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Evaluation of the quality of chest x-ray imaging in Benghazi Hospitals

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الملخص:

هدف الدراسة: تهدف هذه الدراسة إلى تقييم الجودة الشاملة لتصوير الصدر بالأشعة السينية في مستشفيات بنغازي. وتركز على تقييم معايير الجودة التقنية والإجرائية والتشخيصية للصور لتحديد مستوى الالتزام بالمعايير السريرية والإشعاعية الدولية .

المنهجية: أُجريت دراسة وصفية مقطعية باستخدام استبيان مُهيكل وُزِّع على 120 من العاملين في مجال الرعاية الصحية .شملت العينة أخصائيي الأشعة، وأطباء الأشعة، والاستشاريين، وأطباء أمراض الرئة من المستشفيات الحكومية (67.5%) والخاصة (32.5%) في بنغازي .تم تحليل البيانات المتعلقة بأنظمة التصوير (الرقمية والتقليدية والمحوسبة)، والممارسات التقنية، والتحديات الإجرائية الشائعة باستخدام برنامج SPSS الإحصائي للعلوم الاجتماعية.

النتائج: كشفت النتائج أن تقنية التصوير الأمامي الخلفي هي الأكثر استخدامًا .(53.3%) وتم تحديد تحديات كبيرة، بما في ذلك صعوبات في وضع المريض (34.2%) ومشاكل متعلقة بالأجهزة (56.7%) تؤثر بشكل مباشر على جودة الصورة .وكانت أكثر المشكلات التقنية شيوعًا هي التشوهات (37.5%) ونقص التعريض .(32.5%) وبينما كان الوعي بمعايير جرعة الإشعاع إيجابيًا بشكل عام (أجاب 37.5% بـ "نعم")، فقد تباين استخدام مخططات التقنية الموحدة بشكل كبير، مما أظهر ارتباطًا إحصائيًا بعمر وخبرة فني الأشعة ($p = 0.001$).

الخلاصة: خلصت الدراسة إلى أنه على الرغم من الفهم العام لبروتوكولات التصوير الأساسية، إلا أن جودة الصورة في مستشفيات بنغازي غالبًا ما تتأثر سلبًا بمحدودية الأجهزة والتشوهات الإجرائية .هناك حاجة واضحة لمعايرة المعدات بشكل منتظم، وتنفيذ برامج ضمان الجودة المنظمة، والتدريب المهني الموجه لتقليل الفحوصات المتكررة وتعزيز دقة التشخيص.

الكلمات المفتاحية: الأشعة السينية للصدر ، جودة الصورة، تقنية التصوير الشعاعي، ضمان الجودة .

Abstract: Chest radiography (CXR) remains the most fundamental and frequently performed diagnostic imaging procedure in clinical practice. However, its diagnostic efficacy is highly dependent on technical and procedural factors, ranging from patient positioning to exposure optimization. In developing regions, inconsistencies in these variables can lead to poor image quality, potentially compromising diagnostic accuracy and increasing patient radiation dose through unnecessary repeat exposures.

Aim of the Study: This study aims to evaluate the overall quality of chest X-ray imaging in Benghazi hospitals. It focuses on assessing technical, procedural, and diagnostic image quality parameters to determine the level of adherence to international clinical and radiological standards.

Methodology: A descriptive cross-sectional study was conducted using a structured questionnaire distributed to 120 healthcare professionals. The sample included radiographers, radiologists, consultants, and pulmonologists from both public (67.5%) and private (32.5%) hospitals in Benghazi. Data regarding imaging systems (digital, conventional, and computed), technical practices, and common procedural challenges were analyzed using the Statistical Package for the Social Sciences (SPSS).

Results: The findings revealed that the Posteroanterior (PA) projection is the most utilized technique (53.3%). Significant challenges were identified, including difficulties with patient positioning (34.2%) and equipment-related problems (56.7%) that directly affect image quality. The most common technical issues reported were artifacts (37.5%) and underexposure (32.5%). While awareness of radiation dose criteria was generally positive (37.5% reported "Yes"), the use of standardized technique charts varied significantly, showing a statistical association with the age and experience of the radiographer ($p = 0.001$).

Conclusion: The study concludes that while fundamental imaging protocols are generally understood, image quality in Benghazi hospitals is frequently compromised by equipment limitations and procedural artifacts. There is a clear need for regular equipment calibration, the implementation of structured Quality Assurance (QA) programs, and targeted

professional training to minimize repeat examinations and enhance diagnostic accuracy.

Keywords: Chest X-ray (CXR), Image Quality, Radiographic Technique, Quality Assurance (QA).

I. INTRODUCTION

Since the discovery of X-rays in 1895, chest radiography has established itself as one of the oldest and most commonly used imaging modalities in medicine (Bontrager & Lampignano, 2018). It remains the most frequently performed radiologic examination due to its effectiveness, low cost, and rapid availability in diagnosing a wide range of thoracic conditions, including pneumonia, tuberculosis, pleural effusion, pneumothorax, and cardiac enlargement (Kim, Lee, & Park, 2019).

Despite its apparent simplicity, the diagnostic quality of chest X-rays is highly dependent on several technical and procedural factors. These include correct patient positioning, appropriate exposure parameters, proper equipment use, and accurate image processing. Variations in these factors can significantly affect diagnostic accuracy, potentially leading to image misinterpretation, missed pathology, and unnecessary repeat examinations that increase radiation exposure for both patients and staff (Bushberg *et al.*, 2012).

Chest radiography has evolved considerably from early film-based systems to modern digital radiography (computed radiography and digital radiography). Digital imaging has improved image acquisition, manipulation, and storage; however, it has also introduced challenges such as exposure creep. This underscores the need for continuous training and strict adherence to radiation protection principles, particularly the ALARA (As Low As Reasonably Achievable) concept (Korner *et al.*, 2007; Bushberg *et al.*, 2012).

Chest X-rays are indispensable in emergency departments, intensive care units, outpatient clinics, and preoperative assessments, serving as a first-line imaging tool for a wide spectrum of cardiopulmonary conditions (Lee et al., 2020). Given this extensive use, maintaining high image quality is essential for accurate interpretation and optimal patient management.

International organizations, such as the European Commission (EC), the American College of Radiology (ACR), and the World Health Organization (WHO), have established standardized image quality criteria for chest radiography. These guidelines emphasize proper exposure, complete lung field visualization, correct patient positioning, absence of artifacts, appropriate collimation, and clear depiction of anatomical structures to ensure diagnostic consistency and reduce variability (European Commission, 1996; ACR, 2022).

The diagnostic value of chest radiography also depends on the selected projection. The posteroanterior (PA) projection is considered the gold standard for adult patients due to reduced cardiac magnification and superior visualization of thoracic structures. In contrast, the anteroposterior (AP) projection is commonly used for critically ill or bedridden patients despite its limitations. Lateral and oblique projections provide additional diagnostic information when performed correctly (Bontrager & Lampignano, 2018; Whitley *et al.*, 2015; ACR, 2022).

Furthermore, radiographer expertise, optimized exposure parameters, the use of standardized technique charts, and adherence to quality assurance and quality control (QA/QC) programs are critical factors in maintaining high image quality. Regular equipment maintenance, calibration, and continuous professional training significantly reduce technical errors and repeat examinations (Andersson *et al.*, 2012; EFRS, 2017; Williams *et al.*, 2021; Ayasrah *et al.*, 2025). In summary, the literature indicates that chest X-ray image quality is influenced by a combination of technical, human, and organizational factors. Evaluating these factors is essential for improving diagnostic accuracy and optimizing chest radiography practices, particularly in hospitals in Benghazi.

II. METHODS

This descriptive cross-sectional study aimed to evaluate the quality of chest X-ray imaging in hospitals in Benghazi. A structured questionnaire was used as the primary data collection tool,

distributed to healthcare professionals, including radiographers, radiologists, consultants, and pulmonologists. The sample included participants from various public and private hospitals in Benghazi.

The questionnaire contained both closed and open-ended questions covering essential aspects related to chest X-ray imaging, such as patient positioning, exposure parameters, image clarity, the presence of artifacts or defects, and adherence to standard imaging protocols.

Approximately 120 completed questionnaires were collected. The data were coded and entered into the Statistical Package for the Social Sciences (SPSS) software for analysis. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were calculated. The results were presented using tables and graphs to illustrate trends, strengths, and areas requiring improvement in chest X-ray imaging practices.

III. RESULTS

It is important to introduce the background of respondents participating in the survey to understand their level of expertise. Thus, this study aimed to evaluate the quality of chest X-ray imaging in Benghazi Hospitals. A brief profile (age, gender, hospital type, imaging system, educational level, and years of experience) of the survey respondents is presented in Table 1.

Table 1: shows that 18 out of 120 (15.0%) respondents were from the age group (20–29 years), representing the minority, whereas 41 out of 120 (34.2%) were from the age group (30–39 years), representing the majority. The table also shows that the majority of respondents were female (65.0%), while males constituted 35.0%. Regarding hospital type, 81 respondents (67.5%) worked in governmental hospitals and 39 (32.5%) in private hospitals.

Table .1: Description of the samples according to the background of respondents:

Variables	Classification	Numbers of respondents	%
Age Group	20-29	18	15.0
	30-39	41	34.2
	40-49	35	29.1
	50+	26	21.7
	Total	120	100
Gender	Female	78	65.0
	Male	42	35.0
	Total	120	100
Hospitals	Public	81	67.5
	Private	39	32.5
	Total	120	100
Imaging system	Digital	49	40.8
	Conventional	45	37.5
	Computed	26	21.7
	Total	**120**	**100**
Educational level	Bachelor's//High Diploma	82	**68.3**
	Master's	30	**25.0**
	PhD	8	**6.7**
	Total	**120**	**100**
Experience in years	Less than 5 years	27	22.5
	5–10 years	39	32.5
	More than 10 years	54	45.0
	Total	120	100.

Figure 1 demonstrates that 40.8% and 37.5% of respondents used digital and conventional imaging systems, respectively, representing the majority. It can be seen from the table that almost all (93.3%) respondents held a bachelor's or master's degree, while only 8 (6.7%) had a Ph.D.

Regarding length of work experience, 54 respondents (45.0%) had more than 10 years of experience, while the remaining 55.0% had 10 years or less.

Figure 1 illustrates the relationship between age groups and three variables: PA positioning, use of technique charts, and training in chest imaging. The results indicate that the 30–39 age group demonstrates the highest levels of PA application and technique chart usage, suggesting an active professional stage supported by adequate experience and regular practice.

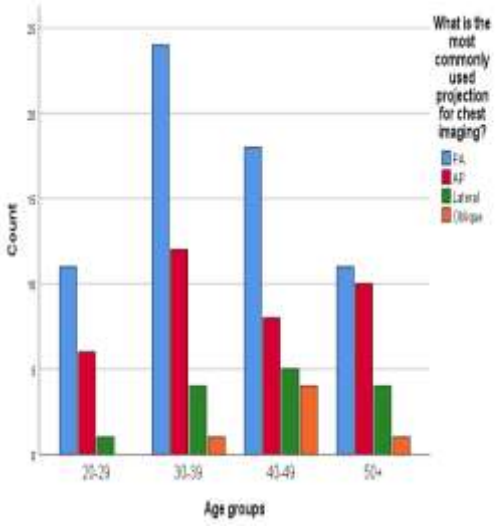

Fig 1: Shows age groups with the most commonly used projection for chest imaging.

The Above 50 age group shows the highest percentage in training related to chest imaging, which may reflect accumulated professional experience and a greater emphasis on continuous training. In contrast, the 20–29 age group records the lowest values across all variables, likely due to limited practical experience compared to other age groups. Overall, the chart highlights that technical skills and experience vary across age groups, increasing progressively with age until mid-career, while older professionals tend to focus more on specialized training.

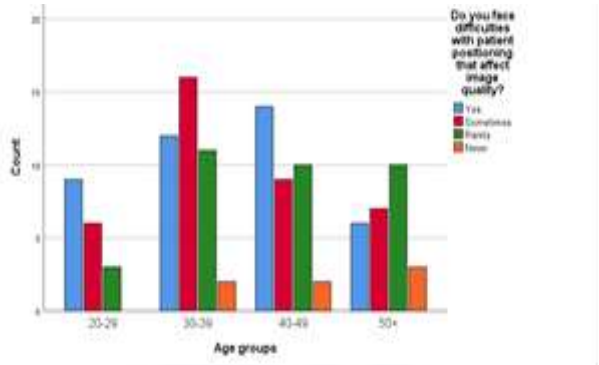

Fig 2: Demonstrates age groups with difficulties with patient positioning that affect image quality.

Figure 2 shows that the PA projection is the most commonly used technique for chest imaging across all age groups, representing 53.3% of total responses. The AP projection follows with 30.0%, while the lateral and oblique projections are used much less frequently, accounting for 11.7% and 5.0%, respectively. The Chi-square test result (χ^2 = 7.937, p = 0.541) indicates no statistically significant association between age group and the type of projection used.

This is supported by the Chi-square test result (χ^2 = 7.937, p = 0.541), which indicates no statistically significant association between age group and the type of projection used. Overall, the findings suggest that the PA projection remains the standard and preferred approach in chest radiography regardless of radiographer age, reflecting adherence to established imaging protocols.

Figure 3 presents adherence to dose criteria. The majority of respondents reported following dose criteria "Sometimes" (40.0%) or "Yes" (37.5%). Only a minority chose "Rarely" (16.7%) or "Never" (5.8%). The Chi-square test (χ^2 = 10.659, p = 0.300) confirms that age does not significantly influence adherence to dose criteria.

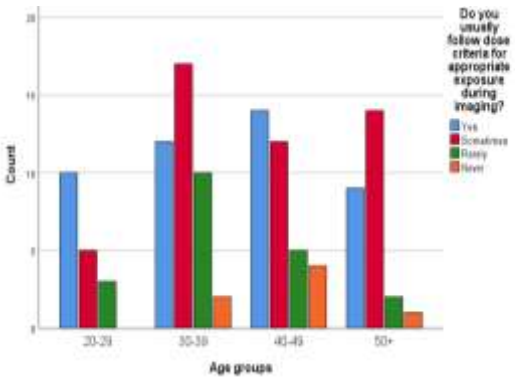

Fig. 3: Shows age groups with follow dose criteria for appropriate exposure during imaging.

The majority of respondents reported in figure 3 adhering to dose criteria “Sometimes” (40.0%) or “Yes” (37.5%). Only a minority chose “Rarely” (16.7%) or “Never” (5.8%). This indicates a generally positive trend toward awareness and application of dose optimization principles in chest imaging. Across the age categories, the distribution remains comparable, with no major discrepancies in dose-criteria compliance. The Chi-square test ($\chi^2 = 10.659$, p = 0.300) further confirms that age does not significantly influence adherence to dose criteria. Overall, the results highlight a strong awareness of radiation protection standards among radiographers across all age groups, although full consistency in following dose criteria.

Figure 4 displays the use of technique charts across age groups. While older radiographers (40–49 and 50+) report higher use of technique charts "Rarely" or "Never", younger radiographers (20–29 and 30–39) show a more balanced distribution, with greater reliance on "Sometimes" or "Yes". The Chi-square result ($\chi^2 = 27.377$, p = 0.001) reveals a statistically significant association between age group and use of technique charts.

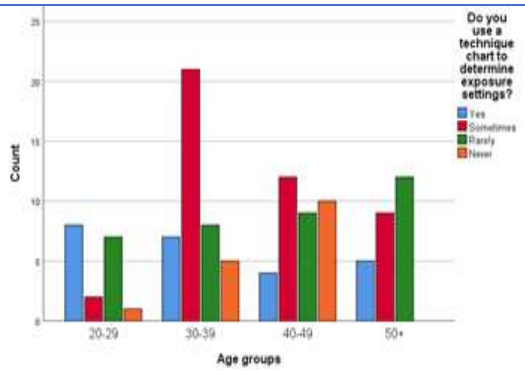

Fig.4: Displays age groups with use a technique chart to determine exposure settings.

The use of technique charts shows in figure 4 substantial variation across age groups. While older radiographers (40–49 and 50+) report higher use of technique charts “Rarely” or “Never”, younger radiographers (20–29 and 30–39) show a more balanced distribution, with greater reliance on “Sometimes” or “Yes. "The Chi-square result ($\chi^2 = 27.377$, p = 0.001) reveals a statistically significant association between age group and use of technique charts. This indicates that technique chart utilization differs meaningfully by age, suggesting differences in training styles, familiarity with modern protocols, or confidence in manual exposure selection. These findings imply that targeted retraining or standardized protocol reinforcement may help ensure consistent use of technique charts across all age categories.

Figure 5 shows the use of grids during chest X-ray examinations. The highest proportion reported using grids "Sometimes" (42.5%), followed by "Yes" (22.5%). A considerable proportion indicated "Never" (25.0%), while only 10% reported "Rarely". The Chi-square test ($\chi^2 = 5.014$, p = 0.833) confirms no statistically significant association between age group and grid usage.

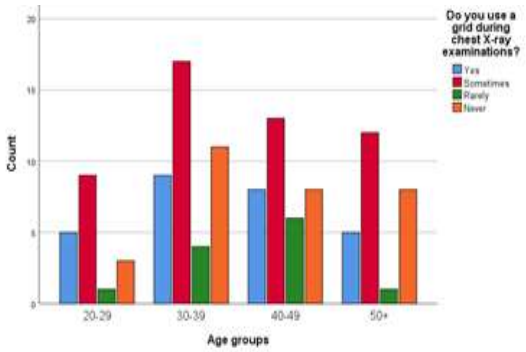

Fig. 5: Shows age groups with use a grid during chest X-ray examinations.

The findings in figure 5 demonstrate that the use of grids during chest X-ray examinations varies across response categories but remains broadly similar among age groups. The highest proportion reported using grids "Sometimes" (42.5%), followed by "Yes" (22.5%). A considerable proportion indicated "Never" (25.0%), while only 10% reported "Rarely. "Across the age groups, the distribution does not show any pronounced or systematic trend. The Chi-square test (χ^2 = 5.014, p = 0.833) confirms that there is no statistically significant association between age group and grid usage. These results suggest that grid usage may depend more on institutional protocols, patient size, or equipment availability than on radiographer age or experience.

Figure 6 illustrates the frequency of repeat examinations due to poor image quality. Image repetition is relatively common, with "once" (35.8%) and "none" (27.5%) being the most frequently selected options. Fewer respondents indicated repeating the exam twice (24.2%) or three times (12.5%). The Chi-square test result (χ^2 = 13.222, p = 0.153) indicates no statistically significant relationship between age and repetition frequency.

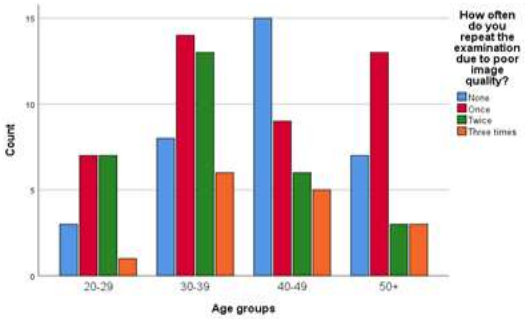

Fig. 6: Illustrates age groups with repeat the examination due to poor image quality.

The results show that image repetition is relatively common, with once (35.8%) and none (27.5%) being the most frequently selected options. Fewer respondents indicated repeating the exam twice (24.2%) or three times (12.5%). Across age groups, the distribution is generally comparable, and no specific age group stands out as having significantly higher repeat rates. The Chi square test result (χ^2 = 13.222, p = 0.153) indicates no statistically significant relationship between age and repetition frequency. These findings imply that image repetition is influenced primarily by technical factors or patient cooperation rather than radiographer age.

Figure 7 shows the most common problems affecting image quality. The most frequently reported issue is artifacts or foreign materials (37.5%), followed by underexposure (32.5%). Overexposure (22.5%) and incorrect patient positioning (6.7%) were less common, while lack of image sharpness was reported minimally (0.8%). The Chi-square test (χ^2 = 15.195, p = 0.231) confirms no significant association between age group and the type of image quality issue.

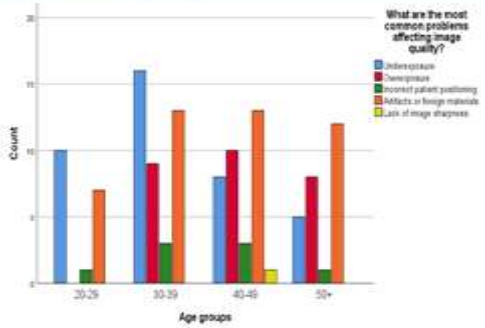

Fig. 7: Illustrates age groups with the most common problems affecting image quality.

The most frequently reported issue as shown in figure 7 affecting image quality is artifacts or

foreign materials (37.5%), followed by underexposure (32.5%). Overexposure (22.5%) and incorrect patient positioning (6.7%) were less common, while lack of image sharpness was reported minimally (0.8%). The distribution of these responses across age groups appears consistent, and the Chi-square test (χ^2 = 15.195, p = 0.231) confirms that no significant association exists between age group and the type of image quality issue encountered. Overall, the findings suggest that image quality problems are largely systematic and not dependent on radiographer age, highlighting potential equipment or workflow-related sources of error.

Figure 8 displays the perception of equipment problems affecting image quality. The majority of respondents indicated that equipment issues "Yes" affect image quality (56.7%), followed by "Sometimes" (27.5%) and "Rarely" (13.3%). Only 2.5% selected "Never". The Chi-square test (χ^2 = 10.932, p = 0.280) shows no statistically significant association between age and perception of equipment-related issues.

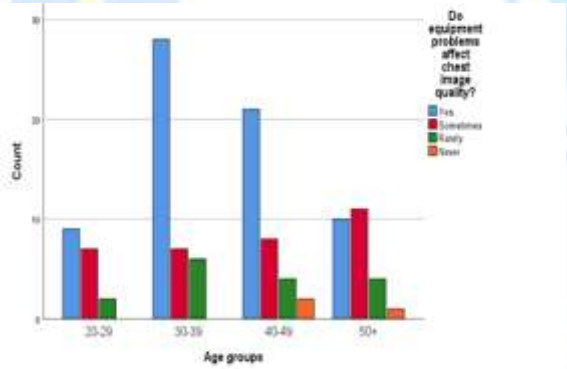

Fig. 8: Displays age groups with equipment problems affect chest image quality.

As shown in figure 8, the majority of respondents indicated that equipment issues “Yes” affect image quality (56.7%), followed by “Sometimes” (27.5%) and “Rarely” (13.3%). Only 2.5% selected “Never.” These results highlight that equipment-related problems are a major contributing factor to compromised image quality. However, the distribution across age groups is fairly consistent, and the Chi-square test (χ^2 = 10.932, p=0.280) shows no statistically significant association between age and perception of equipment-related issues. Thus, equipment problems appear to be a systemic issue affecting all radiographers, regardless of age or experience.

Figure 9 displays the perceived impact of image quality on diagnostic accuracy. The vast majority indicated that image quality has a "Moderate" (34.2%) or "Significant" (50.0%) impact on diagnostic accuracy, reflecting strong awareness of its clinical importance. The Chi-square test (χ^2 = 9.559, p = 0.387) indicates no significant association between age and this perception.

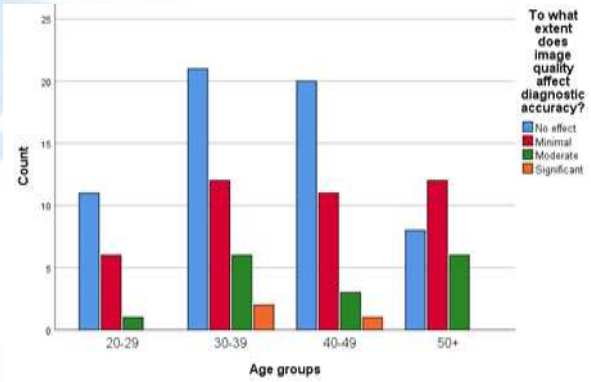

Fig. 9: Displays age groups with image quality affect diagnostic accuracy.

The vast majority of respondents in figure 9 indicated that image quality has a “Moderate” (34.2%) or “Significant” (50.0%) impact on diagnostic accuracy, reflecting strong awareness of the clinical importance of high-quality radiographs. Very few selected “Minimal” (13.3%) or “No effect” (2.5%). The response distribution is consistent across age groups, and the Chi-square test (χ^2 = 9.559, p = 0.387) indicates no significant association between age and the perceived effect of image quality on diagnostic accuracy. These results suggest that regardless of age, radiographers share a common understanding of the critical link between image quality and accurate diagnosis.

Figure 10 displays responses regarding device calibration. A plurality selected "Rarely" (32.5%), followed by "Yes" (27.5%) and "Sometimes" (26.7%). Only 13.3% reported "Never". The Chi-square test result (χ^2 = 13.975, p = 0.123) indicates no significant association between age and calibration frequency.

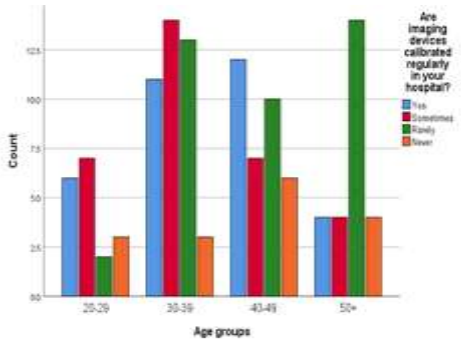

Fig. 10: Displays age groups with imaging devices calibrated regularly in the hospital.

Responses regarding device calibration show in figure 10 that a plurality selected "Rarely" (32.5%), followed by "Yes" (27.5%) and "Sometimes" (26.7%). Only 13.3% reported "Never." This distribution suggests that regular calibration practices may be inconsistent, potentially affecting image quality and radiation safety. Across age groups, the pattern remains fairly uniform, and the Chi-square test result (χ^2 = 13.975, p = 0.123) indicates no significant association between age and calibration frequency. Thus, the findings highlight an institutional issue rather than an age-related one, emphasizing the need for standardized and enforced calibration protocols in radiology departments.

IV. DISCUSSIONS

This study aimed to evaluate chest X-ray imaging practices in Benghazi hospitals by examining radiographers' demographic characteristics, adherence to imaging standards, and factors influencing image quality. The findings provide a comprehensive overview of current practices and highlight areas where clinical performance, education, and institutional procedures may require strengthening (Creswell & Creswell, 2018).

The demographic distribution revealed that most respondents were aged 30–39 years, with fewer in the youngest (20–29) and oldest (50+) groups. The sample was predominantly female, and the majority worked in public hospitals. A nearly equal use of digital and conventional systems was observed, indicating that digital transformation is progressing but remains incomplete. Most participants held a bachelor's degree or higher, and almost half had more than 10 years of professional experience. These characteristics suggest a relatively experienced and well-educated workforce, which is essential for maintaining high standards in radiographic imaging (Andersson *et al.*, 2012; EFRS, 2017).

The PA projection was the most commonly used technique across all age groups (53.3%), confirming adherence to international guidelines that recommend PA projection as the standard for routine chest imaging (ACR, 2022; Bontrager & Lampignano, 2018). The non-significant Chi-square result (p = 0.541) indicates that age has no influence on projection preferences. This consistency emphasizes that radiographers follow established protocols regardless of experience or training differences.

A large proportion of respondents reported experiencing difficulties with patient positioning ("Yes" = 34.2%; "Sometimes" = 31.7%). The absence of a significant association with age (p = 0.476) suggests that positioning challenges arise from patient-related or environmental factors rather than radiographer skill level. This finding aligns with existing literature, which highlights that patient condition, mobility, and clinical workload significantly impact positioning quality (Whitley *et al*., 2015).

Most radiographers reported following dose criteria always or sometimes, indicating good awareness of radiation protection principles. However, a notable portion still reported rarely or never adhering to dose standards. No significant relationship with age (p = 0.300) suggests that inconsistencies in adherence may reflect varying departmental protocols or workload pressures rather than experience level (Bushberg *et al*., 2012; WHO, 2016).

The use of technique charts varied significantly by age group (p = 0.001). Younger radiographers reported more frequent use, whereas older radiographers tended to rely less on charts. This may reflect differences in training styles, confidence in manual technique selection, or reduced exposure to updated protocols. This result highlights the need for standardized technique-chart implementation across all radiology departments (ACR-STR, 2022).

Grid usage showed no significant association with age (p = 0.833). Most respondents reported using grids "Sometimes,"

reflecting situational decision-making based on patient size or clinical need. A sizeable number selected "Never," which may indicate equipment limitations or protocol differences between facilities (Bontrager & Lampignano, 2018).

Repeat rates were relatively high, with 72.5% reporting at least one repetition due to poor image quality. There was no significant association with age ($p = 0.153$), confirming that repetition is largely influenced by systemic factors such as equipment performance, patient cooperation, or workload intensity rather than radiographer experience. This is consistent with findings from other studies (Williams *et al.*, 2021; Liaqat *et al.*, 2021).

Artifacts and foreign materials were the most commonly reported issues (37.5%), followed by underexposure (32.5%). Incorrect positioning and overexposure were less frequent. No link with age was found ($p = 0.231$), suggesting that these errors stem from environmental or procedural deficiencies rather than individual performance. Artifacts being the main issue highlights the need for better patient preparation and enhanced attention during the imaging process (Ayasrah *et al.*, 2025).

Most respondents (66.7%) had received training in image-quality assessment, but the rate varied by age group. Although the association was not statistically significant ($p = 0.205$), younger radiographers showed higher training participation. More importantly, the timing of the last training showed a highly significant association ($p = 0.000$): younger radiographers had more recent training, while those aged 50+ reported infrequent participation in refresher courses. This trend indicates the need for continuous and structured education for all age groups, especially for senior radiographers (EFRS, 2017; ESR, 2019). A majority (56.7%) stated that equipment problems affect image quality, and this perception was consistent across age groups ($p = 0.280$). This finding emphasizes systemic and institutional challenges such as aging equipment, lack of preventive maintenance, or limited availability of advanced imaging systems. Similar challenges have been reported in other developing regions (WHO, 2019).

Half of the respondents indicated that image quality has a "Significant" effect on diagnostic accuracy. Although no significant association with age was found ($p = 0.387$), the responses strongly underscore radiographers' awareness of the critical role that high-quality radiographs play in clinical diagnosis (Kim *et al.*, 2019; Lee *et al.*, 2020).

Most respondents reported irregular calibration, with "Rarely" being the most frequent response (32.5%). The lack of significant association ($p = 0.123$) indicates that inadequate calibration is a widespread institutional issue. Poor calibration is known to increase radiation dose and reduce image consistency, highlighting the urgent need for strict QA/QC programs in Benghazi hospitals (EC, 1996; IAEA, as cited in WHO, 2016).

V. CONCLUSION

This study provides important insights into chest X-ray imaging practices in Benghazi hospitals. Overall, radiographers demonstrate reasonable adherence to established imaging procedures, particularly in projection selection and awareness of image quality's diagnostic importance. However, several systemic and procedural issues were identified:

- The PA projection is universally preferred, reflecting compliance with international standards.
- Positioning difficulties and repeat examinations are common but not related to age or experience, suggesting patient-related or institutional factors.
- Adherence to dose criteria is generally good, though inconsistencies remain.
- Technique chart use differs significantly by age, with younger radiographers more likely to follow structured protocols.
- Equipment problems and poor calibration are widespread, contributing to compromised image quality.
- Training is common, but the frequency of recent training varies sharply, indicating a need for more consistent continuing education.
- Artifacts and underexposure are the most frequent image-quality issues, highlighting areas for workflow improvement.

VI. RECOMMENDATIONS

1. Implement standardized imaging protocols across all hospitals.
2. Provide regular and mandatory professional development for all radiographers.

3. Enhance patient preparation procedures to reduce artifacts.
4. Strengthen quality assurance and quality control programs.
5. Ensure consistent calibration and maintenance of imaging equipment.
6. Encourage greater use of technique charts for improved exposure consistency.
7. Address equipment limitations and workflow inefficiencies through coordinated efforts involving radiographers, radiology departments, and hospital administration to enhance diagnostic accuracy and patient safety in Benghazi hospitals.

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