12)}\).

**Quality control:** This is an integrated component of the quality assurance programme that is used to track and maintain the optimal performance of diagnostic x-ray equipment.\(^{(6),(9)}\). Quality control is a component of the quality assurance programme, and both are components of the quality management system (QMS). “Quality control tests used to intend verify the systems, structures and components of correspond to predetermined requirements”.\(^{(5),(7),(11)}\).

**Quality assurance/quality control tests:** According to Atomic Energy Regulatory Board of India, there are many Q.A. or Q.C. tests are mainly used to sale the x-ray’s equipment but some
routine tests should necessary to follow for check the performance of equipment similarly its starting point value and inside tolerance limit stated by the regulatory body.\textsuperscript{(10), (17), (12)} These examinations should be done at systematic intervals and whenever major maintenances of the equipment.\textsuperscript{(8), (10). These quality assurance tests should be done by a well-qualified service engineers at institutions.}\textsuperscript{(1), (4)}

1. Congruence of radiation and optical field test  
2. Central beam alignment  
3. Effective focal spot size measurement  
4. Timer accuracy  
5. Accuracy of tube potential (kVp)  
6. Linearity of radiation output test  
7. Timer loading test  
8. The output consistency test  
9. The total filtration test  
10. Radiation leakage from tube housing\textsuperscript{(3), (12)}.

**Quality assurance and quality control test Tools:** 1. Collimator test tool  
2. X-ray beam alignment test tool  
3. Focal spot tool  
4. Spinning test tool  
5. Kilo-voltage power or kVp meter  
6. Pocket dosimeter and charger  
7. Radiation survey meter\textsuperscript{(19), (20)}.

**MATERIALS AND METHODS**

**Study Type-** The questionnaire based cross-sectional study was carried out in college of department of radiological and imaging techniques, college of paramedical sciences at Teerthaker Mahaveer University, Delhi Road Moradabad, Uttar-Pradesh, India. In this study the questionnaire was based on the knowledge of radiography students about quality assurance and quality control tests of diagnostic x-ray equipment.

**Study design-** This study was cross-sectional and questionnaire based designed and carried out among radiography students of department of radiological and imaging techniques, college of paramedical sciences at Teerthaker Mahaveer University, Delhi Road Moradabad (Uttar-Pradesh). This study was approved by the college review committee.

**Study Area:** A questionnaire based cross-sectional study was carried out in college of department of radiological and imaging techniques, college of paramedical sciences at Teerthaker Mahaveer University, Delhi Road Moradabad (Uttar-Pradesh).

**Study duration:** This questionnaire based cross-sectional study carried out for the time period of one year from June 2020 to May 2021 at College of Paramedical Sciences (TMU)
Teerthanker Mahaveer University Moradabad Uttar Pradesh, India.

SAMPLING CRITERIA

A. Inclusion criteria
1. BRIT 2\textsuperscript{nd} year students
2. BRIT 3\textsuperscript{rd} year students
3. MRIT 1\textsuperscript{st} year students
4. MRIT final year students

B. Exclusion criteria
1. First year radiography students
2. All diplomas’ radiography students
3. Other Non- radiography students
4. Nursing students

STUDY POPULATION- This cross-sectional study was consisted 155 students who were all selected from the Department of radiological and imaging techniques, Teerthanker Mahaveer University, college of paramedical sciences Delhi road, Moradabad as per the exclusion and inclusion criteria. Some incorrect responses were excluded from this study; finally, 130 correct responses were selected for this study. The verbal consent was taken from the all participants who were taking a part of this study.

METHOD OF DATA COLLECTION- The questionnaire was structured by using goggle form & was distributed in different groups of social media applications like what’s app via internet. The questions were comprised after going through various literature related to that, which consisted of self-structured questionnaire divided into two sections. The first section of questionnaire consisted of demographic data including academic qualification (semester/year). The second portion of the questionnaire included 30 specific questions aimed at determining if the participants had sufficient theoretical and practical knowledge of quality assurance and quality management tests of diagnostic x-ray equipment based on their course analysis. The all-data collection was done by the online with the help of “Google form” and the link of questionnaire was shared in the classroom as per inclusion criteria, by which all the responses were obtained in Ms-excel.

RESULTS
In this cross-sectional study, the sample size was 155 but finally received correct responses 130 were received and some incorrect and repeated responses were excluded due to stastical and technical error. This study included students of BRIT second year and BRIT third year and also the students of MRIT first year students and MRIT final year students. (See Pie chart 1)
Pie chart 1: Distribution of the number of participant’s data used in this study

The questionnaire is filled by total 130 students of radiography out of which 51(39%) were female and 79(61%) were male students. *(See Pie chart 2)*

Pie chart 2: Pie chart represents the total no of male and female participants
At the end of this study after analysis of following results were observed for the question first question out all 130 students and 93(71.53%) students were writing the correct answer and 37(28.46%) were not write the correct answer. This question was about the full form of the QMS (quality management system). The second question was about the full form of QA (quality assurance) out of 130 students 121(93.07%) students were write the correct answer while rest 9(6.92%) were not write a correct answer. For the question number third 119(91.53%) students were write the correct answer while rest 11(8.46%) students were not gave the correct answer this question was about the full form of quality control (QC). The fourth question was about the full form of QCT (quality control techniques). Only 7(5.38%) students were written the correct answer and rest 123 (94.61%) students were not written the correct answer. For the fifth question out of 130 students 119 (91.53%) students were says YES while rest 11 (8.46%) were says NO. this question was about quality, “is the state of end product that fulfilled the requirements and expectations of the customers (patients). The sixth question was about the quality control,” is an integrated part of the quality assurance programme”.122(93.84%) were says YES while rest 8(6.15%) students were says NO. For the question number seven 123(94.61%) students says YES and rest 7(5.38%) students were saying NO. this question was related to the both parts of the Q.M.S. such as Q.A. and Q.C. The question number eight was about quality assurance and quality control tests both are helpful for achieving high quality of diagnostic x-ray images. 118(90.76%) students were saying YES while rest 12(9.23%) students were says NO. For the question number nine 82(63.07%) students were says YES while rest 48(36.92%) students were says NO. this question was related to the quality control testing. The question number ten was about both quality assurance and quality control tests both are necessary for diagnostic x-ray equipment. 75 (57.69%) students were agreed, 51(39.23%) were strongly agree,3(2.30%) students were disagreed and only 1(0.76%) student was strongly disagree. For the question eleven Q.A. and Q.C. tests are helpful for removing the error of the diagnostic x-ray equipment.73(56.15%) were agreed, strongly agree 44(33.84%) and 9(6.92%) were disagree. The question number twelve was related to the diagnostic x-ray equipment checked periodically for optimal quality radiographic image. 75(57.69%) were agree, 46(35.38%) students were strongly agreed and 9(6.92%) were disagree. For the question number thirteen was about significant role of Q.A. and Q.C. tests for care and maintenance of the diagnostic x-ray equipment. 74(56.92%) students were agreed, 46(35.38%) were strongly agree, 3(2.30%) students were disagreed and only 2(1.53%) were strongly disagree. The question number fourteen was who is mainly performing the Q.A. and Q.C. tests of diagnostic x-ray equipment. 19(14.61%) students gave the correct answer medical physicist while rest 111(85.38%) students not gave the correct answer. For the question number fifteen was related to the test tool used for the beam alignment test. 93(71.53%) students gave correct answer while rest 37(28.46%) were gave the wrong answer. The question sixteenth was about to performing frequency of the beam alignment test of diagnostic x-ray equipment. 39(30%) students gave the correct answer while 91(70%) gave the wrong answer. The question number seventeen was about the tolerance limit of the central beam alignment test of diagnostic x-ray equipment. 26(20%) students gave the right answer while rest 104(80%) gave wrong answer. For the question number eighteen 40(31%) students gave the right answer while rest 90(60%) gave the wrong answer. For the question number eighteen 40(30.76%) students gave the right answer while rest 90(69.23%) gave wrong answer. this question is related to test tool used in collimation test. The question number nineteen was about test tool used for focal spot test 84(64.61%) students gave the right answer while rest 46(35.38%) were gave another answer. For the question number twenty was about performing frequency of focal spot test 20(15.38%) students gave the right and rest 110(84.61%) students gave the wrong answer. The question number twenty-one was related to the type of test tool used to check the accuracy of tube potential or kVp. 105(80.76) students gave the right answer and rest 25(19.23%) gave the wrong answer. For the question
number twenty-two was about the performing frequency of accelerating potential kVp. 38(29.23%) students gave the right answer and rest 92(70.76%) gave the wrong answer. The question twenty-three was about the test tool used for timing checking test of diagnostic x-ray equipment. 48(36.92%) students gave the correct answer while rest 82(63.07%) students gave not a correct answer. For the question number twenty-four 53(40.76%) students gave the correct answer while rest 77(59.23%) gave not a correct answer. The question number twenty-five was about the test tool used for linearity of radiation output test. 50(38.46%) gave the correct answer while rest 80(61.53%) students gave not valid answer. The question number twenty-six was about the tolerance limit of the linearity of radiation output test of the diagnostic x-ray equipment. 23(23.07%) students gave the right answer while rest 100(77%) gave not a correct answer. For the question number twenty-seven 46(35.38%) students gave the correct answer while rest 84(64.61%) gave not right answer. This question was about the tolerance limit of the linearity of radiation output test. The question number twenty-eight was related to quality assurance test tool used for radiation leakage test. 54(41.53%) students gave the right answer while rest 76(58.46%) gave not right answer. The question number twenty-nine was related to full form AMC (Annual maintenance cost). For this question 5(3.84%) students were writing the correct full form. while rest 125(96.15%) students were write correct form OF AMC. The question number thirty was related to the full form CMC (cumulative maintenance cost). For this question 13(10%) students were writing the correct answer while rest 117(90%) students gave not a right answer. In the last part of the questionnaire for specify the student’s opinion regarding the Q.A. and the diagnostic x-ray equipment's Q.C. tests. The majority of the students wrote in their own words that quality assurance and quality control tests for diagnostic x-ray equipment are required to maintain the diagnostic x-ray equipment's care and maintenance. (See Table No.1 and Table No. 2)

DISCUSSION

Several previous studies of Q.A. and Q.C. tests suggest that most of these are based on the quality assurance and quality control tests conducted on the diagnostic x-ray equipment, as well as some other studies included the radiographers. But this current study is aimed at evaluating student’s knowledge about Q.A. and Q.C. tests of diagnostic x-ray equipment. As far as seen, this is perhaps the first attempt that such research work has involved the students of radiography.

In earlier studies, they were used the semi-structured questionnaire and interview of employees primarily 28 radiographers and technicians and five 5 head of department were taken from 23 hospital's imaging department. The participants were selected based on their long experience approximately was minimum 10 years. They noticed that lack of quality assurance systems in all selected hospitals there were no procedural protocols, exposure chart, manuals and any organizational systems for imaging department in the hospitals. (EK Ofori1 PhD, M Phil, et al. 2011). This current study included only undergraduate and postgraduate students of radiography.

In another study they include eleven (11) radiographers and five (5) managers from (4) four public hospitals in Nelson Mandela Bay Health District. They were used individual semi structured interviews (approximately30-40minutes). (M.M. Willemsen1* et al.11july, 2019).

In this current study conducted with the help of goggle form questionnaire.

CONCLUSION

In the present study of 130 radiography students, we found that male students were 79(60.76%) and numbers of female students were 51(39.23%). The mean percentages of knowledge level of BRIT second year’s
students were 51.50%, for BRIT third year’s students was 47.87%, for MRIT first year’s students was 49.09%, for MRIT final year’s students it was 56.19% and the knowledge level of over-all student’s mean of percentages 49.27%. On the basis of the results, it found that the knowledge level of BRIT third year’s students very low (47.87%) and for MRIT final year’s students it also was average (56.19%) and finally the over-all knowledge level of all radiography students was (49.27%) low. Therefore, it should be needed to be organizing the classes, seminars, CME (continuous medical education) programs, Conferences about the quality assurance and quality control tests in the regular interval of times.

**LIMITATION OF THE STUDY**

In this present study included only the bachelor’s students of radiological and imaging techniques second and third year and master’s students of radiological imaging techniques first year and final year. The radiological and imaging techniques first year students and other diplomas students of radiography were not taking a part of this study. The sample size was small because this study included one college’s students from undergraduate and postgraduate degree program. Therefore, it should be needed further study on large sample size for the more accurate and better results.

**Ethical clearance:** Taken from PRC committee.

**Source of funding:** Self.

**Conflict of interest:** Nil

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Table 1 shows the percentages of correct responses observed from different categories from which data collected (For the question number 1 to 9 and 14 to 30)

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<th>BRIT THIRD YEAR %49</th>
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http://www.webology.org
Table 2 shows the percentages of incorrect responses observed from different categories from which data collected (For the question number 1 to 9 and 14 to 30)

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Table 2: Percentages of Incorrect Responses
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