Advancing Radiographic Quality in Resource-Limited Countries: An Audit of Quality Assurance Practices in Ghana

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Purpose To assess the quality of clinical radiography systems by auditing quality assurance (QA) and radiation protection compliance in Ghanaian diagnostic imaging facilities and by evaluating x-ray exposure indicator (EI) metrics through quality control (QC) testing to assess equipment performance.

Methods An empirical audit assessed QA and radiation protection compliance using internationally harmonized guidelines. Experimental QC tests measured EI metrics using a solid-state x-ray multimeter based on the International Atomic Energy Agency Technical Cooperation Regional Project RAF6/053 protocols. Deviations from standard EI metrics were analyzed to determine compliance.

Results This study evaluated 43 radiography systems used throughout 41 facilities. One facility had an established QA program with periodic QC measurements. Radiation protection compliance was satisfactory concerning aprons, barriers, and waiting areas; however, no facility had infant immobilization devices. EI deviations were within acceptable tolerances, except the half-value layer, which fell below recommended limits (< 2.9 mm aluminum [Al] but > 2.3 mm Al) in 11 facilities.

Discussion Although compliance was high for certain QA and radiation protection guidelines, deficiencies were noted. Lack of QA documentation and essential radiation protection accessories necessitates increased regulatory enforcement, structured training programs, and standardized nationwide QA implementation.

Conclusion Gaps exist in QA and radiation protection implementation in some Ghanaian radiography facilities. Strengthened regulatory oversight, comprehensive QA and QC practices, and improved radiation protection compliance are essential for enhancing radiographic quality and safety.

Keywords | *quality assurance, quality control, radiation protection, radiography, radiologic audit*

Recent technological advancements in radiography have refined the techniques used in medical image acquisition, processing, analysis, storage, and retrieval, leading to enhanced diagnostic accuracy and reduced patient dose.[1,2] General radiography accounts for 63% of medical exposures and 23% of patients' collective effective dose.[3] The mutagenic and carcinogenic potential of x-rays necessitates patient dose optimization and radiation safety for medical staff and the public.[4] This involves the application of radiation protection strategies such as the use of diagnostic reference levels for medical exposures, increased distance from radiation sources, appropriate shielding, and reduced ionizing radiation exposure time.[5,6]

Radiation safety in radiography can be achieved by implementing an effective radiology quality management program, which includes the establishment of quality policies, quality objectives, quality planning, quality improvement, quality control (QC), and quality assurance (QA).[7,8] QA programs integrate QC and administrative protocols to optimize systems, equipment performance, and procedures for high-quality imaging with minimal radiation and cost. After installation and acceptance testing, continuous verification of radiography equipment is essential to ensure consistent technical performance. These standardized ongoing verifications (ie, QC tests) are intended to detect deviations from the initial performance baseline or changes

in the radiography system that could degrade image quality or substantially affect radiation exposure levels. Regular implementation of QA and QC programs ensures that the deviation in exposure indicators (EIs), which are metrics that indicate the level of radiation exposure received by digital x-ray detectors, remain within acceptable limits.[9]

QA programs in medical imaging are recommended in International Atomic Energy Agency (IAEA) safety standards,[10] the European Council Directive 2013/59/EURATOM,[11] and the IAEA harmonized QC protocols for Africa.[12,13] Several resource-rich countries have legal requirements for QA and QC in radiography.[7] Conversely, resource-limited countries face challenges in implementing QA programs due to limited resources and trained personnel such as clinically qualified medical physicists (CQMPs).[14] Furthermore, research and regulatory-driven QA compliance audits in resource-limited countries, including Ghana, remain scarce.

An imaging equipment inventory in Ghana in September 2020 indicated there were 674 diagnostic imaging systems for 226 medical facilities; system modalities included general radiography, fluoroscopy, dental radiography, computed tomography (CT), single photon emission computed tomography, mammography, and magnetic resonance imaging. However, many diagnostic radiology medical physicists in Ghana lack the necessary onsite resources for efficient implementation of QA and QC programs.

The lack of regular QA programs in general radiography was highlighted by Ofori et al, who evaluated the QA status in 23 Ghanaian hospitals. They noted that the absence of QA activities and functional supervisory structures for diagnostic imaging services in Ghana could adversely affect quality service delivery.[15] To mitigate this situation, governmental research institutions, other qualified institutions and companies, experts, and others intermittently conduct QC tests on radiography systems, as well as QA and radiation protection programs in radiography departments. In addition, some researchers, as part of their studies, conduct QC tests at selected facilities.[16] These ad hoc practices are not consistent with best QA and QC standards, which require every radiology department to maintain a comprehensive QA program. Some of the best practices include[12]:

- continual evaluation of imaging techniques
- ongoing radiation safety monitoring
- periodic patient dose audits
- regular compliance assessments
- regular staff dosimetry monitoring
- routine QC testing

The current study aimed to assess the quality of clinical radiography systems by auditing QA and radiation protection compliance in Ghanaian diagnostic imaging facilities and by evaluating x-ray EI metrics through QC testing to assess equipment performance. The findings might help promote awareness and support efforts toward establishing unified national radiographic quality standards. In addition, the outlined quality management recommendations in this study could promote seamless implementation of QA and radiation protection programs in Ghana and other resource-limited countries.

Methods

This study used an empirical audit to assess QA and radiation protection compliance at 41 radiology facilities throughout Ghana. Using guidelines from international standards, the authors designed a simplified, comprehensive model that can be used for QA and radiation protection programs in resource-limited countries.

Experimental QC testing also was conducted on 43 radiography systems following guidelines from a diagnostic radiology QC manual recently developed through an IAEA project. Ethical approval was obtained from the Ghana Health Service Ethics Review Committee (No. GHS-ERC: 015/05/23) and the University of Ghana Ethics Committee for Basic and Applied Sciences (No. ECBAS 023/22-23).

Study Design and Sampling

An empirical audit study design, combined with an experimental approach, was employed to assess the quality management systems in radiology facilities throughout Ghana. The data collection instruments used to gather information about the facilities and radiography systems were designed in accordance with the data collection guidelines from the European

Commission,[17] IAEA Technical Report Series 457,[18] and IAEA's harmonized QC protocols for Africa.[12,13]

The facilities were selected through a maximum variation representative sampling methodology to capture proportional representation of hospitals in urban, suburban, and rural settings in 12 of 16 regions throughout the country (see **Figure**). Stratification by geographic location and clinical service level ensured inclusion of diverse radiology facilities.

Study Sites and Radiography Systems

Forty-one facilities, with 43 radiography systems distributed among them, were surveyed, including:

- district and municipal hospitals
- polyclinics
- quasi-governmental hospitals
- regional hospitals
- teaching hospitals

Inclusion criteria for the facilities were based on the availability and functionality of radiography systems, administrative authorization, willingness to cooperate, and ease of accessibility. Because of the transition from analog to digital radiography systems[19] and the declining use of analog systems,[20] this research only included facilities with digital radiography systems.

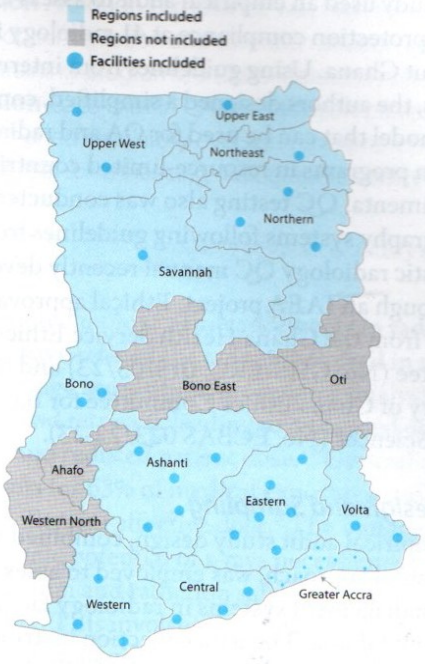


Figure. *Regional distribution of the 41 surveyed facilities throughout Ghana. Image courtesy of the authors.*

Twenty computed radiography (CR) and 23 direct digital radiography (DDR) systems were included in the study and were anonymized with codes F1 to F43. The predominant radiography system brands were Philips (n = 11), Shimadzu (n = 10), and Varian (n = 7). Varex, Mikasa, Samsung, and Siemens were the least-identified brands, each notated once. The remaining systems were from IMD Generators, GE Hualun, Shenzhen, and Medex. Four different CR cassettes sizes were observed: 18 × 24 cm^2, 24 × 30 cm^2, 35 × 43 cm^2, and 35.4 × 43 cm^2. The DDRs' flat panel detector sizes were 35.6 × 43.2 cm^2 and 45.7 × 38 cm^2. The radiography systems in this study were equipped with antiscatter grids. The radiography systems' inherent filtrations were 1.0 to 2.0 mm aluminum (Al) at 70 kV, 0.7 to 2.5 mm Al at 75 kV, and 2.0 mm Al at 76 kV. The small focal spot sizes ranged from 0.3 to 0.8 mm, and the large focal spot sizes ranged from 1.0 to 1.5 mm. Thirty-three of the radiography systems were equipped with functioning automatic exposure control.

Quality Assurance and Radiation Protection Audits

A qualitative QA and radiation protection audit was conducted using an empirical study design meant to evaluate facilities' compliance with international QA and radiation protection standards.[12,21-26] Guidelines from international standards were used to design a simplified but comprehensive integrated model that can be used for initial implementation of QA and radiation protection programs in resource-limited countries.[12,21-26] This model is comparable to the practice standards outlined by the American Society of Radiologic Technologists (ASRT).[27] This model incorporates key elements emphasized by ASRT, including systematic coordination and monitoring of QC procedures, adherence to radiation protection principles consistent with maintaining radiation doses as low as reasonably achievable, and strict compliance with state and federal regulatory requirements.[27] Furthermore, the model integrates the performance of physics surveys, procedural optimization, and continuous quality

improvement, which are consistent with ASRT's practice standards.

A semistructured data collection tool for collating radiographic parameters and procedural technique data was developed by blending measurands from the European Commission[17] and the IAEA Technical Report Series 457[18] radiography-related data collection templates. Content validity of the data collection tools was assessed by 2 medical physicists and 3 experts from radiography, biomedical engineering, and biostatistics. Item-level content validity index was estimated as the proportion of experts who rated each item 3 (quite relevant) or 4 (highly relevant). Items with an item-level content validity index less than 0.8 for clarity, relevance, or comprehensiveness were revised or removed. Consenting radiography personnel provided responses that were transcribed and authenticated through exploration and observation methods.

Quality Control Testing of Radiography Systems

A Black Piranha 657 solid-state meter (RTI Group) was used for direct exposure measurements for the QC tests. It can measure x-ray tube voltage for outputs as low as 50 kV and 0.05 mA at 50 cm.[28] The QA software was Ocean 214 (RTI Group), installed on a Microsoft Windows operating system. A measuring tape was used to determine the focus-to-detector distance during the exposures. Aluminum attenuators of 0.5 mm, 1 mm, and 2 mm thicknesses were used for conducting half-value layer tests. The Model 161B collimation test tool and the Model 162A beam alignment test tool designed by Radiation Measurement Inc were used to evaluate x-ray field congruence and the beam's perpendicularity to the image receptor. All measuring instruments had been calibrated.

The procedures used to experimentally conduct the QC tests in this study are those outlined in the new harmonized diagnostic radiology QC manual developed through the IAEA Technical Cooperation Regional Project (TCRP) RAF6/053 for conducting QC measurements in Africa.[12,13] This QC protocol has been successfully piloted by some studies.[29,30] The EI of an x-ray detector is influenced by metrics such as tube voltage (kilovoltage peak [kVp]), filtration, collimation, and beam centering.[9] Thus, the evaluated QC tests in this study included the accuracy and reproducibility of these metrics, as well as exposure time and x-ray tube output.

Results

A total of 86 radiography personnel from radiography departments throughout Ghana were involved in this study, including radiographers (n = 42), radiography technicians (n = 11), CQMPs (n = 2), student interns (n = 12), and radiographer national service personnel (n = 19). Radiography technicians usually hold a diploma in medical imaging; they assist radiographers and sometimes perform simple radiological procedures. Radiographer national service personnel are university graduates in radiography who undergo approximately 1 year of supervised, hands-on training in medical imaging as part of a compulsory national service program.

Quality Assurance Audit

The 8-point QA criterion framework, developed by harmonizing measurands from the literature,[12,21-26] and the respective compliance rates for each of the facilities are presented in **Table 1**. The QA assessment items are numbered QA1 to QA8.

Radiation Protection Audit

A 13-point model developed for auditing radiation protection compliance, along with the corresponding results, is presented in **Table 2**. This model is designed to ensure compliance with fundamental radiation safety requirements throughout medical, occupational, and public exposure situations in radiology facilities. The radiation protection assessment criteria are labelled RP1 to RP13.

Quality Control Tests

The results of the QC tests are presented in **Table 3**, with acceptable deviation limits adopted from the IAEA TCRP RAF6/053 protocols.[12] Measured QC parameters for EIs are relatively simple to measure. The measurements also require fewer and less sophisticated materials. Therefore, they are recommended for inclusion in a QA program in most radiology facilities in resource-limited countries. The tolerance levels outlined in the IAEA's harmonized QC test protocols[12] are generally consistent with those of the Institute of Physics

Table 1

Quality Assurance (QA) Audit Criteria and Compliance Rates

Criterion No.	Audit criteria	Compliance, n (%)[a]
QA1	List of radiography personnel with their duties, authority, and responsibilities	43 (100.0)
QA2	List of equipment and guidelines for equipment specification	40 (93.0)
QA3	Existence of quality control (QC) manual	1 (2.3)
QA4	Quality acceptance of radiographs from routine examinations	1 (2.3)
QA5	Guidelines for equipment maintenance and replacement	43 (100.0)
QA6	Documented training programs for professional development of radiologic staff	49 (66.2)
QA7	Existence of QA committee	1 (2.3)
QA8	QA corrective actions	1 (2.3)

[a] *N = 43 for all criteria except QA6. For QA6, N = 74 (ie, total number of radiologic staff).*

Table 2

Radiation Protection Audit Criteria and Compliance Rates (N = 43)

Criterion No.	Audit criteria	Compliance, n (%)
RP1	Personal monitoring badges for radiologic staff	34 (79.1)
RP2	Appropriate patient waiting area	43 (100.0)
RP3	Trefoil radiation hazard warning sign	32 (74.4)
RP4	Red exposure warning light	25 (58.1)
RP5	Shielding gloves	0 (0.0)
RP6	Protective aprons	43 (100.0)
RP7	Gonad shields	37 (86.0)
RP8	Thyroid shields	32 (74.4)
RP9	Shielding goggles	1 (2.3)
RP10	Protective barrier between control panel or operator and radiography system	43 (100.0)
RP11	Immobilization for infants	0 (0.0)
RP12	Exposure factors chart	9 (20.1)
RP13	Local diagnostic reference levels	0 (0.0)

and Engineering in Medicine[31] for equivalent tests. For radiography systems introduced after 2012, the IAEA harmonized protocols[12] specify a different deviation limit for half-value layer (ie, > 2.9 mm Al) to reflect advancements in radiography system technology.[32]

Discussion

Compliance in QA, QC testing, and radiation protection are vital to maintaining high-quality clinical services. The 43 radiography facilities evaluated in this study showed high compliance with certain QA and radiation protection guidelines, but deficiencies remain, such as a lack of QA documentation and essential radiation protection accessories.

Compliance With Quality Assurance

Similar to other countries, QA is a legal requirement in Ghana, as stipulated in the Nuclear Regulatory Authority Act, 2015 (ACT 895) sections 38(e) and 40(h), to be designed at the preconstruction and precommissioning stage of nuclear installations.[33] A well-documented QA program with clearly defined quality requirements is essential for effective QA implementation. Although some aspects of QA were met, none of the surveyed hospitals had a comprehensive and unified radiography QA manual.

Criterion QA1

QA1 highlights the importance of clearly defining the roles and responsibilities of radiography personnel to improve operational efficiency and accountability in clinical radiology facilities. The efficacy of a QA

Table 3
QC Test Parameters and Compliance Rates

Parameter	Tolerance	Compliance, n (%)[a]
Kilovoltage peak (kVp) accuracy at 80 kVp, %	< 10	43 (100.0)
Exposure time accuracy at 80 kVp, %	< 10	43 (100.0)
Beam collimation, cm[b]	≤ 2	43 (100.0)
Half-value layer at 80 kVp and 10 mAs, mm Al	> 2.3[c] or > 2.9[d]	32 (74.4)
kVp reproducibility at 80 kVp and 10 mAs, %	< 10	43 (100.0)
Exposure time reproducibility at 80 kVp and 10 mAs, %	< 10	43 (100.0)
Output reproducibility at 80 kVp and 10 mAs, %	< 10	43 (100.0)
X-ray beam perpendicularity[e]	≤ 1.5°	39 (90.7)
X-ray beam perpendicularity[e]	> 1.5° to ≤ 3.0°	4 (9.3)
X-ray beam perpendicularity[e]	> 3.0°	0 (0.0)

[a] *N = 43*
[b] *Less than 2% of focus-to-detector distance (FDD); FDD = 100 cm.*
[c] *For radiography systems marketed before June 1, 2012.*
[d] *For radiography systems marketed after June 1, 2012.*
[e] *Five radiography systems exhibited perfect congruence (0°).*

program hinges on effective collaboration among health care professionals. According to the IAEA Human Health Series No. 4, the core QA team might include CQMPs, radiographers, and service engineers.[26] All facilities included in this study had at least 1 radiographer on staff. In 8 hospitals, permanent radiographers were not available, thus qualified personnel served in part-time or locum capacities. Of approximately 93 radiologists in Ghana, 18 were at the 41 hospitals included in this study.[34] Although recommendations are that a QA program be developed under the supervision of a CQMP with appropriate training in radiologic QA, 2 permanent CQMPs were encountered among the 41 hospitals.[24] This deficiency could explain why 93% of the surveyed hospitals have not established QA programs.[35-37]

Criterion QA2

QA2 emphasizes the need to maintain a comprehensive inventory of radiography equipment, along with clear specification guidelines to ensure proper use and effective maintenance. Facilities with high compliance demonstrated well-structured procedures and active collaboration among CQMPs, biomedical engineers, the Nuclear Regulatory Authority, and national health institutions.

Criterion QA3

Lacking a QC manual could hinder a facility's ability to uphold consistent quality testing standards. A comprehensive QC manual might include:

- a list of parameters to be tested, including procedures and testing frequency
- an inventory of QC test materials with technical details (eg, manufacturer, model, serial number, calibration dates, and laboratory)
- baseline acceptance test results
- defined tolerance limits for each parameter
- designated QC personnel and their responsibilities
- recent QC test results certified by the responsible CQMP, including recommended corrective actions for deviations

QC procedures should be easy to implement using readily available onsite test materials, particularly in resource-limited settings. The IAEA TCRP RAF6/053 protocols outline practical, user-friendly methods for QC measurements, making routine quality checks

accessible and efficient. In Ghana and other resource-limited countries where CQMPs in diagnostic facilities are relatively new in the profession, this protocol is invaluable for bolstering their capacity for effective clinical practice.

QC testing typically includes constancy, status, and performance tests, along with follow-up tests (based on previous test results) or equipment tests after repair. Personnel responsible for QC must have access to properly calibrated instruments and phantoms to conduct effective testing. However, this was a notable deficiency among the surveyed facilities; none had the necessary dosimeters or QC materials onsite for the required periodic QC measurements.

Among the radiography systems equipped with functioning automatic exposure control, 45.5% of them were predominantly used in routine imaging. Because automatic exposure control consistently delivers reproducible exposures for a wide range of kVp to compensate for different body habitus, the recommendation is that the QC manual be optimized by incorporating automatic exposure control constancy and sensitivity tests for general radiography systems.

Except for 11 radiography systems that did not meet the acceptable half-value layer deviation limit, all systems were operating satisfactorily, with technical parameters within acceptable limits.[12] The low compliance rate of 2.3% for the availability of a QC manual is a substantial concern because of its indispensable role in standardizing QC procedures. One hospital had a documented QC manual and a QC testing schedule, though its test materials were outsourced. A limitation with the QC testing in this study was the inability to perform exposure time tests in 13 of the facilities due to system constraints that prevented exclusive selection of exposure time.

Criterion QA4

QA4 relates to the importance of clear guidelines on accepting or rejecting patient radiographs. High noncompliance in this area can lead to increased rejection rates and inconsistent image quality assessment, potentially resulting in diagnostic errors. Improving QA4 compliance therefore is essential. As part of radiographic QA, a radiologist might be responsible for visually grading radiographs using standard criteria such as those set by the European Commission.[17] EIs and objective image quality should be assessed by a CQMP for parameters such as modulation transfer function, dynamic range, detective quantum efficiency, signal-to-noise ratio, and contrast-to-noise ratio.[38,39] Therefore, CQMPs, radiographers, and radiologists could jointly establish unified acceptance criteria for diagnostic radiographs and implement a structured image rejection analysis to prevent the acquisition of suboptimal radiographs.

Criterion QA5

QA5 emphasizes the importance of equipment maintenance guidelines to enhance radiography equipment longevity, functionality, and durability while minimizing downtime. Some hospitals followed defined procedures for servicing faulty equipment, involving in-house biomedical engineers, suppliers, or manufacturers. However, reliance on external providers occasionally caused delays, especially for major repairs. After-sales service agreements often facilitated remote manufacturer support to resolve software issues and ensure continuity of radiologic services. Effective collaboration between CQMPs and service engineers during equipment reintroduction is highly recommended to maintain patient and staff safety after equipment servicing.

Criterion QA6

QA6 emphasizes continuous in-service training of radiology personnel to enhance skills, adapt to technological advances, and ensure safety. Although continuing professional development participation was reported, documentation was often lacking. Staff should record training details, including the organizer, objectives, duration, date, assessment, and continuing professional development points as part of QA programs.

Criteria QA7 and QA8

In compliance with QA7, 1 hospital had a functional radiologic QA committee. IAEA recommends forming a QA committee to conduct periodic assessments of a facility's QA program.[26] This multidisciplinary team might include radiologists, radiographers, CQMPs, biomedical engineers, and other health care professionals.

In addition to addressing failed EIs from QC tests, the committee must resolve deviations from local QA standards as required by QA8. A quality program should define timelines, assign responsibilities, and document corrective actions in accordance with hospital policies, accreditation standards, or regulatory requirements.[40]

Compliance With Radiation Protection

The IAEA General Safety Requirements Part 3 and the European Council Directive 2013/59/Euratom advocate for establishing a radiation protection program to minimize radiation risks.[11,41] In Ghana, radiation protection in medical imaging is regulated under ACT 895 sections 23 (1e, 1f, 1g), 24 (1, 2), and 40 (c, d).[32] Recommendations for QA programs outlined in the American Association of Physicists in Medicine (AAPM) Report No. 4 do not include radiation safety measures but state that a separate radiation safety program is essential.[24] Modern practices often integrate radiation protection into broader QA frameworks due to their overlapping objectives.[12,15,42,43] In such instances, ensuring comprehensive coverage of the radiation safety program within the QA framework is vital. Principle I of the IAEA Fundamental Safety Principles stipulates that the prime responsibility for safety must rest with the person or organization responsible for facilities and activities that give rise to radiation risks[44]; this is echoed by the ACT 895 section 23 (1e, 1f, 1g).[32] Therefore, hospitals using ionizing radiation are required to establish and implement a radiation protection program that addresses all facets of diagnostic and interventional radiology.

Criterion RP1 of the audit stresses the importance of providing personal monitoring badges to radiology staff to track radiation exposure during shifts. This study found that most hospitals used thermoluminescence dosimeters (73.2%) and electronic digital dosimeters (9.8%). High compliance with RP1 reflects a good awareness of staff radiation safety and regulatory adherence. However, some hospitals lacked individual badges for all radiography personnel, and inconsistent badge use during duty highlighted gaps in safety practices.

Criterion RP2 highlights the importance of designing patient waiting areas to minimize unintended radiation exposure outside the controlled area. Although all surveyed hospitals had appropriately located waiting areas with sufficient seating and spacing, none featured safety interlock systems. During high workloads, some radiographers resorted to manually locking doors to prevent accidental entry during exposures. According to IAEA Specific Safety Guide-11, clear warning signs, such as trefoil radiation hazard warnings (RP3) and exposure warning lights (RP4), are essential to alert individuals to potential radiation hazards near controlled area entrances.[45] Compliance results revealed the need for hospitals to enhance efforts to meet these safety standards.

Lead (Pb) shielding devices, such as gloves (RP5), protective aprons (RP6), gonad shields (RP7), thyroid shields (RP8), and goggles (RP9), can improve radiation safety during imaging procedures.[21] Depending on lead thickness in protective aprons, radiation dose to the wearer can be reduced by an estimated 95% to 99.5% in the 70 to 100 kV range.[46] However, the U.S. National Council on Radiation Protection and Measurements, supported by AAPM,[1] the British Institute of Radiology,[47] and the Asia-Pacific Forum on Quality and Safety in Medical Imaging (APQS),[48] has recently advised against patient gonadal shielding during radiography. This is due to its potential drawbacks, including obscuring anatomical details, reducing diagnostic accuracy, and increasing patient radiation doses from repeat imaging.

Because general radiography systems are sometimes used for procedures like hysterosalpingography, as observed during this study and others,[49] radiology staff are encouraged to adhere to the radiation protection principle of dose limitation, which could be achieved by appropriately wearing leaded gear. Furthermore, standing behind fixed or mobile protective lead glass barriers or windows (RP10) during exposures can enhance the radiation safety of radiology staff.[1] In this study, the thyroid and the gonad shields at the facilities were 0.5 mm Pb, and the aprons were 0.25 mm Pb or 0.35 mm Pb. In this study, assessment of protective gear (RP6, RP7, and RP8) demonstrated a high average compliance rate of approximately 87%, reflecting commitment to safety practices by the surveyed hospitals. However, improper storage of lead protective garments was observed in some facilities. This could result in degradation of

QM systems in resource-limited countries. The audit revealed commendable efforts by the surveyed hospitals, particularly in staffing documentation, equipment specification, and maintenance practices. However, compliance was notably low for radiograph rejection criteria and the establishment of QA committees. Although EI results were within acceptable tolerance levels, 11 facilities recorded half-value layer values less than 2.9 mm Al but greater than 2.3 mm Al. High radiation protection compliance was noted for radiation safety gear (except shielding gloves and goggles), but gaps existed in pediatric immobilization and diagnostic reference levels application.

Greater engagement of CQMPs and strengthening regulatory oversight would help facilities improve compliance with radiologic quality requirements. By addressing identified deficiencies and adopting the proposed recommendations, radiologic facilities could improve the quality of radiologic services and strengthen radiation safety for patients, staff, and the public while advancing sustainable practices that are consistent with best practices.

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