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Scientific validation of the technologist's training for the technological procedure in magnetic resonance imaging health sciences

Abstract

Technological advances in science and today's rapidly changing healthcare environment, driven by demographic change and high economic pressures on healthcare systems, requiring disease diagnoses with high accuracy and specificity in a short period of time, implies that Magnetic Resonance Imaging must adapt to these challenges, as well as updating new approaches, This means that the Magnetic Resonance Imaging technique must adapt to these challenges, as well as the updating of new approaches, updated on Physical Principles, Human Anatomy and Radiological Semiology, in the theoretical-practical skills in the performance of technologists, related to the procedure of the Magnetic Resonance Imaging technique, which demands the need to scientifically validate a proposal for the training of the health technologist in Magnetic Resonance Imaging in its technological procedure.

Objective: The objective of the present work is to scientifically validate a proposal for the training of the technologist in the technological procedure in Magnetic Resonance Imaging in Health Sciences.

Methods: Methods of the theoretical level such as the synthetic analytical, of the empirical level the observation and of the mathematical statistical level the statistical analysis of the methods used, the Expert criterion, with the Delphi method were applied.

These methods made it possible to propose the needs of the Technologist in the technological procedure for his training in Magnetic Resonance Imaging. The proposal was scientifically assessed by experts by means of the Delphi method and was applied to the technologists of the Provincial Hospital of Cienfuegos, Cuba.

Results: The scientific validation is evidenced, through the Delhi Method and Expert Criteria, of the proposal for the training of the Technologist in the technological procedure in Magnetic Resonance Imaging, for medical health. The updating of the contents on the Physical Principles, Human Anatomy and signs of Radiological Semiology, through theoretical and practical workshops in the workplace, stands out.

Conclusions: The proposal was validated as very adequate by the experts and its application in the context of Secondary Health Care demonstrated its relevance. It is considered that in the training of the Technologist, the technological procedure for Magnetic Resonance Imaging requires the updating of Physical Principles, Human Anatomy and signs of Radiological Semiology.

Keywords: technological proceeding, magnetic resonance imaging, technologist training, delphi method

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Introduction

The knowledge system of Magnetic Resonance Imaging technique is reflected in the proper movement of Imaging as a science of medical imaging that deals with all normal and abnormal images, structures, tissues and internal organs.[1]

The technique of Magnetic Resonance Imaging: is based on the ability of some nuclei to absorb radiofrequency waves, when subjected to the effect of a magnetic field.[2] Among the gaps to be solved in the training of the technologist for the technological procedure, there are updating needs related to the technique of Magnetic Resonance Imaging, such as Physical Principles, Human Anatomy and signs of Radiological Semiology.

The Magnetic Resonance Imaging technique constitutes a body of knowledge and skills aimed at satisfying the scientific needs of this professional's training. It is nourished by essential contents, provided by particular sciences such as Physics, Human Anatomy, Radiological Semiology and in general by the Medical Sciences; all these contents are approached in an integrated and/or coordinated manner.

The articulation of the logic of the theoretical-practical process in the formation of the technologists' technological procedure requires training in: the technique of Magnetic Resonance Imaging, the contents of the Physical Principles, Human Anatomy and signs of Radiological Semiology. Mastery of these contents is required. Assuming this position, it is possible that Imaging and Medical Radio Physics need to assimilate knowledge, skills and values "to teach these contents from a precept: from the logic of science and social practice.[3]

It is agreed that nowadays it is known with certainty that, in the organized preparation for professionals, priority is given to the

contents of the particular science they practice, it is considered that along with the knowledge of the science they need, they must be prepared in professional practice to master the practical skills of the profesión.[4]

The training of technologists is conceived as a process of transmission of the knowledge of their specialty and the implication of this knowledge in their performance, in addition to using personal experiences and their scientific-technical updating in the area of the profession in which they work. This approach leaves its mark in the selection and prioritization of knowledge, in the way professional problems are handled and in the orientation of contents towards practice.[5]

In references, they allude to offers and spaces for training in research, management, pedagogy and knowledge management. They recommend different modalities that focus their content on particular branches within the different branches of knowledge.[6]

In the Medical Sciences, as in other areas of knowledge, it is common to implement proposals that promote learning content related to the appropriate use of information and communications technology, information literacy, knowledge management and distance learning models.[7]

In this sense, in the current context it is evident in the training of imaging technologists that there are gaps in the training of the technique in Magnetic Resonance Imaging, therefore, it is necessary to update the contents in:

a. Physical Principles (examination sequences, radiological protection, as well as establishing a correlation between the physics of magnetic resonance as an expression in human anatomy and radiological semiology).

b. Human Anatomy (anatomy of organ systems, applied to MRI physics).

c. Content such as signs of Radiological Semiology (comparison of normal images with pathological images of organ systems, according to the sequences and physical principles of this diagnostic technique).

d. These contents constitute a need to be resolved in the training of Medical Imaging and Radiophysics technologists.

This implies, therefore, a change of conception about the importance and transcendence of education at work, which facilitates the development of attitudes committed to the contents of the Magnetic Resonance Imaging technique from each of the contents of Introduction to Technology and Comprehensive Training in Imaging. In the process, it is essential that the thematic nuclei proposed are approached in an integrated manner, where the fundamental scenarios of their execution are in health institutions.

The training conditions of the contents of Magnetic Resonance Imaging in current professional practice should be aimed at achieving mastery of the theoretical and procedural knowledge of how to work with an integrated approach. To be able to appropriate the conceptual, procedural and attitudinal contents in the model demanded by the social conditions of health. The actuality of these contents, through theoretical and practical training as a way of professional preparation will favor an integral performance.

Methods

Analytical-synthetic: To analyze the existing literature on the technological procedure of the technique in Magnetic Resonance Imaging in the technologist of Health Sciences.

Observation is to assess the skills of the technological procedure for the Magnetic Resonance Technique in the technologist.

Expert Criteria (Delphi Method). The method used to validate the proposal for the training of the Technologist in the technological procedure of the Magnetic Resonance Technique, through the application of surveys. For the selection of the experts, the coefficients of knowledge Kc and argumentation Ka of the experts were taken, selecting 16 of them from the Health System. The competence coefficient $K = ½ (Kc + Ka)$[8,9] was calculated. Scale for the selection of the experts, according to the coefficient K is taken as:

high competence if $K > 0.8$

medium competence if $0.5 < K \leq 0.8$

low competence if $K \leq 0.5$

The average value of K for the 16 experts was: average K = 0.85 with average values Kc = 0.9 and Ka = 0.8. The Delphi method is applied by means of a survey to the selected experts for their evaluation of the criteria previously elaborated in the evaluation categories according to the Likert scale (1. Inadequate, 2. Poorly Adequate, 3. Adequate, 4. Fairly Adequate and 5. Very Adequate), in this way the 36 aspects or criteria are evaluated by the experts.

Results

The objective of the present work is to scientifically validate a proposal for the training of the health technologist in Magnetic Resonance Imaging in its technological procedure.

Steps to be followed

The statistical steps to be followed by the Delphi method are as follows:[9,10]

a. Calculation of the table of observed frequencies

b. Calculation of accumulated frequency table

c. Calculation of the relative cumulative frequency table

d. Calculation of accumulated inverse normal inverse frequency table,

e. Calculation of the average by aspects.

f. Calculation of the N-P value for each aspect.

g. Calculation of the Numerical Ray or cut-off points for the location of each aspect

h. According to the experts' criteria.

i. Calculation of Kendall's W Coefficient to obtain the experts' agreement on the results (Table 1 & 2, Figure 1).

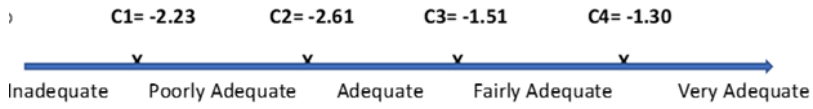

Figure 1 Numerical ray or cut-off points.

Table 1 Strategy for the formation of the technologist in the technological procedure in magnetic resonance imaging in health sciences

Table of observed frequencies	1	2	3	4	5
General objective: To contribute to the training of the technologist in the technological procedure of Magnetic Resonance Imaging.	0	1	0	0	15
Stage 1 Diagnosis of the technological procedure in magnetic resonance imaging technologists.	**0**	**1**	**0**	**0**	**15**
Objective: To diagnose the training needs of the technologist in the technological procedure of Magnetic Resonance Imaging.	0	0	1	0	15
Fundamental actions					
a) Characterization of Magnetic Resonance Imaging technologists.	1	0	1	0	14
b) Identification of the main needs of the technologist in the technological procedure of Magnetic Resonance Imaging.	0	0	1	1	14
c) Determination of the technologist's needs in the technological procedure of Magnetic Resonance Imaging.	0	1	0	0	15
d) Analysis of the conditions of the context, in the technological procedure of the Magnetic Resonance Imaging technologist.	0	0	0	0	16
e) Definition of the ways to update the technologist in the technological procedure of Magnetic Resonance Imaging.	0	0	2	0	14
f) Knowledge of the technologist's updated content on the technological procedure on Magnetic resonance imaging	0	0	2	0	14
Stage 2 Planning of the technologist's training in the technological procedure of Magnetic Resonance Imaging.	**0**	**0**	**1**	**0**	**15**
Objective	0	0	1	1	14
To plan the training in the Technologist the technological proceeding on Magnetic Resonance Imaging.					
Fundamental actions					
a) Determine the objectives and contents of the training of the technologist in the technological procedure of Magnetic Resonance Imaging, according to the diagnosis made.	0	1	1	1	13
b) To organize the conditions to develop the instructive and educational activities in the training of the technologist in Magnetic Resonance Imaging. of Health.	1	0	1	1	13
c) To elaborate the activities, with the contents of the technological procedure of Magnetic Resonance Imaging according to the diagnosis.	0	1	1	1	13
d) To organize the orientations for the different theoretical and practical activities planned.	0	0	2	0	14
e) Organization of theoretical and practical training activities through theoretical and practical workshops in order to contribute to the training in the technological procedure of the Magnetic Resonance Imaging technologist.	1	0	1	1	13
f) To consider in the theoretical and practical activities, on the training in the technological procedure of Magnetic Resonance Imaging.	0	0	1	0	15
· To develop each of the proposed activities, the interrelation between them linking the theoretical and practical, with theoretical and practical actions that enable the technological procedure of the Magnetic Resonance Imaging Technologist.	0	0	1	1	14
· Consider the diagnosis made in the first stage the technological procedure of the Magnetic Resonance Imaging Technologist.	0	0	1	0	15
· To create conditions at work (hospital context) to carry out the workshops proposed in order to contribute to the training in the technological procedure of Magnetic Resonance Imaging.	0	1	0	0	15
· To structure the contents of the workshops on the training of Magnetic Resonance Imaging Technologists	0	0	0	1	15
Stage 3 Execution of the training of the technologist in the technological procedure in magnetic resonance imaging.	**0**	**0**	**0**	**0**	**16**
Objective	0	0	1	0	15
Execute the planned theoretical and practical training activities in the technological procedure of the Magnetic Resonance Imaging Technologist					
Fundamental actions:					
· Develop the planned forms of training (Workshops) with theoretical and practical activities, for the training of the Technologist in the technological procedure of Magnetic Resonance Imaging.	0	0	1	0	15
· To guarantee in the execution of the instructive and educational training in an integrated way in the performance of the Technologist, by means of the objectives, contents and conditions in the hospital context.	0	0	1	0	15
· To develop in the workshops theoretical and methodological debates on the actuality of the contents related to the technological procedure of the Magnetic Resonance Imaging Technologist, and the characteristics of the Health Technologies.	1	0	0	0	15
· To guarantee workshops for the development of practical activities, related to the technological procedure of Magnetic Resonance Imaging.	0	0	1	0	15
· The training, which the author selected (theoretical and practical workshops), for the training of technologists, will be carried out in an interrelated, contextualize way and with cooperative exchange.	0	0	1	0	15
· Enable teamwork in workshops for training in the technological procedure of the Magnetic Resonance Imaging Technologist in accordance with the requirements of Health Technologies.	0	0	1	0	15

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Table Continued...

Table of observed frequencies	1	2	3	4	5
Stage 4 Evaluation and improvement of the technologist's training strategy in the technological procedure in magnetic resonance imaging	**0**	**0**	**1**	**0**	**15**
Objective;_To evaluate the results achieved, in the training activities defined in the Strategy in the technological procedure of Magnetic Resonance Imaging Technologists					
Actions for this stage					
· Theoretical and practical activities of each workshop selected in the technological procedure of the Magnetic Resonance Imaging Technologist will be evaluated.	0	0	2	0	14
· The planned training activities will be evaluated using self-evaluation, co-evaluation and heteroevaluation.	0	0	2	0	14
· Team work will be used to develop the evaluation in the workshops in the technological procedure of Magnetic Resonance Imaging by the technologists.	0	0	2	0	14
· To carry out group exchanges, created for this purpose, and to socialize the results, once the training received has been completed, in a systematic way, as set out in the strategy.	0	0	2	0	14
· Workshops are recommended, to use the correction of the difficulties both in the instructive and educational levels when interacting with individual and group experiences.	1	0	2	0	13
· To correct the details that are pending in the treatment of the selected topics, which favors in the Technologist the technological procedure of Magnetic Resonance Imaging, as well as to evaluate the strategy used and its improvement proposal.	0	0	2	0	14

Table 2 Delphi method average by aspects and N-P values

Aspects to be evaluated	Average by aspects	N-P Value
General Objective	-1.923	0.389
Stage 1	-1.923	0.389
ObjectiveE1	-2.312	0.778
Action E1a	-0.186	-1.346
Action E1b	-2.216	0.683
E1c Share	-1.923	0.389
E1d share	-2.12	0.587
E1e share	-2.605	1.071
Action E1f	-2.312	0.778
Stage 2	-2.216	0.683
Target E2	-2.054	0.521
Action E2a	-1.665	0.132
Action E2b	-0.12	-1.412
E2c Stock	-1.665	0.132
E2d share	-2.12	0.587
E2f Stock E2f	-0.12	-1.412
Action E2g	-2.046	0.512
Develop	-2.216	0.683
Consider	-2.312	0.778
Create	-1.923	0.389
Structure	-2.701	1.167
Stage 3 3	3 -3.09	1.556
Objective E3	-2.312	0.778
Action E3 Develop	-2.312	0.778
Action E3 Ensure	-2.312	0.778
Action E3 Develop 1	-0.378	-1.155
Action E3 Guarantee 2	-2.312	0.778
Action E3 Forms -2.312 0.77	-2.312	0.778
Action E3 Enable	-2.312	0.778
Stage 4 Objectives	-2.312	0.778
Co-evaluation and Hetero-evaluation.	-2.12	0.587
Shares E4 to Evaluate	-2.12	0.587
Action E4 Evaluate	-2.12	0.587
Action E34 Utilize	-2.12	0.587
Action E4 Perform	-0.054	-1.478
Action E4 Recommend	-2.12	0.587

The 36 aspects have been well evaluated by the experts falling in the following ranges: Fairly Adequate = 4 aspects, Very Adequate = 32 aspects. So the Delphi result gives that all aspects are validated very positively by the 16 experts.

Kendall´s W test

Table 3.

Table 3 Kendall´s W Test

	Mean rank
Inadequate	2,07
Poorly Adequate	2,19
Adequate	3,43
Fairly Adequate	2,31
Very Adequate	5,00

Kendall´s coeficient of concordance

Table 4.

Table 4 Kendall´s coeficient of concordance

N Kendall's Wa	36,771
Chi-Square	111,092
df Asymp. Sig.	4,000

Kendall's coefficient confirms the experts' agreement with the results of the Delphi method

Table 5.

Table 5 Results of the survey applied to the technologists on the need to update the contents

Aspect	% consider it very necessary
For the magnetic resonance imaging technique in imaging and medical Radiophysics technologists	100%
For physical principles	89%
For human anatomy	87%
For semiology and imaging	81%

Discussion

This research considers central elements for a proposal for the training of the health technologist in: Magnetic Resonance Imaging, Physical principles, Human Anatomy, Semiology and Imaging, aspects to be taken into account in the whole process.

Conclusion

The result of the validation of the Strategy for the training of the Technologist in technological procedure is presented, with the updating of theoretical and practical knowledge in Magnetic Resonance Imaging, in the contents of the Physical principles, Human Anatomy and Semiology and Imaging, the same was carried out by means of the Delphi Technique and the Expert criteria method.

It was demonstrated that the proposed strategy is pertinent given the results of the Numerical Ray which shows that the experts consulted coincide with the criteria of: Very adequate and Fairly adequate with the activities planned in the stages of the strategy consulted. The concordance of the experts was corroborated by the calculation of Kendall's W coefficient. The strategy to improve the training of these health professionals is presented, and its contribution to the better performance of the technologists in their technological procedures in Magnetic Resonance Imaging.

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None.

Conflicts of interest

The authors declare that there are no conflicts of interest.

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