

# A PROPOSAL FOR A MEDICAL RESIDENCY PROGRAM IN RADIOLOGY AND DIAGNOSTIC IMAGING\*

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**Abstract** **OBJECTIVE:** To propose a model of a program of medical residence in radiology and diagnostic imaging comprising theoretical and practical training. **MATERIALS AND METHODS:** The program was based on a literature review and critical analysis, following recommendations from Colégio Brasileiro de Radiologia e Diagnóstico por Imagem (Brazilian College of Radiology and Image Diagnosis) and Comissão Nacional de Residência Médica (National Commission for Medical Residency), and based on the program of Accreditation Council for Graduate Medical Education. **RESULTS:** The present proposal has been developed for a three-year-duration program divided into modules by subspecialties or diagnostic methods. Objectives have been described and targeted proficiencies specified. Evaluation models have been presented and discussed. **CONCLUSION:** Changes in the current teaching-learning model have become necessary because of the increasing information availability and fast technological development in the latest years. The hierarchical organization of the knowledge acquisition process with essential programmatic contents allows an appropriate education of the future specialist. It is anticipated that the present proposal may contribute to improve the medical residency programs, thus stimulating the implementation of a countrywide model.

*Keywords:* Medical residency; Radiology – education. Imaging diagnosis – education; Medical education.

**Resumo** *Proposta de um programa básico para a formação do médico residente em radiologia e diagnóstico por imagem.*

**OBJETIVO:** Propor um modelo de programa para residência médica em radiologia e diagnóstico por imagem, com programa básico de treinamento teórico e de treinamento em serviço. **MATERIAIS E MÉTODOS:** O programa foi idealizado a partir de uma análise e revisão da literatura, com base nas recomendações do Colégio Brasileiro de Radiologia e Diagnóstico por Imagem e da Comissão Nacional de Residência Médica, e tendo como modelo o programa do Conselho Americano de Regulamentação de Educação Médica para Graduados. **RESULTADOS:** A proposta foi desenvolvida para um programa de duração de três anos, dividido em módulos de subespecialidades ou métodos diagnósticos. Foram descritos os objetivos e especificadas as competências a serem alcançadas pelos médicos residentes. **CONCLUSÃO:** Mudanças no modelo de ensino-aprendizado se tornaram necessárias face ao crescente acúmulo de informações e o desenvolvimento tecnológico. A organização da aquisição de conhecimentos de forma hierarquizada, com um conteúdo programático básico, permite uma formação adequada do futuro especialista. Espera-se que esta proposta possa contribuir como subsídio para o aprimoramento dos programas de residência médica, permitindo a implementação de um modelo em âmbito nacional.

*Unitermos:* Residência médica; Radiologia – educação; Diagnóstico por imagem – educação; Educação médica.

## INTRODUCTION

Medical residency is a specialization post-graduation course directed to physicians, utilizing the in-service-training as the main teaching procedure<sup>(1)</sup>. The availability of an appropriate infra-structure, a sufficient dynamics of services in health, and a well elaborated pedagogical program are prerequisites for an institution to offer a medical residency program.

The basic criteria for the education of resident physicians have been widely discussed by several institutions in many countries. Among these criteria, it is impor-

tant to highlight the recommendations from the Accreditation Council for Graduate Medical Education – ACGME) in 2002<sup>(2)</sup>, regarding inclusion in the curriculum of not only the theoretical fundamentals and training applied to every field of the medical praxis, but also, opportunities for the development of the necessary attitudes considered as of great relevance for the accomplishment of future professional activities by the resident-physician. Additionally, these recommendations consider the necessity of establishing a basic program and consolidating, among the resident-physicians, an attitude towards a constant learn-

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ing habit, especially for those who are attending programs in radiology and diagnostic imaging, considering the huge development of this specialty in the last years<sup>(3,4)</sup>.

A minimum programmatic content must be developed on the basis of a set of priority topics defined by means of a careful analysis performed by representatives of institutions involved in medical residency programs as well as associations and agencies representing the specialty. The Association of Program Directors in Radiology – APDR, in the United States, has developed the programs to be accomplished by resident-physicians in radiology and diagnostic imaging, in radiological anatomy and systems or diagnostic methods, including head and neck, chest, cardiovascular, gastrointestinal; genitourinary, breast, musculoskeletal, neuroradiology, and ultrasonography<sup>(2,5)</sup>.

In Brazil, the Comissão Nacional de Residência Médica (CNRM) (National Commission for Medical Residency) has established standards and criteria for accreditation of medical residency programs, and the Colégio Brasileiro de Radiologia e Diagnóstico por Imagem (CBR) (Brazilian College of Radiology and Diagnostic Imaging) has defined minimum requisites<sup>(6)</sup> for the services to be able to offer a training in this specialty. Most recently, still at the normative level, some significant resources, like elaboration of brochures for qualification in physics<sup>(7)</sup> and mammography<sup>(8)</sup>, have been implemented with the support of CBR. However, both institutions have not determined a pedagogical program with clearly defined objectives.

In this study, the authors suggest a basic program for resident-physicians education in radiology and diagnostic imaging.

## MATERIALS AND METHODS

The authors have performed a literature review and critical analysis about curricular norms and minimum programmatic content regarding medical residency in radiology and diagnostic imaging.

The currently effective CBR and CNRM norms have been analyzed and compared, the essential topics being identified and included in the present proposal.

## RESULTS

According to the currently effective norms<sup>(6,9)</sup>, the length of the training period is three years. The resident-physician is entitled to a 30-day vacation period per year. The CBR recommends that, preferentially, the whole training should be accomplished in a single accredited institution. However, in cases where the accredited institution has not a determined equipment or diagnostic resource, consent is given by CBR for the trainee to undergo up to 4-month training period in a service indicated by the accredited institution.

The CBR basic program determines that the resident-physician should be trained in conventional radiology, ultrasonography, nuclear medicine, computed tomography, magnetic resonance imaging, bone densitometry, and, also, in the following areas: neuroradiology, head and neck radiology, chest, digestive system, genitourinary system, musculoskeletal system, gynecology and obstetrics, breast, pediatrics, and interventional radiology (biopsies, drainage, vascular procedures).

The minimum criteria established by CNRM<sup>(9)</sup> for accreditation of programs in this specialty determine that the training should be in general and contrast radiology, ultrasonography, mammography, computed tomography, bone densitometry, magnetic resonance imaging, interventional radiology, examination techniques, urgencies and emergencies, respecting a minimum 80% of the annual full-time load. The training in nuclear medicine is considered as optional, and the institution must offer mandatory courses in medical physics and radiological protection, and cardiorespiratory reanimation.

Ten to twenty per cent of the annual full-time load should be reserved for complementary theoretical activities, including anatomoclinical sessions, discussions on scientific papers, clinical-radiological sessions, clinical-laboratory sessions, courses, lectures and seminars. These activities must obligatorily include themes associated with bioethics, medical ethics, scientific methodology, epidemiology, and biostatistics<sup>(9)</sup>.

In the present study, the model developed is didactically divided into modules, in compliance with CBR and CNRM rec-

ommendations. The module includes stages in different modalities of investigation by diagnostic imaging, whenever possible focusing on an organ of the system. This kind of division is aimed at organizing the acquisition of theoretical knowledge, allowing an appropriate transposition into the practice. Modules based on stages in diagnostic methods like bone densitometry, nuclear medicine, computed tomography, magnetic resonance imaging and ultrasonography, also are scheduled to allow a more comprehensive experience in the global practice of the specialty. Each module will have a mean duration of one month, these modules being harmonically distributed throughout the three-year period, according to the content extent, in an attempt to familiarize the resident-physician with the all the specialty domains (Table 1).

Considering the cumulative character of the knowledges and schedules, the training in conventional radiology initiated in the first year will remain as an integral part of the schedules in the subsequent years, with a proportional part-time load, as the other diagnostic methods are added.

During the stage in these modules, the resident-physician should be offered training in different diagnostic methods, in a schedule with progressive complexity. The

**Table 1** Quantitative distribution of modules in radiology and diagnostic imaging.

Neuroradiology	4 months
Chest radiology	3 months
Gastrointestinal radiology	3 months
Musculoskeletal radiology	3 months
Head and neck radiology	2 months
Breast radiology	2 months
Pediatric radiology	2 months
Interventional radiology	2 months
Genitourinary radiology	1 month
Radiology in gynecology	1 month
Radiology in obstetrics	1 month
Radiology in emergency medicine	1 month
Ultrasonography	2 months
Computed tomography	2 months
Magnetic resonance imaging	2 months
Nuclear medicine	1 month
Bone densitometry	1 month
Vacations	3 months
Total	36 months

chest module, initiated with conventional radiology during the first year of training. In the second year, although this activity remains as a part of the schedule, more time will be dedicated to computed tomography; and in the third year, stages in magnetic resonance imaging and cardiovascular system radiology (echocardiography, computed tomography and magnetic resonance imaging) will be developed.

A performance evaluation must be undertaken by means of practical and theoretical tests applied by the work team and preceptor. It is important to note the necessity of establishing previously defined models for these tests, aiming at allowing an evolutive and comparative analysis both at individual and collective levels along the years. The results of such evaluations should be utilized as material for reflection and eventual adjustments in the program.

At each module, the resident-physicians will be evaluated as to their acquisition of practice competences involving not only examinations performance but also their interpersonal relationship both with patients and the health team. The model for practical evaluation is of easy implementation and should be performed during the daily routine, including all the steps of the examination since the first contact with the patient up to the elaboration and discussion of the medical report.

The theoretical test should be applied every quarter, as recommended by CNRM<sup>(9)</sup>.

The evaluation of the resident-physician attitudes must be undertaken by members of the health team other than the preceptor, who should analyse the evolution of the resident-physician relationship both with patients and health team, establishing an arbitrary classification of sufficient, regular, or insufficient.

The preceptor's evaluation consists of a global appreciation on the level of competences in five domains: patients care, medical knowledges, interpersonal relationship and communication, learning from practice and professionalism.

At the end of each module, the resident-physician must write down a maximum two-page report, summarizing his/her experience, difficulties, and suggestions for improvements, besides a self-evaluation.

This report must be delivered to the preceptor responsible for the module for appreciation.

In case of lack of local availability of determined equipment necessary for the resident-physicians training, the accredited institution should enter in a formal agreement with another institution or service which can offer such a training modality. This institution must assign a preceptor as responsible for this part of the training, including evaluation, besides presenting a program with defined objectives.

For discussions of themes regarding bioethics and medical ethics, didactic material available in the Regional and Federal Medicine Councils can be utilized<sup>(10)</sup>, besides attendance at events periodically held on these themes. It is recommended that during the learning of these themes, situations experienced by resident-physicians and their preceptors are discussed in ethical-clinical sessions<sup>(11)</sup>.

Activities associated with scientific, biostatistical and epidemiological methodologies may be developed in the form of expositive classes, discussions on scientific papers, or even by means of discipline approaching these three themes.

### **Proposal for distribution of practical and theoretical activities for each of the years of residency**

**1 – The first year (R1)** – From the conceptual point of view, the first year of medical residency is a landmark in the transition between the phase of graduation and the commencement of the medical specialty practice. The main objective of this stage is to allow that the resident-physician acquires good habits for the development of his/her career on a solid basis of fundamental concepts.

#### *Activities to be developed:*

- Course on radiation physics, Imaging and radiological protection.
- Bioethics and medical ethics, aiming at allowing the acquisition of good habits of clinical practice, and improvement of the interpersonal relationship with patients and health team.
- Hospital infection control, according to CNRM recommendations<sup>(9)</sup>.
- Scientific methodology and epidemiology.

- Study of radiological anatomy and development of perception of normal and abnormal structures.

- Radiological semiology: to consolidate a model of organized analysis of structures in the several diagnostic modalities. To recognize and classify the signs associated with conditions.

- Norms for an appropriate utilization of equipment and materials for diagnostic investigation, as well as notions of costs involved in each procedure.

- Learning of routine of examinations and reports elaboration.

- Learning of theoretical bases for attendance in emergency situations, including training in cardiorespiratory reanimation.

- The training must give priority to conventional radiology and ultrasonography.

- Clinical-radiological, anatomo-radiological sessions, and discussion on specialty-related scientific papers selected by the preceptors. These papers should be, preferably, of state-of-art or review-type, adapted to the training complexity level.

#### *Proposal for organization and distribution of training schedules:*

First half year – Chest radiology, digestive system radiology, musculoskeletal system radiology, radiology in rheumatology and bone densitometry, radiology in emergency medicine and breast radiology.

Second half year – Ultrasonography, computed tomography, neuroradiology, urology (including the male genital system), pediatrics.

Vacations – 30 days.

**2 – The second year (R2)** – The objectives of this stage are; basically, to consolidate and deepen the learned concepts, advancing in the training in other diagnostic methods.

#### *Activities to be developed:*

- Courses of physics and imaging applied to computed tomography and ultrasonography, including Doppler.

- Learning of interventional radiology techniques.

- Training in medical emergencies in the form of shifts. This training must be developed in public health services, according to CNRM recommendations<sup>(9)</sup>.

- Activities related to medical ethics and bioethics.

- Clinical-radiological, anatomic-radiological sessions, and discussion of specialty-related scientific papers, selected by the training preceptors.

- The in-service training must include conventional radiology, ultrasonography, Doppler, endocavitary probes, and computed tomography.

- In some institutions with magnetic resonance imaging facilities, the training in this modality can be initiated during this stage.

*Proposal for organization and distribution of training schedule:*

First half year – Radiology in gynecology, chest radiology, digestive system radiology, musculoskeletal radiology, head and neck radiology, radiology in pediatrics.

Second half year – Ultrasonography, computed tomography, neuroradiology, interventional radiology, breast radiology.

Vacations – 30 days.

**3 – The third year (R3)** – The main objective of the third year is to allow that the resident-physician gradually progress to an independent posture, like that to be adopted in his/her professional life.

*Activities to be developed:*

- Course of physics and imaging applied to magnetic resonance imaging and nuclear medicine. Principles of protection in nuclear medicine.

- Training in methods of higher complexity in interventional radiology.

- Training in medical emergencies in the form of shifts.

- Activities associated with medical ethics and bioethics.

- Clinical-radiological, anatomic-radiological sessions and discussions on specialty-related scientific papers. The selection of papers must be made by the resident-physician under the preceptor's supervision.

- Full training in all diagnostic modalities, including magnetic resonance imaging and nuclear medicine.

*Proposal for organization and distribution of training schedules:*

First half year – Diagnostic imaging in obstetrics, chest radiology, digestive system radiology, musculoskeletal radiology, neuroradiology, nuclear medicine.

Second half year – Magnetic resonance imaging (two months), neuroradiology,

interventional radiology, head and neck radiology.

Vacations – 30 days.

## DISCUSSION

For more than a decade, both CBR and CNRM have demonstrated a clear interest in defining a set of essential competences which should be necessarily incorporated into the education of resident-physicians in radiology. In 1989, in the city of São Paulo, the Fundação Nacional de Desenvolvimento e Apoio à Pesquisa (National Foundation for Research Development and Support) promoted an important seminar on organization of medical residency programs in radiology<sup>(12)</sup>. This seminar was held with the active participation of CBR and CNRM members, as well as innumerable preceptors of medical residency programs from several states of the country. The annals of this meeting, among its main conclusions, indicates the necessity of establishing the minimum knowledges and skills required for a competent practice of the specialty.

In this context, specific requisites for a program of medical residency in radiology and diagnostic imaging were carefully defined on the basis of worldwide consolidated experiences in programmatic organization like the North-American one<sup>(13)</sup>. Their program has been widely accepted and has been implemented throughout the United States. Annual meetings of APDR are held for following-up the development of this program, allowing its coordinators to keep updated with the ACGME guidelines. Additionally, a norms and procedures manual has been issued and periodically updated to inform coordinators on eventual modifications<sup>(14)</sup>.

The rapid technological and scientific development in this specialty has caused a significant accumulation of information. Changes in the teaching-learning system have become necessary to cope with this new reality<sup>(4)</sup>. This requires teaching strategies capable of deliver a model of hierarchical organization of knowledge acquisition, assuring the learning of basic and essential concepts. The resident-physician, at the end of the training, must be able to utilize in a critical way all the resources which

will allow him/her a continuous improvement along his/her professional life.

The elaboration of minimum programmatic contents for each specialty or diagnostic method is aimed at organizing a set of priority topics to be obligatorily learned. Parallely, other activities like bioethics, medical ethics, epidemiology and biostatistics should be offered to supplement the education of radiologists.

Material resources should not be limited to utilization of equipment, since IT resources for reference to data banks and digital images processing and filing systems are essential elements in the modern practice of radiology<sup>(15)</sup>. Resident-physicians should be given access to an updated library, and to the main periodicals of the specialty.

Evaluations are essential tools not only to attribute value judgement on knowledge acquisition by the resident-physician, but also to allow reflections and eventual adjustments in the offered program. Such evaluations should be performed within a model along the three-year period to allow the comparison of results and analysis of the effectiveness of the implemented changes. The evaluations results must be always discussed with the resident-physician to allow his/her improvement.

A nationwide medical residence program adjusted to the Brazilian reality will allow a greater integration of the several programs and a more homogeneous education of future specialists in radiology and diagnostic imaging.

## CONCLUSION

The adoption of a basic program for medical residency in radiology and diagnostic imaging will allow the future implementation of a program for quality control in the education of the specialist in radiology and diagnostic imaging.

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