

# Residence program on Medical Physics at Hospital das Clínicas of São Paulo University

## Programa de residência em Física Médica no Hospital das Clínicas da Universidade de São Paulo

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### Abstract

The main goal of the Residence Program on Medical Physics at Clinicas Hospital is to provide a specialization course of 24 months. The candidate selection is made in 2 steps: a general examination with 50 questions of multiple choices and a specific examination which does not presuppose the candidates must have certain knowledge in the area. After this second written exam, an interview is promoted in order to evaluate other aspects not covered by the previous exams, including some ethical issues, the ability to deal with patients and the multidisciplinary aspect among other professionals in the hospital. The Board Committee also evaluates the candidates' curriculum according to rules established by the Residence Coordination (participation in scientific meetings, trainings performed during graduation in Radiotherapy and scientific publications). The residence is thus directed to students which concluded bachelor's degree or a degree in Physics, and aims to train professionals skilled in Radiotherapy area, including the obtaining of further qualified professional title offered by the Brazilian Association of Medical Physics. The students attend lectures, seminars and the routine of the hospital. They also perform experimental work and develop a monograph to be presented at the end of the residence's period. In the last 5 years, almost 50 candidates have been attending to the selective process for only 2 available positions per year; the candidates come from different parts of the country, including students from the North, Northeast, Central-West, South and Southeast regions. It should be noticed in the last 5 years that most of the approved candidates are students coming from Graduation on Medical Physics, especially in the São Paulo state. For the last 10 residents, 20% were hired by companies in the Radiotherapy area; the remaining residents were hired by hospitals, 20% have found jobs in the Northeast region and 60% in São Paulo state.

**Keywords:** education, human resources, radiotherapy.

### Resumo

A principal meta do Programa de Residência em Física Médica no Hospital das Clínicas é fornecer um curso de especialização de 24 meses. A seleção do candidato é feita em duas etapas: uma prova geral com 50 questões de múltipla escolha e uma prova específica que não pressupõe que os candidatos tenham algum conhecimento na área. Após a segunda prova escrita, uma entrevista é promovida para avaliar outros aspectos que não foram cobertos nos exames anteriores, inclusive algumas questões éticas, a capacidade de lidar com pacientes e o aspecto multidisciplinar com outros profissionais no hospital. Uma Banca de Examinadores também avalia os currículos dos candidatos, de acordo com as normas estabelecidas pela Coordenação da Residência (participação em reuniões científicas, treinamentos realizados durante a graduação em Radioterapia e publicações científicas). Desse modo, a residência é direcionada a estudantes que concluíram o bacharelado ou tenham uma graduação em Física, objetiva treinar profissionais peritos na área de Radioterapia, inclusive com a obtenção de um título de especialista oferecido pela Associação Brasileira de Física Médica. Os estudantes participam de palestras, seminários e da rotina do hospital. Eles também realizam um trabalho experimental e desenvolvem uma monografia, que deve ser apresentada ao final do período de residência. Nos últimos cinco anos, quase 50 candidatos têm participado do processo seletivo para apenas duas vagas disponíveis por ano; os candidatos vêm de diferentes partes do País, inclusive estudantes das regiões Norte, Nordeste, Centro-Oeste, Sul e Sudeste. Deve-se relatar que, nos últimos cinco anos, a maioria dos candidatos aprovados são estudantes graduados em Física Médica, especialmente no estado de São Paulo. Quanto aos últimos dez residentes, 20% foram contratados por empresas na área da Radioterapia; os outros foram contratados por hospitais, 20% conseguiram empregos na região Nordeste e 60% no estado de São Paulo.

**Palavras-chave:** educação, recursos humanos, radioterapia.

## Introduction

The history of Medical Physics in Brazil started in 1969 by the introduction of a graduation course at the Physics Institute of São Paulo University. At that time, due to the lack of specialized laboratories and appropriate equipments, some Radiotherapy centers shared their equipments, as well as their own physical installation to the university. In this sense, the Hospital das Clínicas of São Paulo University School Medicine is the first reference center for training in the Medical Physics area which was established by Alípio Luiz Dias Neto at the Nuclear Medicine Center of São Paulo University, which belongs to Hospital das Clínicas.

The program aims to provide Radiotherapy Physics professionals who are capable of acting as experts in the field of Medical Physics with a specialization in Radiotherapy. This course, offered by the Institute of Radiology of the Hospital das Clínicas (InRad - HCFMUSP), is one of the few programs in the country that offers a comprehensive course in its area, comprising 3,840 hours of a specialized program. It should be pointed out that the Radiotherapy Physics contributes significantly to the quality assurance and radiation safety for all hospitals in the country.

## Methodology

The residence is directed to students that concluded bachelor's degree or a degree in Physics, aims to train professionals skilled in Radiotherapy area, including the obtaining of further qualified professional title offered by the Brazilian Association of Medical Physics.

The course consists of two parts: theoretical (20% of the total of 3,840 hours) and practical (remaining hours), both developed at the Institution. Qualified professionals in classrooms equipped with multimedia will proffer the theoretical part and student teachers will support the scientific collection available in the library of the Institution. In addition, students participate in scientific events organized by professionals of the Institution. Professionals with experience in Radiotherapy Physics will supervise the practical training with experience in Radiotherapy Physics.

Students use the following equipments at the practice: 3 linear accelerators; a CT-simulator; a high-dose-rate brachytherapy; and physical facilities of the Radiotherapy Department at Hospital das Clínicas.

At the Radiotherapy Department, there are 5 different treatment planning systems: Eclipse, iPlan, BrainScan, XiO and Oncentra. These systems allow treating patients with special procedures, such as Intensity Modulated Radiation Therapy (IMRT), Radiosurgery (SRS) and Total Body Irradiation (TBI) among the conventional techniques. The Department also has a whole set of dosimetric systems, such as: 3D automatic water phantom, 2D matrix linear array, ionizations chambers of different sizes with associated electrometers, termoluminescent dosimeters,

semiconductor detectors (diodes and diamond), anthropomorphic phantom, slabs of virtual water, radiochromic films, among others.

The evaluation criteria comprehend written examinations, seminars and cases discussion. Tests and seminars accomplish the evaluation of the theoretical content. It is also taken into account the student's performance in presenting work at scientific meetings. The seminars are evaluated by the content itself, performance, teaching resource, knowledge of the subject, skills of content and treatment planning in accordance with treatment protocols adopted by the Institution. The tests are applied in order to measure if students carried the theoretical knowledge to the practice performed. They include open questions to allow better exposure of the knowledge learned.

The assessment of the practical content is performed by professionals involved in the Residence Program (medical physicists and radiation oncologists), according to the following criteria: initiative, interest, critical capacity, commitment, responsibility, ethical behaviour, attendance, punctuality, personal presentation, scientific knowledge, teamwork, relationship with the Radiotherapy team and with patients. The issues raised by the supervisor are discussed with students and transformed into opportunities for improvement. These professionals also assess various cognitive aspects, such as performance in the daily routine of the Department of Radiotherapy (simulation, planning of patient, dosimetry and quality control of equipment).

Every three months an assessment is sent to the Centre for Training of Hospital das Clínicas containing the following ranks: theoretical subjects, supervised training, development of the monograph and evaluated aspects like ethical and professional attitude. The annual assessment is performed through a global and final evaluation.

In all assessments are required a cut-off score greater than or equal to 7.

The completion of course work (monograph) starts in April when the theme is set with the supervisors. The development of the research project takes place preferably in May and June, including consultations on relevant scientific literature and the subject of analysis and correction guidelines.

Data collection is performed in the months of August to October and is supervised by the supervisor and the remaining staff, aiming to ensure compliance with the technical, scientific and ethical precepts. The data analysis phase occurs in November under the supervision of the supervisor.

The monograph concludes with discussion and conclusion or concluding remarks in December, covering more queries in the scientific literature. The work of completion is presented to the team of Medical Physics and member appraisers in January. The presentation contains introduction, objective, method, results, discussion and conclusion or closing remarks. The abstracts of papers are published on the website HCFMUSP ([www.hcnet.usp.br](http://www.hcnet.usp.br)). The minimum threshold is always with a score equal to 7.

## Syllabus

A theoretical module (40 hours) is given to all residents of Hospital das Clínicas for all programs, including the Medical Physics. It covers the following topics: public health policies and health system; introduction to research methodology; and health education.

The completion of the remaining theoretical module (20% of the total number of hours) contains the following subjects: dosimetry and radiation physics; clinical treatment planning; radiation protection; brachytherapy; radiobiology; fundamentals of anatomy.

The practical training comprehends 3 major modules, such as: dosimetry of ionising radiation, treatment planning and brachytherapy. The bibliography includes the IAEA Syllabus<sup>1</sup>, Khan's<sup>2</sup> and Van Dyk's books<sup>3</sup>; Jani's book<sup>4</sup>; Bentell's book<sup>5</sup>; Godden's book<sup>6</sup>; and Hall's book<sup>7</sup>. All the pertinent publications by ICRU, ICRP, NCRP and IAEA documents are also included in the bibliography employed by the Medical Physics Program.

## Conclusion

In the last 5 years, almost 50 candidates have been attending to the selective process for only 2 available positions per

year. The candidates come from different parts of the country, including students from the North, Northeast, Central-West, South and Southeast regions. It should be noticed in the last 5 years that most of the approved candidates are students coming from Graduation on Medical Physics, especially in the São Paulo state. For the last 10 residents, 20% were hired by companies in the Radiotherapy area; the remaining residents were hired by hospitals, 20% have found jobs in the Northeast region and 60% in São Paulo state.

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