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# Evaluation of Assurance of Quality Control Using X Ray And Ct Among Technicians and Technologist

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**Abstract**

**Objective:** The goals of this study are how well quality control (QC) and quality assurance (QA) are used in X-ray and CT imaging, and how engineers and engineers contribute to ensuring patient image quality and safety.

**Material & Method:** This was a cross-sectional study in which data were collected from radiology technologists and technicians. The aim of the study was to evaluate the assurance of quality control in X-ray and CT imaging among these professionals. The study was conducted over a period of six months, from February to July 2025. It was carried out in Kalsoom International Hospital, Noori Hospital, and Capital Diagnostic Center. A convenient sampling technique was used to select participants for the study. All radiology technologists and technicians working in the selected settings were included, while patients, nurses, doctors, and radiologists were excluded from the study.

**Results**: A total of 80 radiology employees (technicians and technicians) participated in filling out the survey. Most participants were younger between 20 and 30 (78.8%) and had less than 2 years of occupational experience (38.8%). Equal numbers worked primarily on X-ray or CT machines (46.3%). Many people say quality control procedures are available, but they always followed them on a regular basis. Only 42.5% said they checked their X-ray devices every week, while only 32.5% performed weekly checks on their CT machines. Information about 86.3% of facilities had an Xray QA program, sometimes 68.8% still notice. For CT, 61.3% recognized that optimizing radiation dose was an important part of quality control, but only a few regular reviews were performed. Most participants (88.8%) agreed that quality control training was important, while more than half (57.5%) said they did not have enough time to carry out appropriate quality tests. Many were solely involved in quality control.

**Conclusion:** This study shows that there is a clear gap in training, routine procedures, and support from the institution. To improve image quality and patient safety, especially in low resource environments

## Introduction

High-quality images known as diagnostic quality allow for accurate analysis. Image quality is determined by spatial resolution, contrast resolution, noise, detective quantum efficiency (DQE) and artifacts. Digital radiography QA and QC require an understanding of each step in the imaging process. The process card, which is described every 16 steps from the patient's arrival until images are cleared in PACS, helps identify and correct potential errors such as: Refusal to analyze continues to support quality improvements by identifying frequent mistakes and options for better practice. (Seeram, 2019). Quality Control (QC), Quality Assurance (QA), and Continuous Quality Improvement (CQI). QC determines the baseline of acceptable services. QA focuses on minimizing random errors before control measurements are implemented, and CQI is a proactive and continuous process aimed at optimizing results and reducing variability.

Krukal et al., (2016). QC includes many test, inspection and monitoring systems, and Sedatest ensures that the imaging device works best and that image quality is compatible with diagnostic standards. Normal QC also helps reduce patient exposure to light by recognizing errors and suboptimal performance before affecting patient outcomes. (Gregory et al., 2016). The development of digital radiography systems has shifted the responsibility of many QCs to software-based surveillance, but human supervision remains important. (Periard et at., 2010) As explained by Periard et al., (2010), pre-determined criteria such as anatomical orientation points and density swelling evaluated the technician, particularly in situations where radiologist input was not available. In CT imaging, the complexity of the technology and the high doses of ionizing radiation make the need for strict QC even clearer.

Regular reviews of CT count, noise level, layer thickness, radiation output and low resolution accuracy are essential. (Jung 2021) Jung (2021) emphasized the importance of daily and annual QC test protocols, including the use of water phantoms, alignment optical testing, and CT numerical equality testing as part of a standardized quality program. These practices not only help maintain image integrity, but also help ensure compliance with regulatory and accreditation standards. Pulitzer et al., (2024) conducted a multi-center, radiologist reader study to validate automated quality measures for CT scans, correlating radiation dose and image noise with diagnostic acceptability. They analyzed 200 CT exams and found that increased dose significantly improved radiologists' subjective image quality ratings, while higher noise reduced them. Importantly, the study confirmed that combining dose and noise metrics can effectively guide quality-control programs without compromising diagnostic quality. Nagy et al., (2008) found that a decrease in personal interactions between radiologists and technicians often places a greater emphasis on technician initiatives and training to reduce feedback on image quality and maintain QC standards. The assessment of the current status of QC implementations in X-ray and CT, as well as the role and performance of radiological staff, is important in improving diagnostic services, reducing risks, and promoting continuous improvement in clinical practice.

## Problem Statement

To evaluate the assurance of quality control using X ray and CT among technicians and technologists

## Study Objectives

To assess the implementation of Total Quality Management (TQM) practices in X-ray and CT imaging in selected hospitals of Islamabad.

To assess the responsibilities of technicians and technologist in maintaining imaging standards, minimizing errors, and ensuring patient safety in medical imaging

## Material and Method

This was a cross-sectional study in which data were collected from radiology technologists and technicians. The aim of the study was to evaluate the assurance of quality control in X-ray and CT imaging among these professionals. The study was conducted over a period of six months, from February to July 2025. It was carried out in Kalsoom International Hospital, Noori Hospital, and Capital Diagnostic Center. A convenient sampling technique was used to select participants for the study. All radiology technologists and technicians working in the selected settings were included, while patients, nurses, doctors, and radiologists were excluded from the study. A total sample size of 80 technologists and technicians was included in the study.Data were collected using a structured questionnaire consisting of five sections.The first section included demographic information such as gender, age, experience, and imaging modality. The second section focused on general quality control assurance in radiology and included three questions. The third section assessed quality control practices in X-ray imaging with four questions, while the fourth section addressed quality control in CT imaging with three questions. The fifth section evaluated the role of technologists and technicians in quality control and included five questions.The collected data were analyzed using SPSS software version 25.

## Results

In Table 1, The cross sectional study initially included a total of 80 participants and collected data by using self-administered questionnaire. The responses rate of participants was 100 percent. The study include total of 80 technicians and technologist. Among of them 51 participants were male with percentage of (63.7%) out of total sample size, and 29 participants were female with (36.3%). The distribution suggested that male technicians were higher than female technicians of total sample size.

**Table 1: Descriptive statistic of Gender**

| VARIABLES | FREQUENCY | PERCENTAGE |
|---|---|---|
| Male | 51 | 63.7% |
| Female | 29 | 36.3% |
| Total | 80 | 100% |

In Table 2, The technicians and technologist of youngest age group, 20-30 years, with percentage of (78.8 %). The technicians and technologist of old age group, 40-50 years with percentage of (21.3%) of total 80 participants. The number of technicians and technologist increased in young age. This distribution suggests a predominantly young-aged study population of technician and technologist, with a peak in the 20-30 years age groups with (78.8 %).

**Table 2: Descriptive statistic of Age**

| VARIABLES | FREQUENCY | PERCENTAGE |
|---|---|---|
| 20-30 | 63 | 78.8% |
| 40-50 | 17 | 21.3% |
| Total | 80 | 100% |

In Table 3, In this cross-sectional study of 80 participant the experience of technicians and technologist in radiology, the participant with the less than 2 years' experience were 31 technicians and technologist with percentage 38.8% and the participant with 2-3years experience were 27 technologist and technicians with total percentage of (33.8%) and at last the participant with 6-0 year experience were 22 technicians and technologist with percentage of (27.5%).

**Table 3: Descriptive statistics of Experience**

| VARIABLES | FREQUENCY | PERCENTAGE |
|---|---|---|
| Less than 2 years | 31 | 38.8% |
| 2-5 years | 27 | 33.8% |
| 6-10 years | 22 | 27.5% |
| Total | 80 | 100% |

In Table 4, 37 technicians and technologist mostly used X-ray modality with percentage of (46.3%) and 37 technicians and technologist mostly used CT-scan modality with percentage of (46.3%) and the technicians and technologist used to other modality are 6 technicians and technologist with percentage of (7.0%).

**Table 4: Descriptive statistic of Modality**

| VARIABLES | FREQUENCY | PERCENTAGE |
|---|---|---|
| X Ray | 37 | 46.3% |
| CT | 37 | 46.3% |
| Specify if other | 6 | 7.5% |
| Total | 80 | 100% |

In Table 5, Most common response regarding the frequency of quality control (QC) checks had been weekly, reported by (42.5%) of participants. This indicated that nearly half of the respondents had performed QC checks on a weekly basis. However, (26.3%) had reported conducting checks monthly, and only (16.3%) had indicated performing them daily, reflecting a generally poor level of QC implementation, especially in settings where daily checks are critical for ensuring consistent imaging quality. The image receptor quality check had been selected by (46.3%) of participants, suggesting a reasonable level of attention to ensuring detector or film quality as a routine component of QC practices. A strong majority (86.3%) had confirmed the existence of a quality control program for chest X-rays, demonstrating a good level of departmental awareness regarding the significance of quality assurance in radiographic imaging. Nevertheless, despite the acknowledged presence of QC programs, (68.8%) of respondents had admitted that QC tests were performed only occasionally. This revealed a substantial gap between theoretical awareness and consistent practical implementation of QC measures.

**Table 5: Description of Quality Control in X-rays**

| VARIABLES | MOST CHOOSEN OPTION | FREQUENCY | PERCENTAGE |
|---|---|---|---|
| X ray equipment inspected for QC | Weekly | 34 | 42.5% |
| QC test performed in X ray imaging | Image receptor quality check | 37 | 46.3% |
| Quality assurance program for X ray imaging | Yes | 69 | 86.3% |
| Lack of quality control in X ray | Sometimes | 55 | 68.8% |

In Table 6, The most common response for the frequency of CT equipment checks had been weekly, as reported by (32.5%) of participants. This indicated that a portion of departments had adhered to a scheduled weekly quality control (QC) plan, although this practice had not been standardized across all facilities. A monthly frequency had been reported by (30.0%), while daily checks had been performed by only (22.5%) of respondents. Radiation dose optimization had been identified as the most frequently implemented quality control measure, selected by (61.3%) of participants. This reflected a strong emphasis on minimizing patient radiation exposure as a key element of quality assurance in CT imaging. Despite general awareness of the importance of QC, (60.0%) of respondents had stated that QC activities were performed only sometimes, indicating inconsistency in implementation. This suggested disconnect between established protocols and their routine application in clinical practice.

**Table 6: Description of Quality Control in CT**

| VARIABLES | MOST CHOOSEN OPTION | FREQUENCY | PERCENTAGE |
|---|---|---|---|
| CT equipment monitor for QC | Weekly | 26 | 35.2% |
| Quality control measure in CT imaging | Radiation Dose Optimization | 49 | 61.3% |
| Lack of quality control in CT | Sometimes | 48 | 60.0% |

In Table 7, The most common response for how often QC tests are conducted was Monthly, reported by (57.5%) of participants. This shows that more than half of the departments follow a regular monthly quality control schedule. Whereas the weekly response were (23.8%) and the daily response were (8.8%). A large majority, (90%), confirmed the presence of a formal QC program in their department, indicating strong awareness and structure for maintaining imaging quality. Understanding of QC protocols and standards, (42.5%) were very familiar, suggesting that while many are confident in their knowledge, there is still room to improve familiarity among the rest of the staff.

**Table 7: Description of quality control assurance in Radiology**

| SECTION | MOST CHOSEN OPTION | FREQUENCY | PERCENTAGE |
|---|---|---|---|
| QC test conducted in Department | Monthly | 46 | 57.5% |
| Formal QC program in Department | Yes | 72 | 90% |
| QC protocol and standards | Very familiar | 34 | 42.5% |

In Table 8, Most participants (88.8%) suggest that technicians and technologists receive training in quality control, showing that staff education is generally prioritized. The most common challenge in maintaining QC was "insufficient time for quality checks," reported by (57.5%), which suggests that workload or time pressure may affect the consistency of their role in departmental QC, (53.8%) they are "partially involved," indicating that while many contribute, they may not be fully engaged in all QC activities. In terms of reporting or documenting QC tests, (48.8%) they do it "sometimes," showing that documentation is done occasionally but not consistently by everyone. Finally, (42.5%) of respondents were not aware of national standards for QC, highlighting a need for better communication or training on standardized quality protocols.

**Table 8: Description of role of technician and technologist in quality control**

| SECTION | MOST CHOSEN OPTION | FREQUENCY | PERCENTAGE |
|---|---|---|---|
| Technician and technologist receive training to QC | Yes | 71 | 88.8% |
| Challenges faced in ensuring QC | Insufficient time for quality check | 46 | 57.5% |
| Actively involved in department QC procedure | Partially involved | 43 | 53.8% |
| Participate in documenting or reporting QC test | Sometimes | 39 | 48.8% |

| | | | |
|---|---|---|---|
| Aware of National standards used in QC | No | 34 | 42.5% |

**Discussion**

This cross-sectional study assessed the implementation of quality control (QC) measures in X-ray and CT imaging, along with the involvement of technologists and technicians in QC practices. The findings reflect a mixed level of compliance and awareness regarding QC protocols. The study included 51 male and 29 female technicians. The majority of participants (63%) were between the ages of 20 and 30. Most participants had less than two years of work experience (31%). The most commonly selected modality by participants was X-ray and CT, accounting for 37%. The majority of participants (42.5%) reported that X-ray equipment was inspected on a weekly basis, while only 16.3% performed daily checks indicating a suboptimal adherence to regular QC routines. Similarly, in CT imaging, 32.5% reported conducting equipment checks weekly, 30% monthly, and only 22.5% daily, demonstrating inconsistency across facilities. These patterns suggest that while some departments have adopted scheduled QC plans, daily QC, which is crucial for maintaining optimal image quality and radiation safety, is not yet standard practice. Radiation dose optimization, selected by 61.3% as the most critical QC measure in CT, indicates an appropriate focus on patient safety.

In X-ray imaging, image receptor quality check was the most frequently reported test (46.3%), reflecting a foundational understanding of maintaining detector and film quality. However, gaps remain in practice: 68.8% of respondents admitted that QC tests were performed only "sometimes" in X-ray, and 60.0% said the same for CT. This reveals a significant gap between awareness and consistent execution of QC protocols. While 86.3% reported the presence of a QA program for X-ray and 90% confirmed a formal QC program at their department level, only 42.5% considered themselves very familiar with QC protocols. This suggests that the existence of protocols alone is insufficient without thorough training and engagement. In terms of technologist and technician roles, 88.8% acknowledged receiving QC training, but more than half reported challenges in implementation primarily insufficient time (57.5%). Furthermore, only 48.8% reported documenting QC tests "sometimes," and 42.5% were unaware of national or international QC standards. This implies a need for structured orientation programs, improved workflow management, and stronger policy enforcement.

Research by Kruskal et al. (2016) aims to introduce a culture of continuous quality improvement (CQI) into the academic radiology department using formal overall quality control (TQM) using QA, QC, and staff training. Korir et al. (2013) evaluated QC practices at an X-ray centre in Kenya and found excellent performance in basic radiography, but lack of standardization caused poor compliance with special imaging. Pulitzer et al. (2024) research was generalized recommendations and describes traditional QC practices without offering quantitative data, real-world effectiveness measures, or insights into automated quality systems. It also predates recent advancements in dose monitoring, digital QA tools, and technologist training interventions.In this study conducted in Islamabad, QA/QC evaluates X-ray and CT modalities and focuses on the importance of engineers and engineers. In contrast to previous studies, this study shows the training and logging gaps for original regional data and marker technology. Support from (Kruskal et al 2016) leaders and institutions was highlighted, and (Koriel et al., 2013) highlighted the inconsistency of regulations, but the current study highlights the human element in maintaining QC standards.

This study highlights significant gaps between awareness and practical implementation of quality control (QC) in radiology, particularly in X-ray and CT

imaging. Despite most departments having formal QC programs but daily QC practices remain inconsistent, with many reporting QC checks performed only "sometimes." Insufficient time and lack of awareness of national standards were key barriers. These findings emphasize the need for stronger enforcement of QC protocols, improved training, and better time management to ensure consistent imaging quality and patient safety. Enhancing technologist involvement and standardizing QC practices are essential steps toward improving radiology services in Pakistan's healthcare system.

## Conclusion

This study found that while 88.8% of technicians and technologists received QC training, only 42.5% were very familiar with QC protocols, and 48.8% documented QC tests only "sometimes," showing limited practical engagement. Radiation dose optimization was prioritized by 61.3% in CT, but daily checks were done by only 22.5%, indicating inconsistent implementation. In X-ray, 68.8% admitted QC tests were only performed occasionally. Despite 90% reporting the presence of QC programs, key barriers like insufficient time (57.5%) and limited staff involvement (53.8%) hinder effective QC compliance.

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