

Quality control program: the radiology technician approach*

Programa de controle de qualidade: a visão do técnico de radiologia

Helga Alexandra Soares Macedo¹, Vitor Manuel Costa Pereira Rodrigues²

Abstract **OBJECTIVE:** The present study was aimed at evaluating the importance given by radiology technicians to the implementation of a quality control program and the existence of radiological protection criteria in their centers. **MATERIALS AND METHODS:** The data for the present descriptive and cross-sectional study were collected by means of a four-module questionnaire, with data anonymity and confidentiality being assured. The sample consisted of 48 radiology technicians working in health institutions of the District of Vila Real (North of Portugal). **RESULTS:** Among the radiology technicians participating in the present study, 62.5% do not know what a quality control program is, although its implementation is considered as very important for their centers by 85.4% and 89.6% consider that its implementation would be a motivating factor. Also, the authors have observed that hospitals and health centers evaluated are not in compliance with the basic principles of radiation protection. **CONCLUSION:** Although the radiology technicians do not know what a quality control program is, they are willing to collaborate in the elaboration of this program. The present study has allowed the authors to testify a supposedly inexistent reality: public institutions whose mission is based on health promotion ignoring the non-compliance with principles of radiological protection. *Keywords:* Radiation effects; Health care quality assurance; Radiological protection.

Resumo **OBJETIVO:** Pretendeu-se averiguar que importância os técnicos de radiologia atribuem à implementação de um programa de controle de qualidade em radiologia, e conhecer a importância da existência de critérios de proteção. **MATERIAIS E MÉTODOS:** Estudo descritivo e transversal. Os dados foram recolhidos por meio de um questionário (quatro partes), tendo sido garantido o anonimato e a confidencialidade dos dados. Participaram neste estudo 48 técnicos de radiologia que exercem funções em instituições de saúde, situadas no Distrito de Vila Real (norte de Portugal). **RESULTADOS:** Dos técnicos de radiologia participantes do estudo, 62,5% não sabem em que consiste um programa de controle de qualidade em radiologia, mas 85,4% consideram muito importante a sua implementação nos seus serviços, e 89,6% consideram que a sua implementação seria um fator de motivação. Verificamos também que as instituições estudadas (hospitais e centros de saúde) não se encontram adequadas com os princípios básicos da radioproteção. **CONCLUSÃO:** Embora os técnicos de radiologia não saibam em que consiste um programa de controle de qualidade em radiologia, estarão dispostos a colaborar na sua elaboração. Este estudo permitiu constatar uma realidade que pensávamos não ser possível existir: instituições públicas, cuja missão se baseia na promoção da saúde, ignoram as não conformidades existentes nos diferentes serviços, no que diz respeito à proteção radiológica. *Unitermos:* Efeitos de radiação; Garantia da qualidade dos cuidados de saúde; Proteção radiológica.

Macedo H, Rodrigues V. Quality control program: the radiology technician approach. *Radiol Bras.* 2009;42(1):37-41.

INTRODUCTION

Public institutions involved in health care services are aimed at meeting users/clients needs, operating in a world where priority is given to competence and quality. Considering their character of public

utility, radiology/imagenology centers should keep this philosophy in mind.

The European Commission, through the Luxembourg Declaration of April 5, 2005 including topics on the theme "Patient Safety – Making it Happen!", declares that the health sector is a high-risk area because of adverse events resulting from some treatment modalities⁽¹⁾.

Ionizing radiation is utilized in several areas of medicine, therefore this resource should be correctly utilized for assuring that benefit override the possible damages to patients and to the environment⁽²⁾. Diagnostic radiology represents a powerful medical tool. In this context, the adoption of a culture of radiological protection and quality assurance should be emphasized, considering the current tendency towards offering the users transparency in relation to the safety and effectiveness of radiological imaging methods⁽³⁾.

A quality control program (QCP) should be implemented, aiming at acquiring high-

* Study developed at Universidade de Trás-os-Montes e Alto Douro, Vila Real, Portugal.

1. Master in Health Services Management, Radiology Technician at Centro Hospitalar de Trás-os-Montes e Alto Douro, Vila Real, Portugal.

2. PhD, Coordinator Professor and Integrant Member of CI-DESD – Centro de Investigação em Desporto, Saúde e Desenvolvimento Humano – Universidade de Trás-os-Montes e Alto Douro, Vila Real, Portugal.

Mailing address: Dr. Vitor Manuel Costa Pereira Rodrigues. ESEnf. – Universidade de Trás-os-Montes e Alto Douro. Lugar do Tojal – Lordelo. 5000-232 Vila Real, Portugal. E-mail: vmcpr@utad.pt

Received December 31, 2008. Accepted after revision January 22, 2009.

quality medical images, minimizing costs and the radiation dose delivered to patients, practitioners and to the environment⁽⁴⁾. Quality control can be defined as part of an organized effort to assure that diagnostic images have a high quality to provide appropriate information with minimum cost and minimum radiation exposure for both patients and operators⁽⁵⁾. Ionizing radiation protection constitutes an important application of physics to radiology and is translated into the study of rules, development and optimization of methods to allow the management of irradiation⁽⁶⁾. One of the objectives is to minimize the dose absorbed both by patients and practitioners during the process of diagnosis with ionizing radiation, keeping these doses below the recommended levels.

In 1915, the British Roentgen Society released a serious warning that reverberated around the world waking up consciences against the risks from radiation exposure. Early in 1920, this same scientific society constituted an X-Ray and Radium Protection Committee; in July/1921 issued a preliminary report and, in December of the same year, a memorandum. In 1929, the "radiation protection" concept starts being established in several countries as an irreversible process⁽⁷⁾. The development of monitoring programs and procedures in the field of radiological protection is essential in radiology centers with the following objectives: to detect the main sources of ionizing radiation, to evaluate the occupational exposure and the compliance or not with radiation exposure limits, as well as the performance of current control measures and information collection for implementation of new control measures.

Regulations, recommendations or laws have been developed in the last years for implementation of quality control programs in radiodiagnosis centers around the world, including United Kingdom, Germany, United States of America, World Health Organization and European Union where most of countries adopt the mandatory of quality control in radiodiagnosis centers⁽⁸⁾.

In view of the above considerations, the authors have developed a descriptive and cross-sectional study aimed at evaluating

the knowledge of radiology technicians about QCPs, identifying their perception in relation to the implementation of such programs as well as the availability of radiation protection materials, and demonstrating the necessity of a quality control program in their radiodiagnosis centers.

MATERIALS AND METHODS

The present descriptive and cross-sectional study has evaluated a population including 48 radiology technicians working in health care institutions located in the District of Vila Real (North Region of Portugal).

Data collection was performed through a four-module questionnaire. The first module included five questions concerned with the characterization of the sample. The second module included eight questions concerning the respondents' attitude in relation to the existence of quality control programs, their education in this matter, and knowledge about the current regulations in this area. The third module corresponded to a quality control relevance (QCR) Likert scale with seven 5-level items where 1 corresponds to nothing, and 5 corresponds to too much. So, the maximum score in this scale is 35 – the higher the score, the higher is the relevance attributed to quality control. As regards fidelity, the internal consistency analysis of QCR was performed by means of Cronbach's alpha, with a considerable high alpha value (0.845). The fourth module corresponded to a radiological protection relevance (RPR) Likert scale with five 4-level items where 1 means never, and 4 means always. The maximum score in this scale is 20 – the higher the score, the higher is the relevance attributed to radiological protection. A high Cronbach's alpha value was observed (0.705).

All the individuals participating in the present study were previously informed about the research foundations and objectives, data confidentiality and anonymity, besides that, naturally, they could refuse to participate.

The software Statistical Package for Social Sciences (SPSS – version 13.0) was utilized for data analysis and interpretation. For this purpose, the authors utilized rela-

tive frequencies, mean and standard deviation with the Mann-Whitney and Kruskal-Wallis tests, $p < 0.05$ being defined as the minimum value considered for statistical significance.

RESULTS

Among the 48 technicians included in the study population, 41 (85.4%) work in a hospital, and 7 (14.6%), in health centers. As regards sex, 34 (70.8%) were women and 14 (29.2%) men. Aiming at determining the existence of difference between women and men as regards the relevance attributed to the implementation of a quality control program and to radiological protection criteria, the authors have utilized the Mann-Whitney test, finding a statistically significant difference ($p = 0.033$) between men and women in relation to the relevance attributed to the implementation of a quality control program, with men presenting a much higher mean value (Table 1) as compared with women.

The respondents age range was between 21 and 57 years (mean, 37.6 years).

As regards the relation between the number of years in service and relevance attributed to the implementation of a quality control program and the existence of radiological protection criteria in the institutions, the analysis by the Kruskal-Wallis has demonstrated no statistically significant difference between these factors.

Among the 48 technicians, 36 (75%) had no access to educational actions offered by the institution in the area of quality control, 12 (25%) reported the existence of such actions in their institutions, but among them, three informed that this type of educational action was very rarely adopted. As regards their knowledge about a quality control program, 30 (62.5%) did not know and 18 (37.5%) knew this program. The technicians who knew what a QCP is, mentioned that the three main aspects of this program are: standardization ($n = 12$; 66.6%), dosimetry ($n = 9$; 50%) and equipment planning and maintenance ($n = 8$; 44.4%).

Regarding education in the area of quality, 17 (35.4%) had and 31 (64.6%) had not undergone education in this area. In order to evaluate the influence of the education

on the level of relevance attributed to the implementation of a QCP and the existence of radiation protection criteria, the Mann-Whitney test was applied, demonstrating statistically significant difference ($p = 0.003$) only in the relation between education and the relevance attributed to the implementation of a QCP, considering that technicians with education in the area of quality present a much higher mean value as compared with those who had not (32.5 versus 20.0).

Among the 48 respondents, 23 (47.9%) have considered the implementation of a QCP as quite necessary, 18 (37.5%) very much necessary, and only seven (14.6%) reasonably necessary.

Additionally, a comparison between the relevance attributed to quality control programs and radiation protection criteria by technicians in hospitals and by technicians in health centers was analyzed through the Mann-Whitney test, demonstrating no statistically significant difference (Table 2).

Only 5 (10.4%) among the 48 respondents reported the existence of a quality control program in their institution, called Manual of Users Attendance and Reference. However, it is important to observe that 13 technicians work in this institution, that is to say, eight of them are not aware of the program or do not consider it as a quality control program.

As regards the presence of a person of the technical staff in charge of the quality control, only seven (14.6%) respondents report the presence of such element, namely in the following positions: technical coordinator (one), technical coordinator and sub-coordinator (five) and radiology technician (one). Among the criteria involved in a QCP in radiology — evaluation of radiation doses in the environment, measurement of individual doses to the staff, constancy testing of radiodiagnosis equipment, equipment calibration and quantification of rejected films —, only the measurement of individual doses to the staff was reported as a routine by 37 (77.1%) technicians.

Table 3 demonstrates that 41 technicians working in hospitals have reported the availability of lead aprons, only 35, thyroid collars, 30, gonad shields, 14, gloves, and only one have reported the availabil-

Table 1 Relevance attributed to the quality control program and radiological protection according to sex.

Relevance attributed	Sex	<i>n</i>	Mean classification	<i>p</i>
Quality control program	Male	14	31.1	0.033
	Female	34	21.7	
Radiologic protection criteria	Male	14	27.6	0.319
	Female	34	23.2	

n, number of sample.

Table 2 Relevance attributed to the quality control program and to radiological protection criteria according to the place where the activity is developed.

Relevance attributed	Institution	<i>n</i>	Mean classification	<i>p</i>
Quality control program	Hospital	41	24.3	0.886
	Health center	7	25.2	
Radiologic protection criteria	Hospital	41	24.1	0.668
	Health center	7	26.7	

n, number of sample.

Table 3 Presence of radiological protection materials in hospitals and health centers.

Materiais de proteção radiológica	Availability	Hospital	Health center
Lead aprons	Yes	41	7
	No	0	0
Thyroid collars	Yes	35	2
	No	6	5
Gonad shields	Yes	30	3
	No	11	4
Gloves	Yes	14	2
	No	27	5
Lead glasses	Yes	1	0
	No	40	7

ity of lead glasses. On the other hand, among the seven technicians of health centers, all of them have reported the availability of lead aprons, only two, thyroid collars, 3, gonad shields, two, gloves, and none, lead glasses.

As regards the conditions of these radiological protection materials, the 41 technicians working in hospitals have reported a good condition for lead aprons and thyroid collars; however, among those 30 technicians who reported the availability of gonad shields, only 19 have reported good conditions for these materials. And, among the 14 technicians who have reported the availability of gloves, only 10 have reported good conditions for these materials. Among the seven technicians in health centers, six have reported good conditions for lead aprons; The two technicians who have

reported the availability of thyroid collars have also confirmed the good conditions of both collars, only two of the three technicians who have reported the availability of gonad shields have reported good condition for these materials, and good conditions of gloves have also been reported by both technicians who have reported the availability of this material.

The analysis of Table 4 about the presence of physical barriers against ionizing radiation, demonstrates that 40 of the 41 technicians in hospitals have reported the existence of barytes boards, 39, lead glass shielding, and 40, lead doors. The seven technicians in health centers have reported the presence of all the types of physical radiation barriers in their institutions.

As regards radiation hazard warning safety signs, all of the 41 hospital techni-

Table 4 Presence of physical barriers against ionizing radiation.

Physical radiation barriers	Availability	Hospital	Health center
Barytes boards	Yes	41	7
	No	0	0
Lead glass shielding	Yes	39	7
	No	2	0
Lead doors in th unit	Yes	40	7
	No	1	0

cians have reported the presence of these safety signs in their institutions; however, only 11 of them have reported the presence of this type of safety signs for pregnant women in their institutions. All the seven health center technicians have reported the presence of these warning signs in their institutions, but only four of them have reported the presence of such warning signs for pregnant women.

DISCUSSION

As regards the technicians' knowledge about QCP, 30 of them (62.5%) do not know what a QCP is, so it is not very easy to implement quality guidelines since quality concepts are not diffused among practitioners⁽⁹⁾.

Knowledge about the current regulations on radiodiagnosis quality control has been reported by 28 technicians (58.3% of the study population). This result is different from those found by Santos et al.⁽¹⁰⁾, who have verified the necessity of implementation of a QCP, not only for testing equipment, but also for updating practitioners lacking knowledge about regulations regarding the utilization of ionizing radiations by health centers.

In the analysis of the role played by the implementation of QCP as a motivating factor for professionals, the authors have observed that 43 technicians (89.6% of the study population) considered that this would be a motivating factor. However, five technicians (10.4%) have considered that the implementation of a QCP would not be relevant for their professional motivation. These results are compatible with the study developed by Boavista et al.⁽¹¹⁾, demonstrating that this is a subjective question involving individual expectations and motivations. Some people do not feel the necessity of intervening or changing; oth-

ers do feel this necessity, but understand that this problem should be addressed at administrative and governmental level.

In the evaluation of the technicians' interest in the elaboration of a QCP in their institutions, the authors have observed that the interest was high in 77.1% of the study population. These results corroborate the argument of Quaresma in a report about Hospital de Santa Marta⁽¹²⁾, outlining that the positive aspect of the whole accreditation process has ended up being the progressive involvement of the professionals and the change in the organizational culture, considering that the professionals have undergone a behavioral change, from individuals meant to merely do a job that should be strongly submitted to hierarchical and bureaucratic controls into active and innovative individuals involved in the entrepreneurial network⁽¹³⁾. From the quality point of view, this change should be seen as a natural result of a voluntary task consciously accomplished by each professional.

In processes of change, there is always a group of individuals who are the driving force, with higher capacity of development and leadership, as confirmed by a study developed by the Hospital de Santa Marta, demonstrating that 92.7% of their health professionals were involved in the development of quality policies and/or procedures, 94.5% contributed to the involvement of other professionals in the project setup, and 74.4% perceived the recognition of their efforts by the top management of the institution⁽¹²⁾.

The results of the present study as regards radiological protection materials are compatible with the results of another study developed by Pianezzola et al.⁽¹⁴⁾, where the authors observed the non-compliance of the institution evaluated with the baseline principles of radiation protection,

such as the absence of radiation hazard warning safety signs, as well as the absence of lead glass shielding.

CONCLUSIONS

Considering the contemporaneousness of the theme, the present study as a scientific investigation, more than finding answers and conclusions, is aimed at proposing a reflection on the variables involved in the implementation of a quality control program for diagnostic radiology facilities, from the human element and inherent peculiarities concerning his/her personal and professional journey to the expectations regarding the implementation of a QCP.

Such reflection would allow an evaluation of the opinion of practitioners in the area of radiological diagnosis and therapy on the necessity of a QCP implementation, as well as the availability of radiological protection materials in their unities.

So, the authors have undertaken the present investigation to evaluate the knowledge among radiology technicians on principles of quality control in radiology, as well as their interest in the implementation of a QCP in their units and their opinion on the impact of such implementation on their professional motivation, besides evaluating if the institutions where these technicians develop their activities meet the requirements for QCP implementation.

Based on these considerations, the authors conclude that, although radiology technicians do not know what a QCP is, they are willing to collaborate in the elaboration of this program.

REFERENCES

1. França M. Qualidade e segurança do doente na ordem do dia. *Qualidade em Saúde*. 2005;13:23-5.
2. Secca MF. Bases físicas das diferentes técnicas. In: Pisco JM, editor. *Imagiologia básica – texto e atlas*. Lisboa: Lidel; 2003. p. 3-6.
3. Brasil. Ministério da Saúde. Agência Nacional de Vigilância Sanitária. *Radiodiagnóstico médico: desempenho de equipamentos e segurança*. Brasília: Editora Anvisa; 2005.
4. Botelho MZ, Góes EG, Lykawka R, et al. Implantação de programa de garantia da qualidade no laboratório de raios X diagnóstico do Curso de Física Médica do Centro Universitário Franciscano. 2003 [acessado em março 2006]. Disponível em: <http://www.abfm.org.br/c2005/trabalhos/SPEN02.pdf>
5. Kotsubo MTK, Marchiori E, Azevedo ACP. Estudo dosimétrico de radiografias de tórax com o

- emprego de técnicas de alta quilovoltagem. *Radiol Bras.* 2003;36:163-7.
6. Lima JP. Física das radiações e proteção contra as radiações ionizantes. In: Pisco JM, Souza LA, editores. *Noções fundamentais de imagiologia*. Lisboa: Lidel; 1998. p. 5-15.
 7. Quintela de Brito J. Subsídios para a história da proteção contra radiações e historial da Sociedade Portuguesa de Proteção Contra Radiações. [acessado em agosto 2006]. Disponível em: <http://www.sppcr.online.pt>
 8. Navarro M, Gurjão J, Alcantara E, et al. Qualidade em radiodiagnóstico médico e odontológico: a importância da portaria MS 453/98. *Revista E.T.C.* 2000;(2).
 9. Guerreiro I. Três manuais da qualidade implementados. *Qualidade em Saúde – Edição Especial.* 2003;17-27.
 10. Santos CMB, Fausto AMF, Velasco FFG, et al. Implementação do controle de qualidade em equipamentos emissores de raios-X em clínicas odontológicas de Itabuna. *Anais do 11º Seminário de Iniciação Científica – Ciências Exatas e da Terra.* 2004;302-4.
 11. Boavista A, Simões AC, França M. Avaliação do impacto da acreditação nos profissionais de saúde. *Qualidade em Saúde.* 2004;11:10-4.
 12. Hospital de Santa Marta, SA. Em busca da perfeição. *Qualidade em Saúde – Edição Especial “Acreditação de Hospitais”.* 2004;15-20.
 13. Lopes A, Reto L, António NS. Recursos humanos e gestão da qualidade, uma análise de caso. *Revista de Gestão.* 1989;7:18-25.
 14. Pianezzola CH, Velasco FG, Fausto AMF, et al. Contribuição à implantação do programa de controle de qualidade em diagnóstico por imagem em um hospital de Ilhéus. *Anais do 11º Seminário de Iniciação Científica - Ciências Exatas e da Terra.* 2004;307-8.