



Assessment of Ultrasound Quality Control Practices in Anambra State, Southeast, Nigeria.

¹Nwamaka C. Ikegwuonu, ²Christian C. Nzotta,
²Chinedu E. Anyanwu and ²Michael S. Okpaleke

¹ Radiology Department, Nnamdi Azikiwe University Teaching Hospital, Nnewi, Anambra State, Nigeria.

² Department of Radiography, Faculty of Health Sciences and Technology, College of Medicine, Nnamdi Azikiwe University, Nnewi Campus, Anambra State, Nigeria.

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*Corresponding Author

Nwamaka C. Ikegwuonu

E-mail: ncikegwuonu@nauthnnewi.org.ng, zubeamaka@yahoo.com

Phone: +2348033950499

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ABSTRACT

Background: Ultrasound equipment quality control (QC) checks ensure that faults are detected and corrected, to ensure optimal equipment performance for good clinical outcome. Ultrasound practitioners have an essential role in the QC of ultrasound scanners. This study was aimed at assessing QC tasks practiced by ultrasound practitioners in Anambra state, Nigeria, and their compliance to recommended standards.

Materials and Methods: This was a cross-sectional, questionnaire-based study carried out among 37 certified ultrasound practitioners. The hardcopy questionnaire made up of questions on QC practices according to recommendations of the American Association of Ultrasound in Medicine (AIUM) was used for data collection, and included questions on: cleanliness, infection control and safety tasks, and image display and performance tasks. The obtained data were analyzed using descriptive statistics.

Results: The ultrasound practitioners showed good compliance (86.1% - 100%) to infection control QC tasks of cleaning transducer, console and monitor of gel and body fluid; good compliance to equipment physical/mechanical safety tasks (61.1% - 83.3%), but poor compliance to image display and performance tasks (0 - 30.6%). Their compliance to the recommended frequency of practice for these QC tasks was generally poor (0% - 19.4%), except for transducer cleaning after each patient (91.7%) and immediate cleaning of spilled body fluid (100%). All phantom tasks had zero practice among the practitioners. Though none of the facilities had a QC programme in place, in addition to poor awareness (33.3%, n= 12) of recommended QC tests by the practitioners, most (94.4 %, n=34) of the practitioners believed that ultrasound quality control was beneficial.

Conclusion: Except for the phantom-based tasks which had zero practice, other quality control tasks were practiced by the ultrasound practitioners, and in varying degrees, but most times not according to the recommended standards.

Abbreviations: (IPEM) Institute of physics and engineering in medicine; (RCR) Royal College of Radiologists; (ACR) American College of Radiology; (AAPM) The American Association of Physics in Medicine; (EFSUMB); European Federation of Societies for Ultrasound in Medicine and Biology.

INTRODUCTION

Ultrasound equipment undergoes deterioration as a result of usage and normal aging process. Its delicate parts can be physically damaged by improper use and handling [1]. Transducers may be accidentally dropped, wheels may be run over cables, dust or fluid may accumulate on the machine and its electrical boards, connecting ports may become loose, cracks may appear on the knobs due to pressure of touch etc. These factors collectively affect the imaging performance of an ultrasound system. Some changes in performance may be obvious and usually noticed by the operator; however, others may occur subtly over time and usually go unnoticed, while some other problems may go unnoticed because they are masked by patient anatomy [2]. Regular quality control checks are essential in detecting fault that may affect equipment performance. Ultrasound QC is aimed at ensuring proper equipment functionality, clinical usage safety within internationally accepted limit, and performance consistency over time [3]. Ultrasound quality assurance (QA) guidelines and recommendations have been developed by regulatory bodies like AIUM, IPEM, RCR, ACR, AAPM, EFSUMB which if applied, will help in maintaining high equipment performance for better diagnostic accuracy. A substantial effort has been made to determine the most pertinent tests, the recommended frequency of testing, the most useful phantom design(s) and acceptable measured values [2]. Some QA procedures are those that are routinely carried out under good clinical practice, and consist of regular safety and cleanliness checks as well as more detailed checks of image display and performance which are best done using a phantom or a test object [4]. Ultrasound practitioners have an essential role in the QA of ultrasound scanners [5]. A clean and hygienic equipment including transducers, control panel, monitor, and peripherals is mandatory each time before a patient is scanned [3]. In addition, adopting infection control procedures ensures that the risk of infection to patient and staff are minimized [5]. Visual inspection of scanner's physical components ensures that damaged components that may pose electrical safety risks are identified and replaced. QC tests using phantom or test object can provide insight to specific performance characteristics of an ultrasound scanner [2]. The operator of the ultrasound equipment should monitor its optimal operation and immediately report any deficiency or fault for repairs [1].

Some studies in Nigeria have shown poor quality control practices among ultrasound practitioners [6,7]. This study was therefore aimed at assessing the quality control practices carried out by ultrasound practitioners in Anambra state, Nigeria.

MATERIALS AND METHODS

This was a descriptive cross-sectional study carried out among 37 certified ultrasound practitioners practicing in the 25 ultrasound facilities in Onitsha, Awka, and Nnewi, Anambra State. An ethical approval (NAUTH/CS/66/VOL.11/035/2018/031) for this study was obtained from the Human Research and Ethical Committee of the Nnamdi Azikiwe University Teaching Hospital, Nnewi, Anambra State, Nigeria. The entire procedure of the study was adequately explained to the participants and their consent was duly sought and obtained. All the information obtained was treated with confidentiality and used for the purpose of this study only. A questionnaire was used to obtain information from the participants. The questionnaire was validated using content validity, while its reliability was tested using test-retest method; the cronbach's alpha reliability coefficient being 0.804. The questions were about electrical safety, cleanliness and infection control, image display and performance, according to AIUM recommendations. Questions to determine the priority given to ultrasound QA were also included and bothered around the availability of formal QA in place, awareness of ultrasound QC, frequency of QC actions and availability of tissue-equivalent phantom. Opinion on the usefulness of ultrasound QC was equally sought. A total of 37 Questionnaires were self-distributed to the ultrasound practitioners working in the selected centers. Thirty-six (36) were filled by the respondents and collected back by the researcher, giving a 97% return rate. Data were analyzed using a statistical package for social sciences SPSS version 22. Non-numeric performance parameters and quality control practices by ultrasound practitioners were expressed using simple descriptive statistics (mean, frequency and percentages).

RESULTS

The results of the ultrasound practitioners' quality control practices revealed that the tasks of cleaning of ultrasound machine or room, and wiping gel off transducer after each exam had the highest mean score of 1.00 each respectively, while checking power cords and picture archiving had the least mean score 0.09 (Figure 1). Tasks involving use of phantom had zero score (figure 2)

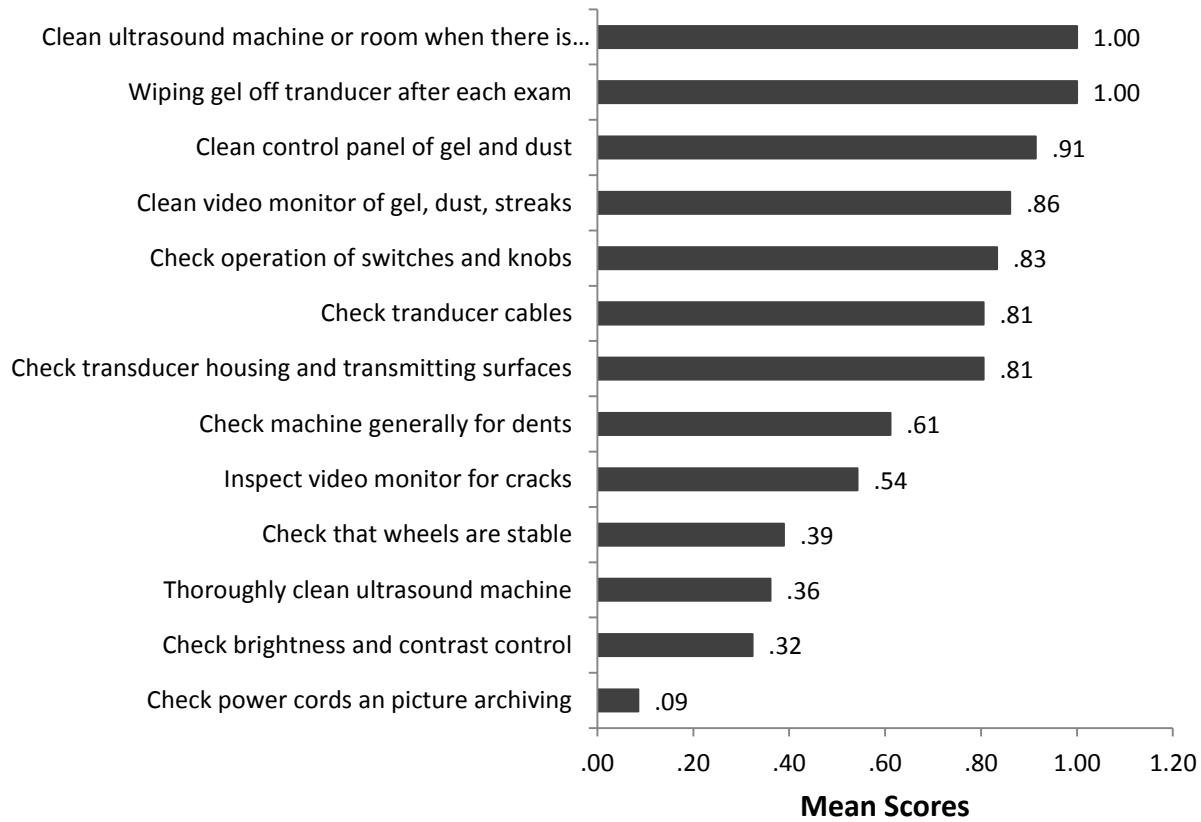


Fig 1: Pattern of Compliance to Cleanliness, Infection Control and Safety tasks

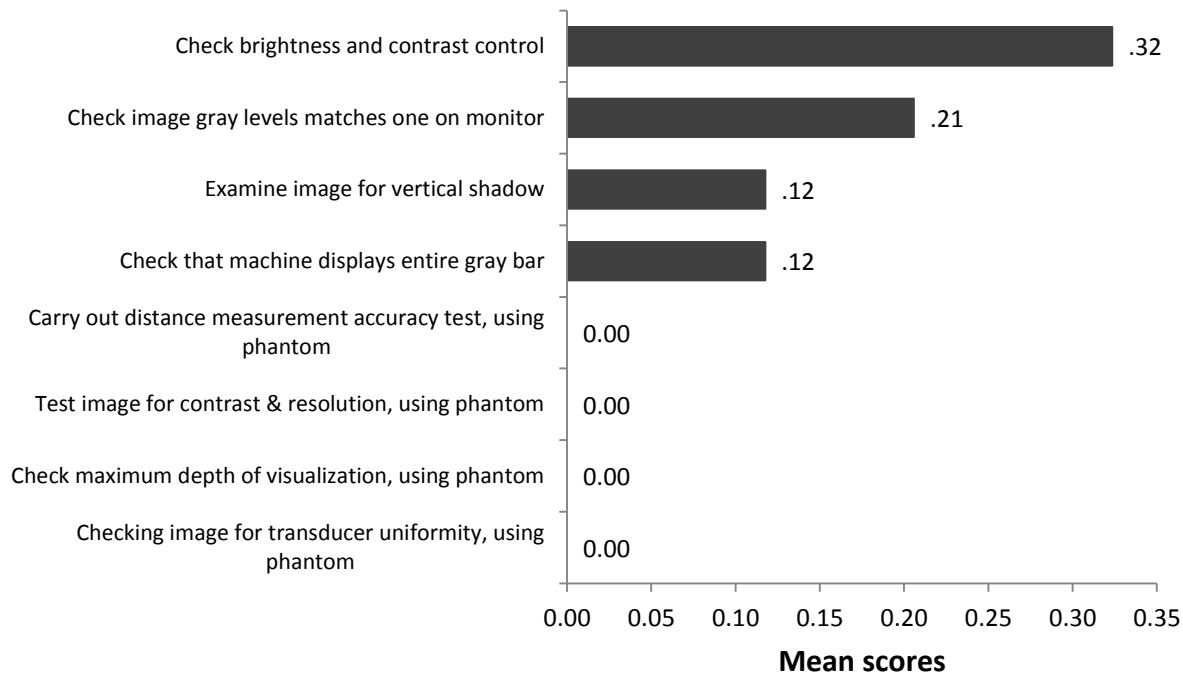


Fig 2: Pattern of Compliance to Image Display and Performance Tasks

Most 94.4 % (n=34) of the practitioners believed that ultrasound quality control is beneficial and a small proportion of them, (33.3%, n=12) were aware of quality control test (Table 1). The majority of the ultrasound practitioners (61.1% -100%) had good quality control tasks of equipment cleanliness, infection control and safety practice. Only a few (0 -19.4%) had compliance with the recommendation of the AIUM [4]. A large

proportion (86.1%) of the ultrasound practitioners had good dust cleaning practices (Table 2). The results of the ultrasound practitioners' practice of QC towards image display and performance, revealed that only a few (0-30.6%) practiced QC tasks for image display and performance while their adherence to the frequency of practice was poor (0% - 2-8%) (Table 3).

Table 1: Frequency Distribution for Quality Control Demographic Characteristics for the Ultrasound Facilities and Practitioners Studied

Quality control related question	Frequency of positive response
Is any quality assurance programme in place?	0%
Any baseline tests carried out the ultrasound machines?	0%
The facility owns a QC phantom?	0%
Awareness of different QC tests	33.3% (n=12)
Is ultrasound QC of any benefit?	94.4% (n=34)

Table 2: Frequency Distribution for Practitioners that Practice AIUM-Recommended Quality Control and their Compliance to Recommended Frequency: Cleanliness and Safety.

Task	% (n) of practitioners that practice QC task	% of compliance according to AIUM-recommended frequency.	AIUM recommended frequency
Cleaning transducer after each patient.	100% (n=36)	91.7% (n=33)	Multi-daily
Immediate cleaning if spillage of body fluid or hazardous material.	100% (n=36)	100% (n=36)	Multi-daily
Cleaning control panels of gel after each patient, if necessary.	88.9% (n=32)	0% (n=0)	Multi-daily
Monitor cleaned of dust, gel and streaks.	86.1% (n=31)	19.4% (n=7)	Daily
Check operation of switches and knobs on machine console.	83.3% (n=30)	19.4% (n=7)	Daily
Check transducer cables, housing, and surface for cracks damage	80.6% (n=29)	19.4% (n=7)	Daily
Generally check machine for dents and other damage.	61.1% (n=22)	2.8% (n=1)	Weekly
Thoroughly clean machine console and other equipment in the room.	36.1% (n=13)	5.6% (n=2)	Monthly
Check power cords and PACS connections for damage	8.3% (n=3)	0% (n=0)	Daily
Cleaning machine console air filters.	2.8% (n=1)	2.8% (n=1)	Weekly

Table 3: Frequency Distribution for Practitioners that Practice AIUM-Recommended Quality Control and their Compliance to Recommended Frequency: Image Display and Performance.

Task	% (n) of practitioners that practice QC task	% of compliance according to AIUM-recommended frequency.	AIUM-recommended frequency
Checking brightness and contrast controls match	30.6% (n=11)	0% (n=0)	Daily
Checking display of gray bars	11.1% (n=4)	0% (n=0)	Daily
Checking image gray level match	19.4% (n=7)	2.8% (n=1)	Daily
Examine images for streaks	11.1% (n=4)	2.8% (n=1)	Daily
Check image uniformity using phantom	0% (n=0)	0% (n=0)	Daily
Check maximum depth of visualization using phantom	0% (n=0)	0% (n=0)	Annually
Check target contrast and imaging resolution	0% (n=0)	0% (n=0)	Annually
Check distance measurement accuracy using phantom	0% (n=0)	0% (n=0)	Annually

DISCUSSION

Results from our study showed that none of the facilities had a formal QA program in place. This finding is consistent with the report of BMUS [8], which stated that many clinical ultrasound services have no formal QA program. We therefore infer that quality assurance is not prioritized in these facilities. In addition, there is poor awareness among the ultrasound practitioners about the quality control tests to be carried out on the ultrasound equipment, nevertheless, most of the practitioners acknowledged the benefits of ultrasound quality control.

In our study, quality control tasks of equipment cleanliness, infection control, and safety have good practice compliance by most of the practitioners, but their compliance to the recommended frequency of practice was generally poor, except for the cleaning transducer of gel after each patient, and cleaning spilled fluid, both which has excellent compliance. Also, except for the scanners' monitor which had good dust-cleaning practice compliance by the practitioners; other tasks of cleaning equipment of dust have poor practice compliance among the practitioners. Tasks for image display and performance by the ultrasound practitioners were found to be poorly practiced, while their adherence to the frequency of practice was even poorer. We found that all phantom-based tasks had zero compliance, likely due to absence of QC phantom in all the facilities. Our findings of poor compliance to some QC practices and

poor compliance to their recommended frequency of practice may not be unconnected with poor awareness of QC tests noted among the ultrasound practitioners. However, despite the poor awareness of QC tests, some of the practitioners showed excellent compliance to some of the recommended QC practices, likely as a result of good clinical practice, infection control consciousness and equipment care. This is in agreement with the AIUM [4], which stated that some QA procedures were those that are routinely carried out as good clinical ultrasound practice, and the BMUS [8], which noted that some elements of QA were not time-consuming and would already be carried out in departments complying with local infection control and equipment management requirements. Poor compliance to some QC tasks in this work may also be because of the lack of a formal QA program in the facilities, which may lead to a lack of commitment to QC.

Phantoms are used to carry out measurable parameters in the ultrasound scanner and help to reveal system defects that may otherwise not be identified and which can affect patients' diagnoses. However, QC phantoms are usually expensive and this may have discouraged their procurement by the facilities we studied, and thus zero compliance to all phantom-based tests. In addition, evidence of a current QA certification is not required for setting up and continuing an ultrasound practice in Nigeria, so the facilities may not readily commit funds for something that has no legal

threats. This agrees with Ward and Stanton [9] who noted that time and resources may not be prioritized to something that is not legally required. The ultrasound operators however believed that ultrasound QC was beneficial. A good practice of quality control in ultrasound is beneficial for improved clinical outcomes.

CONCLUSION

This study revealed that ultrasound practitioners in Anambra state undertake the various recommended ultrasound quality control tasks in varying degrees but not according to recommended frequency of practice. QC tasks involving the use of phantom was entirely lacking among the practitioners. This may result in use of equipment with possible compromised performance, which may affect clinical outcome.

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