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Research Article

Framework for health care quality and evidence-based practice in radiology departments: A regional study on radiographer's perceptions

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ABSTRACT

Introduction: The main goals of this study were to describe, in an integrated and multidimensional way, the conditions related to the quality of care in radiology departments from Algarve (Portugal), to assess the perspective of radiographers on the use of scientific evidence in clinical practice and to validate a model that characterizes the conditions for continuous improvement.

Methods: A cross sectional study was performed in four radiology departments from public and private healthcare facilities from Algarve region (Portugal). A paper-based survey was sent to all radiographers to assess the quality systems implemented in their radiology departments and their perspective on the use of scientific evidence in clinical practice.

Results: In total, 62 radiographers (61.4%) completed the survey. The quality dimensions that obtained the highest degree of compliance were the existence of quality assurance and improvement activities (43.0%), existence of standards in clinical practice of radiographers (42.7%) and the existence of special provisions (37.6%). The quality dimension related to patient's involvement was the one with the lowest level of compliance. Moreover, from the radiographers perspective, positive responses were obtained related to evidence-based actions (83.0%), sources of evidence (76.0%) and the significance of research activities (74.0%).

Conclusion: These findings suggest that a new framework based on four factors (Support for Information; Organizational Capability to Technical Quality of Care; Patient Involvement and Evidence-Based Radiology), should be considered in the establishment of strategic policies that better define the provision of diagnostic procedures and professional practices in radiology departments from Algarve region, based on quality improvement systems and better patient safety.

Implications for Practice: There is a need to include patients in the decision-making process, to involve radiographers in quality assurance and improvement activities and to implement quality monitoring mechanisms within radiology departments under study.

RÉSUMÉ

Introduction: Les principaux objectifs de cette étude étaient de décrire, de manière intégrée et multidimensionnelle, les conditions liées à la qualité des soins dans les départements de radiologie de l'Algarve (Portugal), d'évaluer la perspective des radiographes sur l'utilisation des preuves scientifiques dans la pratique clinique et de valider un modèle qui caractérise les conditions d'amélioration continue.

Méthodologie: Une étude transversale a été réalisée dans quatre services de radiologie d'établissements de santé publics et privés de la région d'Algarve (Portugal). Une enquête sur papier a été envoyée à

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tous les radiographes pour évaluer les systèmes de qualité mis en œuvre dans leurs services de radiologie et leur point de vue sur l'utilisation des preuves scientifiques dans la pratique clinique.

Résultats: Au total, 62 radiographes (61,4%) ont répondu à l'enquête. Les dimensions de la qualité qui ont obtenu le plus haut degré de conformité sont l'existence d'activités d'assurance et d'amélioration de la qualité (43,0%), l'existence de normes dans la pratique clinique des radiographes (42,7%) et l'existence de dispositions spéciales (37,6%). La dimension de la qualité liée à l'implication du patient est celle dont le niveau de conformité est le plus faible. De plus, du point de vue des radiographes, des réponses positives ont été obtenues concernant les actions fondées sur des preuves (83,0%), la source des preuves (76,0%) et l'importance des activités de recherche (74,0%).

Conclusion: Ces résultats suggèrent qu'un nouveau cadre basé sur 4 facteurs (soutien à l'information, capacité organisationnelle à la qualité technique des soins, participation du patient et radiologie fondée sur des preuves), devrait être pris en compte dans l'établissement de politiques stratégiques qui définissent mieux la fourniture de procédures de diagnostic et de pratiques professionnelles dans les départements de radiologie de la région d'Algarve, sur la base de systèmes d'amélioration de la qualité et d'une meilleure sécurité du patient.

Keywords: Quality of care; Continuous improvement; Quality system; Evidence-based radiology, Radiology department, Radiographer

Introduction

Promoting quality and safety in healthcare provision demands organizational structures that have support resources, focusing on continuous improvement and systematical adaptation of standards and practices based on the best available scientific evidence [1]. To achieve this goal, it is necessary to identify the problems, key barriers and facilitators with influence on the quality of care provided in the health services [2]. However, literature reveals a lack of evidence in the measurement and evaluation of the main elements when defining health policies in Europe (patient safety, quality perception, patient satisfaction, continuous quality improvement, certification and accreditation processes based on evidences), and additional studies must be carried out with the inclusion of such elements [3–8]. These concerns are more evident in radiology departments, as the literature reveals little evidence of studies involving the measurement of quality issues and quality management in the different imaging modalities. Also, studies on health quality management mostly consider hospital organizations, not differentiating the different departments and services. Stakeholders do not use or evaluate all types of services and departments in the same way, as they have specific and different characteristics [9]. The literature is not clear regarding the quality of care in different departments of health organizations, as some studies in this field do not have a multidimensional and holistic approach centered on each of these departments [10–12].

Thus, there is a continuing need to increase the quality in the provision of health services, especially in radiology departments, that have grown in resources (number of workers, equipment's, procedures, facilities) in recent decades due to the increasing availability of technology, which has led to the increasing use of ionizing radiation-based procedures performed on patients [13].

The main strategic objectives of a radiology department should include procedures and processes in accordance to the patients' expectations and needs, based on the latest scientific evidence and on the principles underlying the organizational culture of quality improvement (QI) [14]. Thus, there is a need to develop a valid model for the assessment of quality of care in radiology departments.

Therefore, the main goals of this study are (1) to describe, in an integrated and multidimensional way, the conditions related to the quality of care in four radiology departments from Algarve region (Portugal), (2) to assess the perspective of radiographers on the use of scientific evidence in their clinical practice and (3) to validate a model that characterizes the conditions for continuous improvement in radiology departments under study. The study results will provide important policy implications for the ongoing health-care reform in radiology departments in Algarve region (Portugal).

Methods

Participants and sample

A cross-sectional study was carried out in 3 public and 1 private radiology departments from primary and tertiary institutions in the Algarve region. The target population were the radiographers from the facilities, including radiographers with management responsibilities/tasks (n=101; 51 from public tertiary institutions; 31 from primary healthcare facilities and 19 from private tertiary institutions).

Instrument

A paper-based survey was used between November 2018 and June 2019. In order to increase cooperation from the radiographers to answer time-consuming questionnaires, the main researcher distributed the questionnaires in person to explain the objectives of the study and their importance for improving healthcare quality in imaging departments. It was also explained that the answers should be related to their workplace and their daily professional practice.

The questionnaire used in the study (Annex 1) was adapted into three main parts, based on two previously published surveys, after permission from their authors [15–18].

Table 1
– Survey structure.

Sections	Aims	Number of Items	Scale
A - Quality Policy (QP)	Assess availability/existence of documentation	8	Nominal
	Check the appropriateness level of the documents	8	Ordinal
B - Patient Involvement	Assess the patient involvement in QA and improvement activities	6	Nominal
	Check the appropriateness level of the patient involvement	6	Ordinal
C - Standards	Assess availability/existence of written procedures	8	Nominal
	Check the appropriateness level of procedures/standards	8	Ordinal
D - Human Resources Management (HRM)	Assess availability/existence of programs for the implementation of QA and improvement activities	7	Nominal
	Assess the relationship between HRM and QP	5	Nominal
	Assess the incentive by managers for the radiographer participation in QA and improvement activities	6	Nominal
	Check the appropriateness level of programs and indicators	18	Ordinal
E - Quality Assurance (QA) and Improvement Activities	Assess availability/existence of QA and improvement activities	25	Nominal
	Check the appropriateness level of the activities	25	Ordinal
F - Overall Aspects	Assess the impact and satisfaction with the quality system	4	Nominal
	Assess the degree of Satisfaction	4	Ordinal
G – Evidence-Based Actions	Evaluate the use of evidence-based actions by radiographers	5	Ordinal
H – Significance of Research Activities	Evaluate the importance and the participation of radiographers in research activities in their professional practice	6	Ordinal
I – Support in Research Activities	Assess whether radiographers receive support and incentives to participate in research activities	4	Ordinal
		1	Open question
J – Current Use of Research Evidence in Practice	Assess the current usage of research evidence in the clinical practice of radiographers	8	Ordinal
K – Sources of Evidence	Assess the importance of the different sources of evidence in the performance of the radiographers duties	10	Ordinal
L – Knowledge of Research	Evaluate the radiographers perceptions of their abilities, knowledge and self-confidence related to research activities	11	Ordinal

Survey – Part I (quality management system)

The first part of the questionnaire consisted of a multidimensional approach to the Quality Management System (QMS) implemented in the radiology departments under study, across 69 items grouped in six dimensions, namely: A – Quality Policy (QP); B – Patient Involvement; C – Standards; D – Human Resources Management (HRM); E – Quality Assurance (QA) and Improvement Activities and F – Overall Aspects [15,16].

Survey – Part II (evidence-based practice)

The second part was aimed to assess the radiographers' perceptions of evidence-based practice (EBP), through 47 items grouped in six dimensions: G – Evidence-Based Actions; H – Significance of Research Activities; I - Support in Research Activities; J – Current Use of Research Evidence in Practice; K – Sources of Evidence and L – Knowledge of Research [17,18].

Survey – Part III (socio-professional characterization of the radiographers)

The last section of the questionnaire included socio-professional questions about age, gender, academic qualification, and management tasks.

The survey used mainly closed questions with different response scales, as can be seen in Table 1 and Annex 1. All dimensions from the original instruments were kept in this study.

Ethical Considerations

This study was conducted in compliance with all ethical research considerations and with the Portuguese Republic law on data protection [19]. The Institutional Ethical Boards approved the study (Ref: HAL_01_2820 and CFIC_11_11_2020) and written informed consents for participation were obtained by the radiographers using a short form.

Statistical analysis

Statistical analysis was performed through IBM-SPSS® (*Statistical Package for Social Science* V.25)

The reliability of the questionnaire was assessed using the Cronbach's alpha method (global alpha value of 0.92), indicating a very good level of internal consistency.

Socio-professional information and the degree of compliance with quality criteria assessed through the QMS items, were summarized using descriptive statistics. The degree of compliance was evaluated through the absolute frequencies of the answers "Yes", "Always", or "Under Development". Negative responses were considered as non-compliance. A Pareto analysis was performed to map and rank the quality defects (non-compliance) identified in the radiology departments, using a 95% confidence interval. This analysis consists of a complete and informative chart representation of the non-conformities found in terms of absolute and relative frequencies and accu-

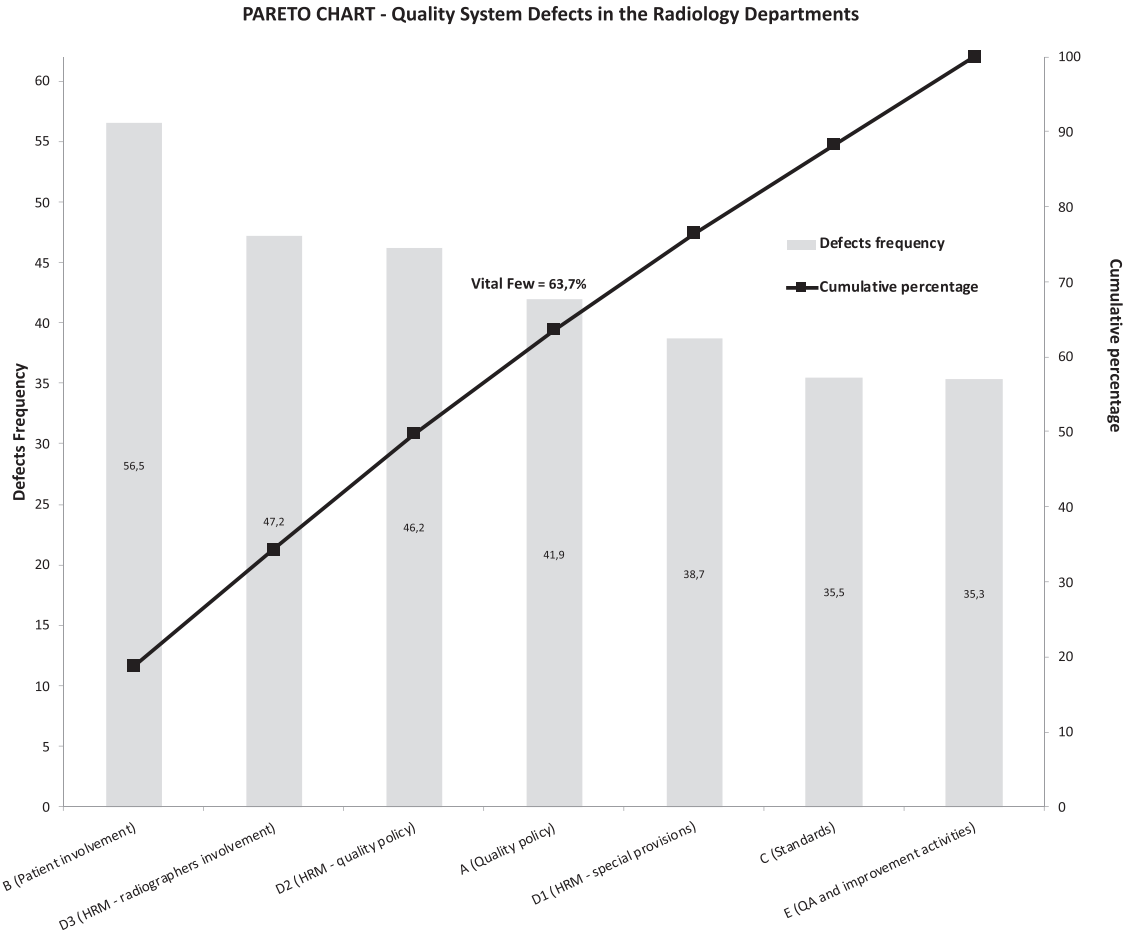

Fig. 1. Pareto chart of the quality system defects (non-conformities) of the radiology departments (dimensions on the x-axis; defects frequency on the left y-axis; ranked bars in ascending order; cumulative percentage of non-conformities on the right y-axis, and cumulative percentage curve traversing the categories from left to right).

mulated percentage (Fig. 1), to assist in prioritization of intervention strategies.

In the analysis of the radiographers' perceptions of EBP, positive responses were considered (absolute frequency of responses "totally agree", "very important", "partially agree", "important" on the *likert* scale). The questionnaire used can be found in Annex 1.

A multivariate analysis (Principal Components Analysis) was performed to identify patterns in the correlations between variables, and thus define the structure/framework of the model under study. Through this statistical method, it was possible to "regroup" the variables into a smaller number of variables. This regrouping was done based on variation that is common to multiple variables. In carrying out this procedure, the necessary assumptions were verified: (1) the adequacy of the sample for running a factorial analysis (*Kaiser-Meyer-Olkin* (KMO) *Measure of Sampling Adequacy*) and (2) the significant correlation between the variables (*Bartlett's test of sphericity*). Eigenvalues were used to select the number of factors to retain in our framework (based on the explained variance values) and a varimax rotation was applied (based on the high loadings on each factor).

Results

Demographic characteristics

Of the 101 radiographers who received the survey, 62 (61.4%) responded. Response rates ranged from 47.4% in the radiology departments from private tertiary institutions to 86.7 in the public institutions. 45.2% of the participants were females and 54.8% males, aged between 25 to 59 years old (mean = 38.1; std. deviation (SD) = 8.84). Regarding their academic qualifications, 72.6% have a bachelor's degree, 22.6% a master's degree and 4.8% a doctoral degree. Professional experience ranged from 1 to 39 years (mean = 12.2; SD = 8.85), and 11.3% radiographers hold leadership positions (management tasks) in their radiology departments. Only one radiographer (1.6%) mentioned being a member of the quality committee.

Conditions related to the quality of care – the radiographers view

The quality dimensions that obtained the highest degree of compliance were dimension E (QA and improvement activities in the radiology department), dimension C (existence of stan-

dards that are used in clinical practice by radiographers) and sub-dimension D1 (existence of special provisions). Dimension B (patient's involvement), sub-dimensions D3 (encouraging the radiographer's participation in QA and improvement) and D2 (relationship between HRM and the QP), and dimension A (quality policy), were the groups with the lowest levels of compliance. The detailed results of the different dimension items can be seen in Table 2.

Thus, 4 dimensions were identified as those that have a negative impact on the QMS, according to the Pareto principle (Fig. 1) [20]. Together, these 4 dimensions represent 63.7% of the total defects found.

The use of scientific evidence in the clinical practice of radiographers

Radiographers' perceptions of EBP were evaluated analyzing the percentage of positive answers. The dimensions that obtained the most positive results (in mean %) were the evidence-based actions with 83%, the sources of evidence with 76% and the significance of research activities of 74%. The dimension with least positive results was the "support in research activities" with 33% of positive answers. The results obtained on the radiographers perceptions for EBP are detailed in Table 3.

Structure of the model: conditions for continuous improvement in radiology departments

The results obtained for the *KMO Measure of Sampling Adequacy* (0.678) and the *Bartlett's test of sphericity* ($Chi^2 = 178.567$; df= 55; $p = 0.000$) suggests that the sample is adequate for running a factorial analysis and the variables are significantly correlated [21]. The extraction communalities were considered appropriated (between 0.615 and 0.790), [21] and a total of 4 factors were obtained which explain 68.7% of the variability in the original 11 dimensions. It appears that the most important determinants for Quality of Care and EBP in radiology departments are those contained in factor 1 with 25.4% of the total variance explained, followed by factor 2 with 19.3%, factor 3 with 13.1% and factor 4 with 10.8%.

Using a varimax rotation, it was possible to determine the initial dimensions that compose the new 4 factors obtained. Therefore, factor 1 is mostly defined by dimension E (QA and improvement activities), dimension D (HRM), dimension A (QP) and dimension C (standards). This first component is most highly correlated with the Conditions for Quality of Care and EBP model. Factor 2 is defined by dimension H (significance of research activities), dimension L (knowledge of research), dimension G (evidence-based actions) and dimension J (Current use of research evidence in practice). Factor 3 is defined by dimensions K and I (sources of evidence and support in research activities) and factor 4 keeps the initial dimension (patients' involvement). The 11 initial dimensions can be now represented by new 4 variables (Support for Information; Organizational Capability to Technical Quality of Care; Patient Involvement and Evidence-Based Radiology), without considerable loss of information, from the perspective of radiographers. Therefore, the 11 initial dimensions have been simplified into just 4 that can be used as the reference dimensions in the departments under study. Based on these results, a conceptual model was designed (Fig. 2), which is intended to summarize the main findings of this research.

Discussion

This study provides important insights into the conditions for quality of care and EBP in the radiology departments, in a perspective of continuous improvement culture. This issue is relevant considering the overuse of ionizing radiation in medical imaging procedures, [22] the need to ensure patient safety in these departments [22] and the need to improve the quality of care [10,23]. Therefore, the obtained framework should be considered in the establishment of strategic policies that better define the provision of diagnostic procedures and professional practices, based on quality improvement systems and better patient safety.

Quality management systems in radiology departments

This study has highlighted the lack of knowledge of radiographers on the existence of documentation on QA and improvement (quality policy dimension) in their departments. In accordance with the principles underlying clinical governance; quality systems should improve the standards of radiology departments, and their managers should be responsible for monitoring and systematically improving the quality, and professionals should be accountable and responsible during clinical practice [24]. Thus, perhaps it would be beneficial to increase the involvement of radiographers in QA and improvement policies, which can be achieved through adequate training and education, including educating radiographers on the importance of supporting documentation [15,25]. Similar results were obtained by Leão et al, [26] who found that radiographers consider the implementation of quality systems to be essential, but that they need training in this field (only 25% had training in this study). In addition, 53.2% of radiographers state they do not know exactly what quality programs are. Thus, it is essential that radiology departments establish strategies for implementing QA and continuous improvement programs, which can be understood by radiographers [27]. At the same time, for their effective implementation, professionals must understand the basic principles of total quality management and make an appropriate use of quality tools. Quality improvement can never be a passive process and radiographers should be engaged [27].

In the radiographer's perspective, there is a high agreement regarding non-involvement of patients in QA and improvement activities. This absence of a patient involvement culture should be changed, since patients are the main reason for the existence of these departments, and they have a unique perspective as users. The paradigm should change and radiology departments of this study must pay particular attention to the

Table 2
Evaluation of QMS implemented in the radiology departments, from the radiographer's perspective (n = 62).

Dimensions and items	Compliance	
	n	%
A: existence of QA and improvement documents		
Written mission statement	29	46.8
Procedures for patients with special needs	15	24.2
QA documents	19	30.6
Quality action plan	20	32.2
Annual quality report	16	25.8
Quality handbook	20	32.3
Procedures in the radiology department	26	41.9
Procedures outside the radiology department	16	25.8
B: patient's involvement		
Developing quality criteria	16	25.8
Developing protocols and standards	10	16.1
Meetings with radiographers about results of satisfaction surveys and complaints	-	-
Participation in quality committees	-	-
Participation in QI projects	3	4.8
Evaluating QI process	4	6.5
C: existence of standards that are used in clinical practice by radiographers		
Standards for performing invasive imaging examinations	19	30.6
Standards for patient communication	20	32.3
Standards for safety and radiation protection	41	66.1
Standards for utilization of imaging equipment	32	51.6
Standards for management adverse reactions to contrast media	29	46.8
Standards for performing imaging examinations (CT, MRI …)	32	51.6
Standards for patient routing from intake to exit	21	33.9
Standards for co-operation with other departments	18	29.0
D1: existence of special provisions		
Training/education of radiographers	52	83.9
Training/education of other professionals/staff	39	62.9
Radiographers has support by quality experts/consultants	14	22.6
Quality coordinator (radiographer) for improvement activities	32	51.6
Quality working groups	14	22.6
Image archive for training/education purposes	11	17.7
Budget for quality management	1	1.6
D2: relationship between HRM and the QP		
Selection of new radiographers with positive attitude to QA	16	25.8
Training new radiographers in QI methods	14	22.6
Continuous education based on priorities in QP	10	16.1
Radiographers are encouraged to develop the radiography profession, including in QP issues	22	35.5
Participation of radiographers in QI projects is mandatory	17	27.4
D3: encouraging the radiographers participation in QA and improvement		
Radiographers pay enough attention to QA/improvement (no other incentives are necessary)	19	30.6
The radiographer with management tasks indicates what is expected from radiographers with respect to QA	18	29.0
The radiographer with management tasks checks whether radiographers stick to commitments	12	19.4
Feedback to radiographers about results achieved	16	25.8
Management encourage the radiographer's involvement in the quality system	11	17.7
Monitoring imaging department action plans	13	21.0
E: existence of QA and improvement activities in the radiology department		
Radiographers performance evaluation carried out by peers	36	58.1
Radiographers performance evaluation carried out by other professionals	10	16.1
Radiographers performance evaluation with their own participation	45	72.6
Internal audit	20	32.3
Satisfaction survey among patients	14	22.6
Satisfaction survey among professionals from imaging department	7	11.3
Satisfaction survey among referring physician	4	6.5
Needs and expectations survey among patients	4	6.5
Needs and expectations survey among professionals	5	8.1
Use of complaints registration for QI	13	21.0
Computer record of radiological exams scheduling	47	75.8
Digital radiology system	50	80.6
Structured review of practices, procedures and results against standards of practice in radiology	20	32.3

(*continued on next page*)

Table 2 (*continued*)

Dimensions and items	Compliance	
	n	%
Procedures performed by qualified professionals with knowledge and training in quality	44	71.0
When critical findings are detected, the radiologist or in his absence the radiographer, informs the referring physician	45	72.6
There are highlighted signs to alert pregnant women to the risks of ionizing radiation	61	98.4
Periodic safety assessment of imaging rooms and equipment's	53	85.5
QA and control program of equipment's	43	69.4
Analysis of waiting times between prescription and imaging examinations	8	12.9
Analysis of patient waiting times in the imaging department	5	8.1
Analysis of waiting times until report is delivered to the patient	5	8.1
Medical prescription for all imaging examinations	49	79.0
Rejection of imaging examinations without justification	27	43.5
Absorbed dose evaluation, in compliance with ALARA principle	27	43.5
Diagnostic reference levels are set	25	40.3
	Satisfaction	
F: overall aspects	**n**	**%**
Overall quality of the radiology department	28	45.2
Overall image of the radiology department	36	58.1
Overall organization and management of the radiology department	26	41.9
Overall services provided by the radiology department	44	71.0

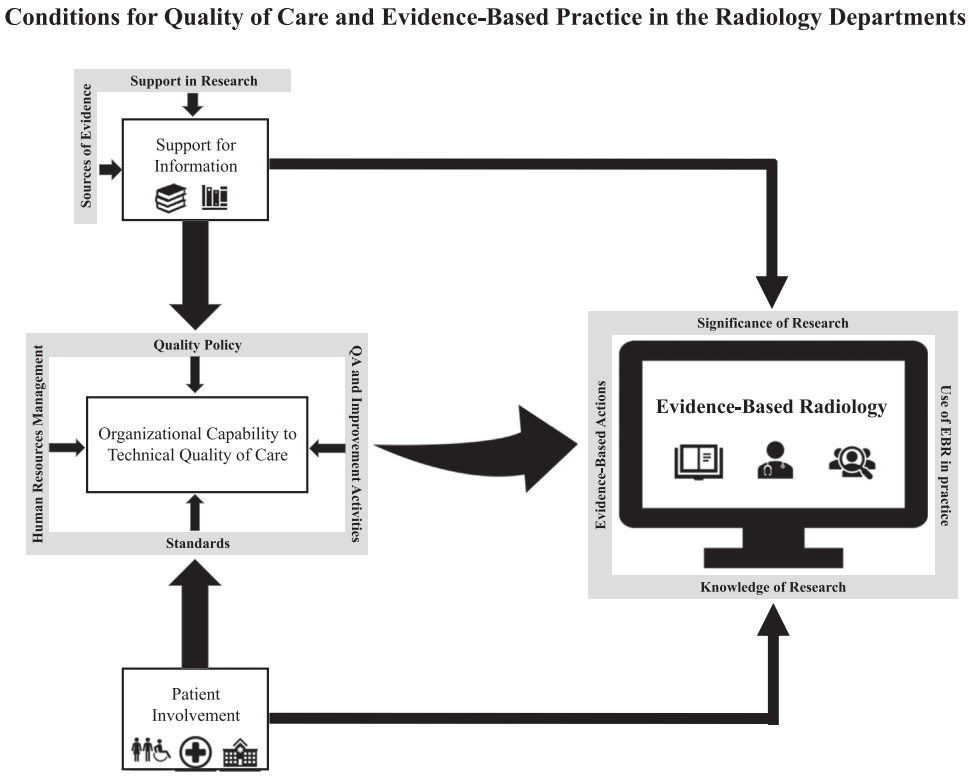

Fig. 2. Conceptual model based on the Factorial Analysis of the main components, describing the different variables and factors.

patient involvement in quality issues, in order to improve their access, literacy, decision-maker power as well as integrating into pathways of care [28]. Also, the effectiveness of a QMS requires a philosophy of continuous quality improvement based on the experiences, expectations and needs of patients, ensuring their physical and psychological well-being [22,29].

Regarding the use of written procedures (standards) by radiographers in their clinical practice, there is still room for improvement, especially in aspects related to invasive procedures, for communication with the patient and for cooperation with other departments. Improving the communication strategy will increase the degree of patient satisfaction and improve the quality of the service provided [30]. Considering the key role of the radiographer in communicating radiation risks to patients, studies emphasize the need to create consensus documents on how to communicate the risks and benefits of imaging proce-

Table 3
Assessment of radiographers' perceptions for EBP.

Dimensions and items	Positive Answers (%)
G: evidence-based actions (n = 62)	
Evidence-based action has relevance to radiographer's work	89
Evidence-based action is part of the radiographer's role	85
It is useful to use evidence-based data to support radiographer role during their practice	94
Evidence-based action is useful for developing/improving radiographer practices	92
Research activities provide information on the radiographer's work	92
Tacit knowledge is a sufficient scientific basis of knowledge in the radiographer's work	77
The radiographer's work is practice-based, so the contribution of scientific research is not necessary	95
Scientific data research takes time off radiographer's work	39
H: significance of research activities (n = 62)	
Participate in research activities is part of the professional activities	65
Participate in research activities improves the possibilities for career promotion/progression	50
Participate in research activities is part of the teacher/monitor role in student education	82
Participate in research activities helps in professional and personal development	84
Radiographers are available to participate in research activities	79
The imaging department should develop research projects	81
I: support in research activities (n = 62)	
Support and encouragement from colleagues to participate in research activities	40
Support and encouragement from other healthcare professionals to participate in research activities	15
Support and encouragement from imaging department manager to participate in research activities	52
Support and encouragement from department director to participate in research activities	24
J: current use of research evidence in practice (n = 33)	
Talk about scientific data with colleagues	67
Talk about scientific data with the hierarchical superior	45
Actions are based on scientific data	73
Question the practices based on scientific data	76
Try to change / adapt practices based on scientific data	85
Talk about scientific data with the students (if applicable)	73
Talk about scientific data with the teachers who guide research work (if applicable)	55
Teach students to search scientific data during clinical internship periods (if applicable)	55
K: sources of evidence (importance in the accomplishment of the radiographer's duties; n = 62)	
Knowledge acquired during graduation	97
Scientific research	92
Reference Manuals	97
Medical literature	79
Practices not registered in the department	44
Practices registered in the department (quality manuals, instructions and procedures)	60
The tacit knowledge	79
Colleagues	74
Instructions and orders from physicians / radiologists	55
Training days (e.g. safety and radiation protection)	81
L: knowledge of evidence (n = 62)	
Ability to participate in research activities	74
Basic knowledge about the research process	78
Knowledge about the stages of the research process	66
Knowledge about scientific studies in the field of imaging	40
Research capabilities are sufficient to search scientific data	63
Know how to use research results during professional practice	73
Know well the results of current investigations in the field of imaging	29
Sufficient English skills to read and understand scientific reports	63
Sufficient knowledge of research methods to understand the scientific studies	65
Sufficient knowledge of statistical methods to understand the results of scientific studies	47
Be able to critically evaluate scientific studies	58

dures, which should be implemented to achieve more effective communication [31,32].

Radiographers should also improve the use of standards and protocols in their clinical practice, so that the procedures are more systematized and always updated according to the new evidence [33]. This need for standardization has also been emphasized by several professional societies, [34,35] including for the definition of low-dose protocols, which allow greater radiation protection for patients [36].

Greater attention should also be given to the involvement of radiographers in relation to QA and improvement activities, through education and training strategies, and managers should

also take the initiative to involve and commit radiographers in quality systems, indicating what is expected and providing feedback systematically. Crosby (1979) argued that quality initiatives should come from the top to bottom management and that radiographers must be trained to use QI tools, [37] which does not appear to happen from the perspective of the radiographers of this study. The inclusion of radiographers in quality management activities and involvement in the definition of quality policies, allow them to remain competitive in an increasingly complex environment [38]. This highly values the radiographer role, assigning new responsibilities and increasing their commitment to the quality system [29]. Accountability underlies the principles of clinical governance, where the need for consistent support mechanisms based on EBP and teamwork are mentioned as essential requirements for continuous improvement [24]. Thus, it seems unequivocal that to improve the assessment of Human Resources Manamement dimension in radiology departments, the involvement and commitment of radiographers in the management process should be required, and the role of radiographer manager is crucial [39]. The lack of encouragement to be involved in the department's quality systems is an obstacle to the process of implementing QMS and to the culture of continuous improvement [40].

The existence of QA and improvement activities in the radiology departments allows the identification of priority areas for improvement and allows the comparison of several departments from a benchmarking perspective [25]. Thus, the results of this study suggest that the fulfillment of the needs and expectations of professionals and patients may be compromised, and it is necessary to foster a greater quality culture in these aspects. Furthermore, the Diagnostic Reference Levels are not establisehd and there seems to be no rejection of medical requests for imaging without clinical justification. The current tendency to practice defensive medicine means that the principle of justification is not respected often, possible compromising the patient safety. So, in this study, there seems to be a need to establish better cooperation between referring physicians and radiology departments, in order to clarify the need for imaging examinations in each situation [38,41].

Evidence-based practice

Radiographers surveyed consider that evidence-based actions are important for their work, part of the profession, necessary and that allow the improvement of practices. As mentioned by different authors, making decisions supported by evidence can avoid the use of unnecessary procedures and avoid ineffective procedures, increasing the quality of service and patient safety [18,33]. Also, by improving professional practice, patient outcomes will also be improved [42].

Research activities are important at different levels. Radiographers are available to participate and they consider that radiology departments should develop research projects. This culture has to be a commitment made by the leaders and managers of the radiology departments, as mentioned [43,44]. However, it is also necessary to allocate resources for research activities, as several studies consider that radiographers intend to obtain some benefit through these activities, whether in terms of salary or professional progression [17]. The research must also be seen as an enhancing tool for EBP, updating practices, rationalizing the available resources and increasing the rigor and quality of the procedures performed in the department [17,18].

The radiology department's management should have the responsibility to provide continuous education and training to radiographers, so that they obtain the skills and tools necessary to conduct research activities, and to incorporate the results of these investigations into their clinical practice [39]. This could be a key element in the implementation of new practices that will improve the quality of the departments under their management [44].

Most radiographers mentioned that already participated in research activities and their practices are based on scientific data. This information is supported by Hillman, [42] who refers that adequate information-seeking behavior and research knowledge are necessary preconditions for the application of EBP. Moreover, radiology departments and academic institutions must collaborate together, provide more knowledge to radiographers about research methodologies and how to translate clinical research data into clinical practice [33].

Clinical practice of radiographers must be constantly reviewed, constantly questioned and decisions must be made on the available evidence. These strategies will help them to formulate the right questions, to develop the skills they need to explore and evaluate the evidence, aiming at possible patient benefits [45].

Framework for continuous improvement in radiology departments

The most revealing factors to take into account from the perspective of radiographers are the organizational capability to quality of care (Factor 1), evidence-based radiology (Factor 2), support for information (Factor 3) and patients involvement (Factor 4). For these professionals, organizational capability for technical quality of care encompasses several elements such as the existence of documentation (QP), the rigor of procedures (standards), the involvement and commitment of radiographers (HRM), and the existence of QA and improvement activities [46]. Moreover, there is evidence that an internal approach through the professionals themselves can lead to the identification of opportunities for quality improvement without using additional resources [10,47]. Patients' involvement in quality systems is essential, as they are the central element of the national healthcare service, and their needs and expectations are fundamental in building quality improvement policies and strategies [46]. These aspects are especially important in the Algarve region, as the reports reinforce barriers experienced by population in accessing hospital care [48].

Support for information is also essential for providing organizational capability to quality of care. The organizational structure of a radiology department should support resources focusing on continuous quality improvement and adapting systematically the standards and professional practices in function

of the best available scientific evidence [1,25]. Close supervision and good cooperation and communication between radiographers and their managers, also allows to identify potential problems, key barriers and facilitators with influence on the quality of care provided in the radiology departments [49]. Systematic monitoring and the proper use of quality improvement tools can also be a valuable aid in this regard [50]. Therefore, in this study, the implementation of Evidence Based Radiology (EBR) in radiology departments is determined by the organizational ability to provide technical quality of care, which is only possible with the patient involvement and with the creation of information support mechanisms, based on research evidence.

Thus, to provide EBR in the radiology departments, the creation of adequate conditions for the support of information based on research and evidence, with the patient involvement, are the necessary determinants to provide a proper organizational capability to technical quality of care in this study [17,18,33].

Limitations and future research

This study was the first to evaluate the health care quality of radiology departments in the Portuguese context, simultaneously exploring the perceptions of EBP in the clinical practice of radiographers as facilitating attributes of continuous improvement. Thus, new evidence was provided to decision makers when defining policies for the ongoing health-care reform in radiology departments in the southern region of Portugal. However, this study is also subject to several limitations. First, data sources come from regional radiology departments, and the sampling method does not account for a nationwide representative sample. Second, other professionals from radiology departments and top management (strategic level) were not included, limiting the insights collected to the radiographers. The third limitation refers to the subjective nature of human interactions, always difficult to explore in perception studies. The fourth limitation identified was the non-use of qualitative methods, as interviews and the analysis of the existing documentation regarding quality systems in each radiology department included in this study.

Based on these limitations, further studies on this topic should be conducted. The implementation of clinical audit mechanisms (internal and external) is also recommended as they are an efficient QI tool

Conclusions

The QMS have a low level of development, and for improvement it is necessary to include patients in the decision-making process (factor 4), to involve radiographers in QA and improvement activities (factor 1) and to implement quality monitoring mechanisms (factor 3). There is a positive attitude by radiographers towards EBP, where the preconditions for their implementation and systematic use in the radiology departments seem to be met (factor 4). Thus, the obtained framework with 4 factors provides specific knowledge about the intrinsic procedures of the radiology departments of this study, which should be considered when defining quality improvement policies and future studies.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jmir.2022.09.006.

References

[1] Furnival J, Boaden R, Walshe K. Conceptualizing and assessing improvement capability: a review. *Int J Qual Heal Care*. 2017;29:604–611. doi:10.1093/intqhc/mzx088.

[2] Kisembo H, Kinengyere A, Sahal A, Malumba R, Salaama D, Kawooya M. Barriers and facilitators to implementing Clinical Imaging Referral Guidelines among medical professionals: protocol for a systematic mixed studies review. *Res Sq*. 2020. doi:10.21203/rs.3.rs-26094/v1.

[3] Fadlallah R, El-Jardali F, Nomier M, et al. Using narratives to impact health policy-making: a systematic review. *Heal Res Policy Syst*. 2019;17:26. doi:10.1186/s12961-019-0423-4.

[4] Langlois E, Straus S, Jesmin A, King V, Tricco A. Using rapid reviews to strengthen health policy and systems and progress towards universal health coverage. *BMJ Glob Heal*. 2019;4. doi:10.1136/bmjgh-2018-001178.

[5] Pomeroy C, Sanfilippo F. How Research Can and Should Inform Public Policy. *The Transformation of Academic Health Centers: Meeting the Challenges of Healthcare's Changing Landscape* Elsevier Inc.; 2015:179–191.

[6] Soulis S, Sarris M, Pierrakos G, Goula A, Koutitsas G, Gkioka V. Public health policies in European Union: An innovation strategy-horizon 2020. *Cord Blood Stem Cells Medicine* Elsevier Inc.; 2015:347–363.

[7] Alkhenizan A, Shaw C. Impact of accreditation on the quality of healthcare services: a systematic review of the literature. *Ann Saudi Med*. 2011;31:407–416. doi:10.4103/0256-4947.83204.

[8] Busse R, Klazinga N, Panteli D, Quentin W. *Improving Healthcare Quality in Europe: Characteristics, Effectiveness and Implementation of Different Strategies*. European Observatory on Health Systems and Policies; 2019 *www.healthobservatory.eu.*

[9] Al Khamisi YN, Khan MK, Munive-Hernandez JE. Assessing quality management system at a tertiary hospital in Oman using a hybrid knowledge-based system. *Int J Eng Bus Manag*. 2018;10:184797901879700. doi:10.1177/1847979018797006.

[10] Mamede FMB, Gama ZA da S, Saturno-Hernández PJ. Improving the quality of radiological examinations: effectiveness of an internal participatory approach. *Int J Qual Heal Care*. 2017;29:420–426. doi:10.1093/intqhc/mzx026.

[11] De Man S, Gemmel P, Vlerick P, Van Rijk P, Dierckx R. Patients' and personnel's perceptions of service quality and patient satisfaction in nuclear medicine. *Eur J Nucl Med Mol Imaging*. 2002;29:1109–1117. doi:10.1007/s00259-002-0869-3.

[12] Tilkemeier PL, Hendel RC, Heller GV, Case JA. *Quality Evaluation in Non-Invasive Cardiovascular Imaging*. Cham: Springer International Publishing; 2016.

[13] Nunes AM, Ferreira DC. The health care reform in Portugal: Outcomes from both the New Public Management and the economic crisis. *Int J Health Plann Manage*. 2019;34:196–215. doi:10.1002/hpm.2613.
[14] Almeida RPP, Gama ZA, Saturno-Hernandez P, da Silva CA. Effects of an internal and participatory intervention: improving the radiological image. *HealthManagement.org*. 2017;17:392–396. https://healthmanagement.org/uploads/article_attachment/effects-of-an-internal-and-participatory-intervention.pdf.
[15] Wagner C, De Bakker DH, Groenewegen PP. A measuring instrument for evaluation of quality systems. *Int J Qual Heal Care*. 1999;11:119–130. doi:10.1093/intqhc/11.2.119.
[16] Costa JPS. *Gestão da qualidade em dois serviços de radiologia da Região de Lisboa e Vale do Tejo em Hospitais SA: contributo para análise das implicações a nível dos técnicos de radiologia*; 2006 *http://dspace.uevora.pt/rdpc/handle/10174/16002* Accessed October 26, 2019.
[17] Ahonen S-M, Liikanen E. Radiographers' preconditions for evidence-based radiography. *Radiography*. 2010;16:217–222. doi:10.1016/j.radi.2010.01.005.
[18] Dias M, Abrantes A, Silva C, et al.. *Evidence-based practice in radiology* Electronic Presentation Online System; 2013:1–16.
[19] *Lei 58/2019 - Regulamento Geral de Proteção de Dados (RGPD)*; 2019:3–40.
[20] Figueiredo F, Gama Z. Enhancement of radiological protection through an internal quality assessment cycle. *Radiol Bras*. 2012;45:87–92.
[21] Maroco J. *Análise Estatística Com o SPSS Statistics*. 7ed ed. Edições Sílabo; 2018.
[22] European Society of Radiology (ESR), European Federation of Radiographer Societies (EFRS)Patient Safety in Medical Imaging: a joint paper of the European Society of Radiology (ESR) and the European Federation of Radiographer Societies (EFRS). *Insights Imaging*. 2019;10:45. doi:10.1186/s13244-019-0721-y.
[23] OECD. *Health at a Glance 2019: OECD Indicators*. Paris: OECD Publishing; 2019.
[24] Rawlins SM, Donaldson SL. Clinical governance: a quality concept. *Clinical Governance in Primary Care* CRC Press; 2018:1–16.
[25] Zygmont ME, Itri JN, Rosenkrantz AB, et al. Radiology Research in Quality and Safety: Current Trends and Future Needs. *Acad Radiol*. 2017;24:263–272. doi:10.1016/J.ACRA.2016.07.021.
[26] Leão M, Ribeiro L, Abrantes A, et al. *Implementation of a quality control program in a radiology department*. Vienna, AT: European Congress of Radiology; 2013 *Eletronic Presentation Online System*.
[27] Staver N, Caramella D. Successful quality management system in a radiology department. *HealthManagement.org*. 2018;18. https://healthmanagement.org/c/imaging/issuearticle/successful-quality-management-system-in-a-radiology-department. Accessed February 25, 2020.
[28] Royal College of General Practitioners, Society and College of Radiographers, Royal College of Radiologists. Quality Imaging Services for Primary Care: A Good Practice Guide. London; 2013. http://www.sor.org/sites/default/files/images/Quality-Imaging-Services-for-Primary-Care_0.pdf%5Cn; http://www.rcgp.org.uk/~/media/Files/CfC/RCGP-Quality-imaging-services-for-Primary-Care.ashx.
[29] Kleinert S, Horton R. From universal health coverage to right care for health. *Lancet*. 2017;390:101–102. doi:10.1016/S0140-6736(16)32588-0.
[30] van den Berg PF, Yakar D, Glaudemans AWJM, Dierckx RAJO, Kwee TC. Patient complaints in radiology: 9-year experience at a European tertiary care center. *Eur Radiol*. 2019;29:5395–5402. doi:10.1007/s00330-019-06158-z.
[31] Portelli JL, McNulty JP, Bezzina P, Rainford L. Benefit-risk communication in paediatric imaging: what do referring physicians, radiographers and radiologists think, say and do? *Radiography*. 2018;24:33–40. doi:10.1016/j.radi.2017.08.009 .
[32] . *Communicating Radiation Risks in Paediatric Imaging: Information to Support Healthcare Discussions about Benefit and Risk*. WHO; 2016.
[33] Abrantes AFCL, Ribeiro LPV, da Silva CA, et al. Evidence-based radiography: a new methodology or the systematisation of an old practice? *Radiography*. 2020;26. doi:10.1016/j.radi.2019.09.010.
[34] European Society of Radiology, ESR Subcommitte on Audit and StandardsClinical audit—ESR perspective. *Insights Imaging*. 2010;1:21–26. doi:10.1007/s13244-009-0002-2.
[35] Howlett DC, Brady AP, Ebdon-Jackson S, Becker CD. The current status of radiological clinical audit - an ESR Survey of European National Radiology Societies. *Insights Imaging*. 2019;10:51. doi:10.1186/s13244-019-0736-4.
[36] Trattner S, Pearson GDN, Chin C, et al. Standardization and optimization of CT protocols to achieve low dose. *J Am Coll Radiol*. 2014;11:271–278. doi:10.1016/j.jacr.2013.10.016.
[37] Crosby PB. *Quality Is Free : The Art of Making Quality Certain*. McGraw-Hill; 1979.
[38] Lau L, Ng K. Radiological Safety and Quality: Paradigms in Leadership and Innovation. In: Lau L, Ng K, eds. *Radiological Safety and Quality: Paradigms in Leadership and Innovation*. Vol 108. Springer; 2015:87. doi:10.1097/hp.0000000000000203.
[39] Kyei K, Antwi W, Suapim J. Evidence-based practice in radiography: attitudes, beliefs, knowledge and practices of radiographers in Ghana. *Omi J Radiol*. 2015;04:1–5. doi:10.4172/2167-7964.1000176.
[40] Willemse MM, Williams M, Grobler AD. Radiographers' experiences of the management of quality assurance programmes in public hospitals, South Africa. *Radiography*. 2020;26:e1–e6. doi:10.1016/j.radi.2019.05.007.
[41] Saini V, Brownlee S, Elshaug AG, Glasziou P, Heath I. Addressing overuse and underuse around the world. *Lancet*. 2017;390:105–107. doi:10.1016/S0140-6736(16)32573-9.
[42] Hillman B. *Evidence-Based Radiology – A Primer for Referring Clinicians and Radiologists to Improve the Appropriateness of Medical Imaging*. Medscape; 2005 *https://www.medscape.org/viewarticle/511342* Accessed June 25, 2020.
[43] Nalweyiso DI, Kabanda J, Mubuuke AG, Sanderson K, Nnyanzi LA. Knowledge, attitudes and practices towards evidence based practice: A survey amongst radiographers. *Radiography*. 2019;25:327–332. doi:10.1016/j.radi.2019.03.004.
[44] Paulo G. Radiographer research in radiation protection: National and European perspectives. *Radiography*. 2020;26:S42–S44. doi:10.1016/j.radi.2020.05.006.
[45] Sardanelli F, Hunink MG, Gilbert FJ, Leo G, Krestin GP. Evidence-based radiology: why and how? *Eur Radiol*. 2010;20:1–15. doi:10.1007/s00330-009-1574-4.
[46] Yesilada F, Direktor E. Health care service quality: a comparison of public and private hospitals. *African J Bus Manag Vol*. 2010;4:20–24.
[47] Cameron ID, Dyer SM, Panagoda CE, et al. Interventions for preventing falls in older people in care facilities and hospitals. *Cochrane Database Syst Rev*. 2018;2018. doi:10.1002/14651858.CD005465.pub4.
[48] Simões JDA, Augusto GF, Hernández-quevedo C. Portugal: Health System Review. *Health Syst Transit.*. 2017;19:1–184.
[49] Eslava-Schmalbach J, Garzón-Orjuela N, Elias V, Reveiz L, Tran N, Langlois E V. Conceptual framework of equity-focused implementation research for health programs (EquIR). *Int J Equity Health*. 2019;18. doi:10.1186/s12939-019-0984-4.
[50] Kruskal JB, Eisenberg R, Sosna J, Yam CS, Kruskal JD, Boiselle PM. Quality initiatives quality improvement in radiology: basic principles and tools required to achieve success. *Radiographics*. 2011;31:1499–1509. doi:10.1148/rg.316115501.