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Baseline survey of level of quality control in medical radiology in Cross River State, Nigeria

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Quality control (QC) in radiology is meant to ensure that accurate diagnoses are obtained with radiation doses kept as low as reasonably achievable. It is also a fundamental requirement by the Regulatory Authorities in issuing operational license to operators of radiology facilities. In Nigeria, QC issues in Radiation Medicine have recently been introduced and are being enforced by the Nigerian Nuclear Regulatory Authority (NNRA). The level of QC practice in the radiology facilities in Cross River State, Nigeria was evaluated to obtain baseline information that could be relied on in the future to determine the level of improvement. It was observed that radiology practitioners appreciate QC and its importance in their practice, the present low level of its implementation notwithstanding.

Key words: quality control, diagnostic radiology, baseline, license, regulatory control.

Introduction

The practice of diagnostic radiology is usually subjected to regulatory control due to the use of X-ray (ionizing radiation). In Nigeria, use of ionizing radiation emitting and radioactive sources is regulated by the Nigerian Nuclear Regulatory Authority (NNRA), which was established by the Nigerian Nuclear Safety and Radiation Protection Act 19 of 1995. The NNRA is charged with the responsibility to categorize and license all practices

involving nuclear and ionizing radiation sources in a manner that would assure the public and users of the safety of such irradiation sources, protection of life, property and the environment from the unhealthy and harmful effects of ionizing radiation.

It is required that the use of ionizing radiation in medicine be justified and optimized to achieve radiological protection of the patients and medical workers [5, 6]. Justification of exposure is achieved by ensuring that all medical exposures are prescribed by qualified medical practitioners who must consider the efficacy, benefits and risk of such exposure compared to available alternative technologies [3, 4]. The use of standard equipment, proper operational parameters for diagnostic procedures, calibration of sources and dosimetry systems, clinical dosimetry and adequate quality assurance are known to enhance optimization of the radiological process [3, 4].

To ensure that the required level of justification and optimization are adhered to in diagnostic radiology practice, regulatory authorities have set aside principal requirements that must be achieved by any diagnostic radiology facility before it could be licensed for operation. Quality assurance and control, personnel, organization and responsibilities, education and training, radiation safety and protection are among the principal requirements in radiation safety regulations governing the practice of diagnostic radiology [3, 4, 7].

The importance of the above listed items need not be over emphasized. However, quality assurance and control, which is used to assure the workers and public of their safety and optimal performance of all the radiology equipment, appears to involve most of the items in the principal requirement list. In view of the importance of quality assurance (QA) and quality control (QC) in the execution of radiation safety and protection in diagnostic radiology and the recent introduction of the Nigerian Radiation Safety in Diagnostic and Interventional Radiology Regulations [7], as well as the Nigeria Basic Ionizing Radiations Regulations [8], it becomes necessary to evaluate the present level of implementation of QC in some diagnostic radiology facilities in Nigeria to establish a baseline, and also recommend the possible ways of enhancing the implementation of QC in this facilities. This study was therefore set up to achieve these objectives by collecting necessary information on QC from diagnostic radiology facilities in Cross River State, Nigeria.

Material and method

The diagnostic radiology facilities selected for this study were grouped into tertiary (those in the teaching hospitals), secondary (those in the general hospital) and private (those in private hospitals and stand alone privately owned facilities). All tertiary and secondary facilities were government owned. A questionnaire designed to obtain information on personnel, type of facility, equipment and QC implementation. Within the QC implementation, the importance of some QC indicators such as the responsibility of the different staff and some important issues in QC management were investigated. A confidentiality clause was incorporated in the questionnaire to guaranty the facilities that the investigation was purely research based and not designed to assist the regulatory authority in establishing their compliance status. This notwithstanding, one of the facilities visited, which is a stand alone diagnostic radiographic facility, declined to corporate with the investigators. Some staff in other radiology facility also declined to fill in the questionnaire. However, a tertiary facility, three secondary facilities and one private facility took part in the investigation. No effort was made in crosschecking the information supplied in the questionnaire with other records in order to minimize the fear of possible intimidation in the respondents.

Results

Based on the information extracted from the questionnaire, a total of 56 respondents consisting of 24 radiographers, 20 X-ray technicians, 1 radiologist and 1 medical resident took part in the survey. It was observed that no Medical Physicist took part in the investigation. The number of respondents did not reflect the actual number of radiology staff in the facilities visited, as some of the staff declined to cooperate with the investigators. It was difficult to extract some basic information (year of purchase, purchased new or refurbished, generator type, equipment selection and acceptance testing) on the x-ray machine because different respondents in the same facility using the same machine presented different data.

Table 1 shows how the respondents rated fundamental issues in QC as not applicable (NA), not important (NI), somewhat important (SM), important (IM) and very important (VI). Varied opinions were presented by respondents and these could be due to the practices in their facilities and the extent of their knowledge of QC. About 47%, 20% and

8% of the respondents maintained that it is very important for the radiologist, radiographer and medical physicist respectively to be in charge of QC programme. However, about 7%, 16% and 32% stated that it was not applicable for the radiologist, radiographer and medical physicist respectively to be in charge of QC. 70% of the respondents maintained that it is very important to perform acceptance testing on new equipment and that acceptance testing ensures that the equipment meets the manufacturer's specifications as agreed upon by the buyer. About 30% of the respondents in each case indicated that the use of acceptance testing results as baseline for subsequent QC test is either not relevant or not very important. It was also observed that about 90% of the respondents indicated that training and retraining of staff is very important as against about 5% that stated that it is not relevant.

Table 1. Rating of fundamental issues in radiology QC. NA – not applicable, NI – not important, SM – somewhat important, IM – important and VI – very important.

Fundamental Issue	NA	NI	SI	IM	VI	NR	Total
Radiologist is in charge of QC	4	19	3	3	26	1	56
Radiographer is in charge of QC	9	3	4	28	11	1	56
Medical Physicist is in charge of QC	18	3	5	25	4	1	56
Equipment log books are kept	11	7	1	17	17	3	56
QC manual/protocol are kept	5	1	2	13	33	2	56
QC charts are kept	3	0	3	15	33	2	56
QC reports are kept	1	0	0	13	33	9	56
QA/QC ensures timely and accurate diagnosis	2	0	8	3	42	1	56
QA/QC minimizes radiation exposure and risk	1	0	5	7	41	2	56
QA/QC provides confidence in radiological practice	0	0	2	17	35	2	56
Equipment faults are reported to superior officer	1	0	0	10	44	1	56

Fundamental Issue	NA	NI	SI	IM	VI	NR	Total
Acceptance testing (AT) is perform on all new equipment	1	1	2	11	40	1	56
AT ensures that equipment meets manufacturer's specifications	1	1	0	12	39	3	56
AT establishes baseline data for subsequent QA/QC	17	1	3	13	18	4	56
Repeat/reject film analysis	28	1	3	15	6	3	56
Personal dosimeters in use	1	1	5	8	39	2	56
Area survey for background radiation	0	1	4	18	32	1	56
QA/QC committee constituted	16	5	2	21	11	1	56
QA/QC review meetings	19	3	4	19	10	1	56
Staff training and retraining	3	0	0	5	47	1	56
Total	141	47	56	273	561	42	1120

Table 2. Rating of the frequency of measurement of QC parameters

QC parameters	Frequency of measurement					
	daily	weekly	monthly	yearly	not at all	total
Repeat/reject analysis	30	1	2	0	23	56
Beam quality	33	3	1	0	19	56
Light/x-ray field alignment	31	1	3	2	19	56
Beam Limitation	38	4	2	2	10	56
X-ray bucky alignment	28	8	2	4	12	54
Focal spot size	40	6	2	0	8	56

QC parameters	Frequency of measurement					
	daily	weekly	monthly	yearly	not at all	total
kVp	41	3	1	2	9	56
mA and s or mAs	43	1	2	0	10	56
Beam quantity (mR/mAs)	40	2	0	1	13	56
AEC detector selection	35	2	3	4	12	56
AEC density control	34	5	2	4	11	56
AEC screen film combination	33	6	1	2	14	56
Grid artifacts	26	8	5	3	14	56
X-ray beam grid alignment	32	5	2	2	15	56
Sensitometry	8	9	18	1	20	56
Densitometry	7	6	19	2	20	56
Film storage	24	6	20	0	6	56
Darkroom conditions	43	4	2	1	6	56
Background radiation survey	35	8	4	2	7	56

Concerning the frequencies at which the different QC tests should be carried out (Table 2), respondents varying between 7 and 23 (about 12% and 41%) stated that the different QC tests should not be performed at all. Between 7 to 43 respondents believed that all the listed tests should be performed daily. Only two of the tests, sensitometry and densitometry had 8 and 7 respondents maintaining that they should be repeated daily, while majority of the tests had about 43% to 77% of the respondents accepting that they should be conducted daily. As indicated in Table 2, support by respondents to the conduct of QC tests on weekly, monthly or yearly bases was weak (0 to 9 respondents), while 18, 19 and 20 respondents accepted that sensitometry, densitometry and darkroom conditions respectively, should be conducted monthly.

Discussion

Results show that 26 (47%), 11 (20%) and 4 (8%) of respondents believe that it is very important for the radiologist, radiographer and medical physicist, respectively, to be in charge of QC while 8%, 16% and 33% maintained that it is not applicable for the radiologist, radiographer and medical physicist to be in charge of QC (Figure 1). The trend observed here is not unexpected as radiologists, followed by radiographers, have

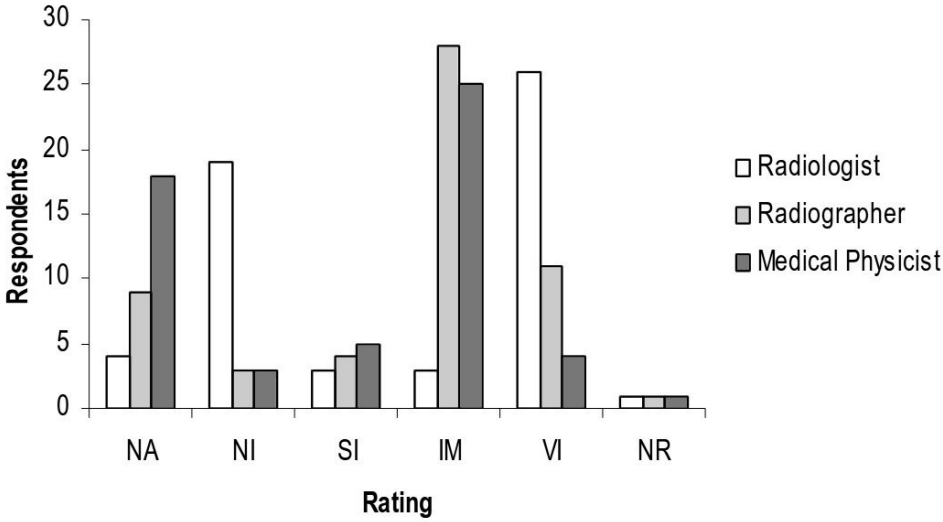

Figure 1. Rating of professional expected to be in-charge of radiology QC.
NA – not applicable, NI – not important, SM – somewhat important,
IM – important and VI – very important.

been long regarded in the country as the major professionals and drivers of all aspects of diagnostic and interventional radiology. This position was followed by 50% and 45% of the respondents who maintained that it is just important for the radiographer and medical physicist respectively to be in charge of QC. However, 33% of the respondent accepted that it is not applicable for the medical physicist to be in charge of QC.

The situation observed here is at variance with the recommendations of the American Association of Physicists in Medicine (AAPM) that the responsibility of establishing a QC programme is clearly out of the domain of the radiology technologist

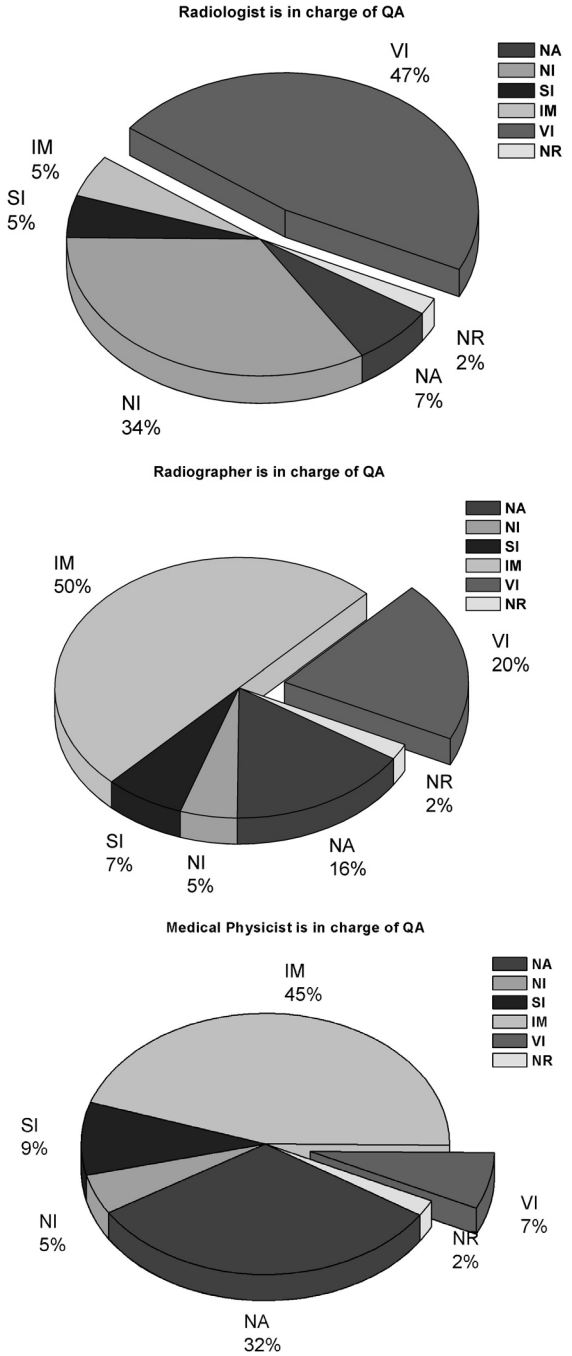

Figure 2. Rating of the level of importance of the different professionals being in-charge of QC

(radiographer) into that of the medical physicist who is expected to develop and supervise a quantitative QA programme [1, 2]. The observed results in this study is not unexpected following the fact that emphasis in QC has recently been officially introduced into the practice of radiation medicine in Nigeria by the Nigerian Nuclear Regulatory Authority (NNRA), which is mandated by law to regulate the use of radiation sources and radioactive materials [7]. It follows therefore that, most practitioners in radiation medicine are yet to properly understand and appreciate the concepts surrounding the conduct of QC in such facilities.

Further analysis of the information presented in Table 1 using the total score shows that the respondents generally accepted that the fundamental issues of QC are important (24%) or very important (50%) (Figure 2). Similarly, total scores of 13%, 4% and 5% were associated with not applicable, not important and somewhat important respectively, in the rating of the fundamental issues of QC. This could be understood as a reflection of how the practitioners appreciate the QC programmes recently introduced by the NNRA. Generally, about 73% of the respondents indicated different levels of importance in the fundamental issues of QC and about 15% stated that the QC issues were either not applicable or not important. Based on this, it may be concluded that QC in diagnostic radiology is regarded by practitioners as an important step towards obtaining good results in their practice.

Most respondents supported daily measurement of QC parameters with about 12-76% of them supporting the different parameters. Most of the QC parameters had 57-76% of respondents supporting their daily measurements. 10-36% of respondents felt the different QC parameters should not be measured at all. Weekly, monthly and yearly measurements of QC parameters were weakly supported by respondents as shown in Table 2. The frequencies of measurement of the different QC parameters presented in Table 2 did not follow the recommendations of the [1], which states that most of the QC parameters do not require daily measurements. It is clear that some of the QC parameters are expected to be tested annually and some semi-annually or quarterly while a few should be tested daily [1].

The level of implementation of QC programme in the different radiology facilities considered in this study was poor as most of the facilities visited did not have any QC programme in place with no medical physicist to develop and implement the required programmes as suggested by AAPM.

Conclusion

The level of implementation of QC programme in most radiology facilities in Cross River State, Nigeria is low, the effort of the NNRA notwithstanding. The practitioners of radiology do accept QC as a requirement for quality output and are ready to incorporate it in their practice. Medical Physicists are almost not available in most facilities to provide the required QC services. The type of hospital (radiology facility) did not influence the level of QC implementation and awareness in the facilities. It is suspected that other States in Nigeria may be operating radiology QC at the same level with Cross River State, therefore it is suggested that this study should be repeated in other States of Nigeria to evaluate if the situation is actually similar to that observed in Cross River State.

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