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The MD/PhD Program: Brazil and the world

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ABSTRACT

Introduction: The Medical Research Training Program was created in the United States in 1956, and consists in the scientific training of undergraduates in medical education in order to train highly qualified professionals for dual work in the medical context: clinical and research. **Objective:** The present article aims to report some occurrences of the MD/PhD Program around the world, using as a starting point, and as inspiration for researching scientific articles and institutional sites that report the MD/PhD experience, the article “The combined medical / PhD degree: a global survey of physician-scientist training programs”. **Methodology:** However, for the Brazilian context, it was used data provided by Capes on the financing of the program until December 2019. The results show the experiences of the MD/PhD programs on the five continents, including its particularities and similarities. **Result/Conclusion:** And in the final remarks, common points addressed in different countries and MD/PhD systems are presented, such as the recurrent inspiration in the American model and the need to act against the recent decline of clinical researchers. In Brazil, as well as in countries with recent implementation, the program still lacks studies that assesses its impacts. The observation of the characteristics and peculiarities of the MD/PhD in the different continents and countries of the world allows us to glimpse at some instruments that can be used to strengthen and expand the program at the national level.

KEYWORDS

Medical Research. Medical Education. Doctoral degrees.

O Programa MD/PhD: Brasil e Mundo

RESUMO

Introdução: O Programa de treinamento em pesquisa médica surgiu nos Estados Unidos, em 1956, e consiste no treinamento científico de graduandos de medicina para a formação de profissionais altamente qualificados para dupla atuação no contexto médico: clínica e pesquisa. **Objetivo:** O presente artigo tem o objetivo de relatar algumas ocorrências do Programa MD/PhD pelo mundo, utilizando como ponto de partida, e como inspiração para a pesquisa de artigos científicos e sites institucionais que relatassem a experiência MD/PhD, o artigo “The combined medical/PhD degree: a global survey of physician-scientist training programs”. **Metodologia:** Porém, para o contexto brasileiro, foram utilizados dados fornecidos pela Capes sobre o financiamento do programa até dezembro de 2019. Nos resultados são apresentadas experiências do programa MD/PhD nos cinco continentes, incluindo suas particularidades e semelhanças. **Resultado/Conclusão:** E nas considerações finais são apresentados pontos comuns abordados nos diferentes países e sistemas MD/PhD, como a recorrente inspiração no modelo estadunidenses e a necessidade de combater o recente declínio de pesquisadores clínicos. No Brasil, assim como em países de recente implementação, o programa ainda carece de estudos que avaliem seus impactos. A observação das características e peculiaridades do MD/PhD nos diferentes continentes e países do mundo nos permite vislumbrar algumas ferramentas que podem ser utilizadas para o fortalecimento e a expansão do programa a nível nacional.

PALAVRAS-CHAVE

Educação Superior. Formação Médica. Medicina e Educação.

El programa MD/PhD: Brasil y el mundo

RESUMEN

Introducción: El Programa de Formación en Investigación Médica fue creado en Estados Unidos en 1956 y consiste en la formación científica de graduados médicos para formar profesionales altamente calificados para el trabajo dual en el contexto médico: clínico e investigador. **Objetivo:** Este artículo tiene como objetivo informar algunas ocurrencias del Programa de MD/PhD en todo el mundo, utilizando como punto de partida y como inspiración para la investigación de artículos científicos y sitios institucionales que informan sobre la experiencia de MD/PhD, el artículo “The combined medical/PhD degree: a global survey of physician-scientist training programs”. **Metodología:** Sin embargo, para el contexto brasileño, se utilizaron datos proporcionados por Capes sobre el financiamiento del programa hasta diciembre de 2019. Los resultados muestran las experiencias del programa de Doctorado / Doctorado en los cinco continentes, incluyendo sus particularidades y similitudes. **Resultado/Conclusión:** Y en las consideraciones finales, se presentan puntos comunes abordados en diferentes países y sistemas de MD/PhD, como la inspiración recurrente en el modelo americano y la necesidad de combatir el reciente declive de los investigadores clínicos. En Brasil, así como en países con implementación reciente, el programa aún carece de estudios que evalúen sus impactos. La observación de las características y peculiaridades del MD/PhD en los diferentes continentes y países del mundo permite vislumbrar algunas herramientas que se pueden utilizar para fortalecer y ampliar el programa a nivel nacional.

PALABRAS CLAVE

Educación universitaria. Entrenamiento médico. Medicina y Educación.

CRedit

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Introduction

The Medical Research Training Program emerged in the United States in 1956. The Case Western Reserve University School of Medicine was a forerunner in the training of medical researchers through this program, which allows for the interconnection of a medical degree with a doctorate in health. Through this medical training, which provides early exposure to the advanced research environment, young clinician-scientists, the MD/PhD, are trained.

MD is the abbreviation of the expression "Doctor of Medicine", derived from the Latin "Medicinae Doctor", and corresponds to the undergraduate degree/diploma in medical school. PhD, also derived from the Latin "*philosophiae doctor* or doctor *philosophiae*", is the degree corresponding to a doctorate, typically awarded by some international universities, such as those in the United States and England. Together these acronyms refer to the medical training program, the focus of the present work.

Doctor of Medicine (MD)/Doctor of Philosophy (PhD) programs were established in American medical schools to improve recruitment into academic medicine. They are an alternative for medical graduates who wish to pursue a research career with scientific training combined with clinical practice. This approach not only provides them with the link to research and academia, but also enhances the clinical skills of the researcher.

Thanks to their dual expertise, these doctors participate in research activities, and thus play a decisive role in developing clinical innovations for the benefit of patients. They are a rare species: their exact number is difficult to define.

And without the intention of presenting an exhaustive list and/or making a classificatory or meritocratic judgment, this article aims to present some occurrences of the MD/PhD Program globally, looking at the achievements of its implementation in other countries, subsidizing reflections for the Brazilian experience.

Methodology

Based on the scientific article "The combined medical/PhD degree: a global survey of physician-scientist training programs" (ALAMRI, 2016), "The combined medical/PhD degree: a global survey of physician-scientist training programs", published in 2016, in the Clinical Medicine Journal, we searched papers and institutional websites, through the Capes Periodicals Portal and online searches, to expand and update the theme of the diffusion of the MD/PhD throughout the world.

To search the Capes periodicals portal and Google, we used the expression "MD/PhD program" in isolation and associated with the names of continents, countries, and universities. In this sense, it is important to note that searches using other expressions or nomenclatures, such as "Physician Scientist training", may result in different and/or complementary results to the scope presented here.

At the national level, we adopted as main reference the article "An MD-PhD program in Brazil: students concepts of science and of common sense" (OLIVEIRA; CAMPOS; MOURAO, 2011), "PhD program in Brazil: students concepts of science and of common sense", in addition to data regarding the current context of MD/PHD in Brazil, for which, analytical reports of scholarship monitoring, in .xlsx format, provided by the Coordination of Induction and Innovation Programs of Capes, were used. The reports were made available in March 2020, after a formal request via letter, and refer to the program funding until December 2019.

Results

The idea of providing simultaneous scientific and clinical qualification and the goal of training high-level professionals for dual practice in the medical field are points in common between MD/PhD programs around the world. Since the 2000s, this program has undergone a significant expansion, reaching all five continents. Below are some examples of countries and institutions involved in offering MD/PhD programs around the world.

Americas

Besides Brazil, in the Americas, we find reports of MD/PhD in Mexico, Canada and the United States of America (USA), the latter being the cradle of the program and the world reference in the supply of vacancies, number of higher education institutions involved with MD/PhD and scientific publications on the subject.

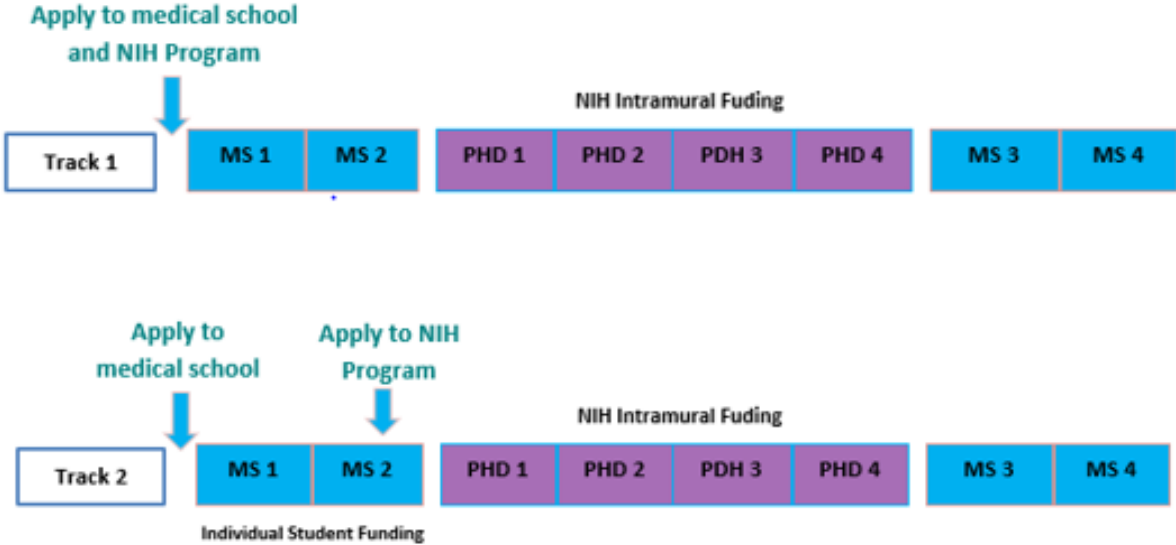
MD/PhD emerged in the USA, at Case Western Reserve University (CWRU) in 1956, and in 1964, the National Institutes of Health (NIH) began supporting MD-PhD programs in three medical schools through the Medical Scientist Training Program. Today, the program has spread and there are more than 120 universities and medical schools across the country. On the North American scene, two institutions are prominent when it comes to the physician scientist training program, the National Institutes of Health (NIH) and the Association of American Medical Colleges (AAMC).

The NIH is a medical research agency of the U.S. Department of Health and Human Services that works to make discoveries important to health and to preserving lives. Through partnerships with medical schools, it invests in the motivation and funding of physician scientists, and one of its action lines deals directly with MD/PhD training.

Since the NIH does not award MD or PhD degrees, this program is affiliated with partner medical schools in the United States during the MD student training phase, and partner universities in the United States and other countries during the PhD student training phase. (NIH MD PHD PARTNERSHIP TRAINING PROGRAM, 2020 s/p).

To enter the MD/PhD, students can apply through one of these modalities: Track 1: before entering medical school or Track 2: after entering medical school.

Figure 1. National Institutes of Health (NIH) MD/PhD structure



Source: The author, adapted from NIH MD PHD Partnership Training Program ([20--?])

In either alternative, the student needs to have outstanding academic performance in the first two years of undergraduate medical school (MD) to enter the NIH MD/PhD program. After four years of training as a physician-scientist (PhD), the student then returns to medical school for two more years to achieve the dual degree.

The AAMC, which was founded in 1876, is a non-profit association dedicated to transforming health care through medical education, patient care, medical research, and community collaborations.

MD-PhD programs offer training in medicine and research. They are designed specifically for those who wish to become physician researchers, also known as physician-investigators or physician-scientists. Graduates of MD-PhD programs often go on to become faculty members at medical schools, universities, and research institutes (ASSOCIATION OF AMERICAN MEDICAL COLLEGES, 2020, s/p).

As stated in the AAMC institutional website, 123 institutions, spread over 44 US states and 13 Canadian institutions are members and have adopted the MD/PhD in their curricula.

The schedule for AAMC MD-PhD training generally follows the same eight-year NIH flow, divided into three stages: two years MD; four years PhD and two more years MD (2-4-2). This general outline may vary with each MD-PhD Program:

- (a) Stage 1: Two years of medical school when the basic concepts of science are mastered;
- b) Stage 2: The graduate course work - completion and defense of the thesis. Full

requisite for the degree of doctor - PhD and

c) Stage 3: Clinical training to prepare the student for residency, a requirement for the MD degree.

In North America, as a whole, the MD/PhD program is offered in its three countries, namely: United States, Canada, and Mexico, in very similar systems.

According to the Clinician Investigator Trainee Association of Canada (CITAC), which represents the interests of students registered in Canada's clinical investigator training programs, including the MD/PhD, 17 major universities offer this degree opportunity in their curricula, and they are distributed in eight of the ten provinces that make up the country.

In an article published in 2016, Canadian MD/PhD programs were evaluated. In June 2015, students and directors expressed themselves regarding the structure, funding, classes, and orientation scheme available in the programs. The results found flexible program formats regarding start-up, funding, and orientation, with "both trainees and program directors identifying the need for more career planning and development support as a student priority." (JONES et al., 2016, p. 132).

In Mexico, the Universidad Nacional Autónoma de México (Unam) and the Escuela de Medicina y Ciencias de la Salud (TecSalud) offer the MD/PhD. In this:

the MD PhD program aims to prepare individuals trained for teaching and research in the field of medicine. Graduates of this program should be able to generate new knowledge independently or apply it in original and innovative ways. (ESCUELA DE MEDICINA Y CIENCIAS DE LA SALUD, 2020, s/p).

Figure 2. MD/PhD Structure of the School of Medicine and Health Sciences (TecSalud)



Source: ESCUELA DE MEDICINA Y CIENCIAS DE LA SALUD – TecSalud (2020)

Despite the coincidence of the educational stages, the MD/PhD course at TecSalud is longer, 11 years: four years of initial medical training, followed by four years of scientific training, the PhD, and finally three more years to complete the degree.

As of the date of this study, in South America, the only country that has adopted, albeit timidly, the MD/PhD as part of the structure of higher medical education, was Brazil.

In Chile, for example, in 2017, Dr. Miguel Concha wrote about MD/PhD and cited Brazil as the only Ibero-American country to adopt the medical research training program: "As far as we know, no Ibero-American university develops this model with the exception of the Federal of Rio de Janeiro," and indeed, the UFRJ was the gateway to MD/PhD in Brazil.

In 1995, in a challenge to the rigid academic structure of Brazilian universities, UFRJ started a pioneering MD-PhD program. The objective was to train doctors who would also be successful in the laboratory. In the pilot phase, 6 medical students entered the graduate program in biochemistry in the last year of the medical course. (OLIVEIRA; CAMPOS and MOURAO, 2011, p. 1106).

From 2008, this medical training began to receive government support through the granting of doctoral scholarships throughout the PhD training period. The Special Scholarship Program - PhD in Medical Research (PBE-DPM), promoted by the Coordination for the Improvement of Higher Education Personnel (CAPES) has already promoted two calls for proposals for MD/PhD training with the offer of more than 150 PhD scholarships.

Doctoral scholarships may be granted to undergraduate medical students, provided they are enrolled in a Higher Education Institution that has officially established an academic program that links the scientific training of undergraduates to their entry into the doctoral program. (CAPES, 2014, s/p).

As of December 2019, 8 Higher Education Institutions (HEI), 19 Postgraduate Programs (PPG), and a total of 97 fellowship recipients were accounted for in the country, and 34 more doctors titled.

In Brazil, medical students begin the MD/PhD program from the fifth year of their undergraduate degree, have 48 months to complete their doctorate, then resume undergraduate activities to acquire clinical practice.

Europe

The UK, more specifically Cambridge University, was the forerunner of the MD/PhD in Europe. Since 1989, this movement has taken hold in the UK and expanded throughout European universities. In addition to Cambridge University, we cite here the Inserm Liliane Bettencourt School in France, the University of Basel in Switzerland, the University of Minho in Portugal, the University of Helsinki in Finland, and Georg-August Universität Göttingen in Germany.

Having more than 30 years of tradition in MD/PhD, the UK has already established a more consolidated structure with the achievement of excellence standards in training and scientific publication. In a survey conducted in 2015 - "The Cambridge Bachelor of Medicine (MB)/Doctor of Philosophy (PhD): graduate outcomes of the first MB/PhD program in the UK", we found reports of high rates of publication in scientific journals, nominations for national and international awards, and a significant number of PhDs who continued their research and/or started academic positions. In Cambridge, MD/PHD training typically:

spans nine years from matriculation. Three years of full-time research are integrated into the standard undergraduate clinical course, which combines a pre-clinical program that focuses on the basic medical sciences; a mandatory third year leading to the baccalaureate degree; and a clinical course with an emphasis on linking knowledge with clinical, practical, and communication skills and attitudinal and professional development. (COX, et al.,2012, p. 530).

And in counterpoint to England, other European countries have started the MD/PhD experience more recently.

In France, the MD/PhD program started at the Inserm Liliane Bettencourt School in 2003 and soon spread to other French universities, "They are largely inspired by the MD/PhD double degrees of North America." (SCHERLINGER et al., 2018, p. 466 - our translation) and have the following structure:

Starting in the second year of medical school, selected students take specific basic courses (biology, chemistry, mathematics, physics) in parallel with their medical studies. They also do extended internships in laboratories (four to six months over two years). This course, sanctioned by evaluations, makes it possible to obtain a scientific Master 1 (M1) equivalency at the end of the third year of medical studies. The early, multidisciplinary scientific training opens access to a wide choice of master's subjects. The Master 2 (M2) is prepared during a sabbatical year between the first and second medical cycle. At the end of M2, students can choose between two tracks:

- track 1: resumption of medical studies; the Doctor of Science degree is then deferred and taken during the interruption of the third medical cycle;

- track 2: the interruption of the medical course is extended for the completion of research work required to obtain the scientific doctorate; the return to medical studies (start of the second cycle) then occurs once the thesis has been obtained. (SCHERLINGER et al., 2018, p. 466 - our translation).

In Switzerland, the University of Basel, in partnership with the Friedrich Miescher Institute for Biomedical Research (FMI), has offered and funded "interdisciplinary training in basic research and access to cutting-edge technologies" since 2016 (EUROPEAN COMMISSION, 2019), and to join the program, a medical degree or an endorsement is required:

In the FMI International MD/PhD program, physicians with an interest in fundamental scientific research work together with internationally recognized scientists in the fields of epigenetics, neurobiology, and quantitative biology, developing a research project with their group leader. (EUROPEAN COMMISSION, 2019, s/p - our translation).

In this partnership, the PhD course lasts 4 years and the selected candidates receive a full scholarship, with social benefits.

In 2006, Portugal began its first MD/PhD experience through the University of Minho. Its intent was to offer a "unique and alternative opportunity for medical students to formally engage in biomedical / clinical research early in their careers" (UNIVERSITY OF MINHO, 2018, s/p - our translation). As a structure the 5+3+2 scheme was adopted, i.e., 10 years of training:

MD/PhD students interrupt their medical degree program at the end of their 5th year and start the doctoral program. Over the course of three years, they develop their doctoral thesis. After that, students are reintegrated into the medical course and complete the sixth and final year of medical school. (UNIVERSITY OF MINHO, 2018, s/p - our translation).

Another European example is the University of Helsinki in Finland. There, students are allowed to start the medical research training program right after their first year of study, with the accompaniment of "two faculty tutors and one to two student tutors" (UNIVERSITY OF HELSINKI, 2019).

The MD PhD program is implemented in collaboration with the graduate schools and doctoral programs on the Meilahti Campus. The program is coordinated by Teaching and Learning Services in collaboration with the MD PhD program steering group (chaired by Professor Antti Mäkitie). (UNIVERSITY OF HELSINKI, 2019, s/p - our translation).

Undergraduate students work in research groups for a total of three (3) months over five summers. Funding for the students' summer courses is provided by the faculty participating in the project, then the university offers another 18 months of funding for completion of the PhD.

In partnership with several departments of the Max Planck Institute, the German Primate Center, the German Excellence Initiative, and the European Neuroscience Institute Göttingen, the Georg-August University School of Science (GAUSS) is one of the German universities that also has an MD/PhD in its curriculum:

The program is open to students from Germany and abroad who hold a bachelor's degree (or equivalent degree) in biosciences, psychology, medicine, physics, or related fields. All courses are taught in English (GAUSS, 2019, s/p - our translation).

At this German university, the training of the medical researcher follows an intense first year of immersion in research activities, then, depending on the results, the students can choose one of these two paths:

Doctoral Program: Good to excellent results after the first year qualify for direct admission to a three-year doctoral project in one of the participating research groups. The master's thesis requirement is waived. Upon successful defense of a doctoral thesis, the degree Doctor of Philosophy (PhD) or the equivalent title Doctor rerum naturalium (Dr. rer. Nat.) is conferred. Students who have completed medical school prior to entering the program can apply for an MD-PhD degree.

Master's program: Alternatively, students can complete the program with a master's dissertation, based on six months of experimental scientific research. The Master of Science (MSc) degree is awarded upon completion of the master's thesis. (GAUSS, 2019, s/p - our translation).

In addition to the capillarization and great results of MD/PhD, Europe draws attention for the European MD/PhD Association (EMPA). This association founded, managed, and aimed at European MD/PhD students was created in 2015 and aims to:

To form a scientific network in which cooperation, exchange of knowledge and exchange of students between research centers is encouraged.

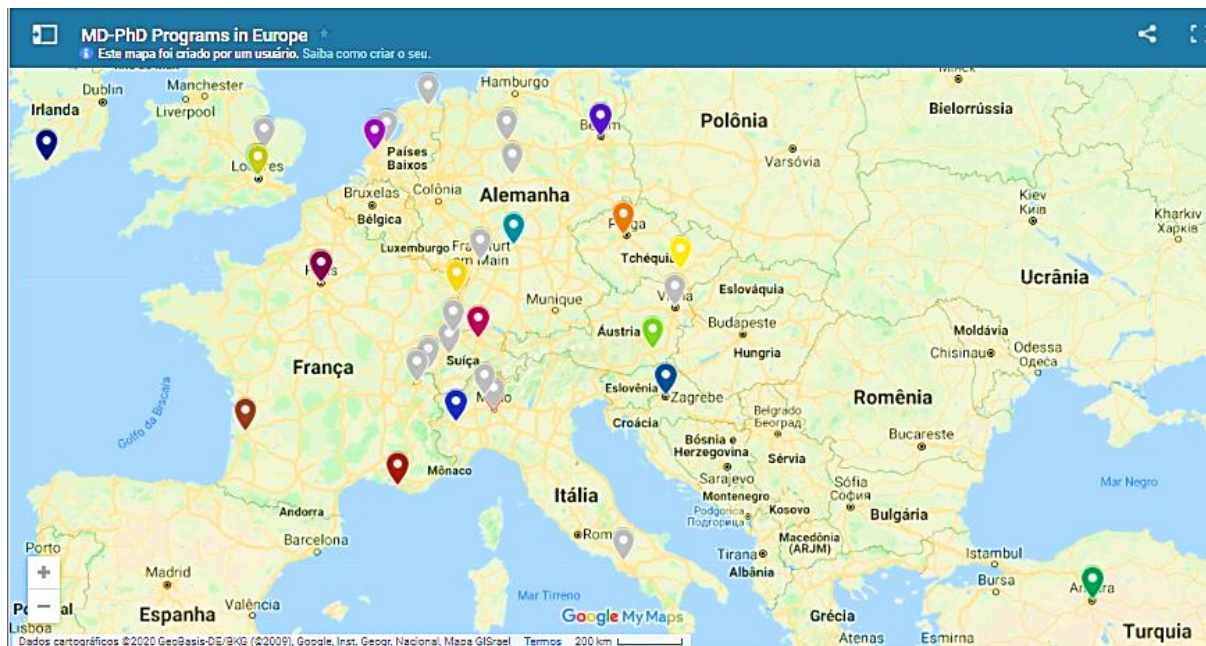
To form a social network, where connections between MD/PhD organizations, researchers, and MD/PhD candidates in particular can be made.

To give political weight to the voice of MD/PhD candidates in Europe and in each individual connected country.

To form a legal body to which financial contributions can be made for the achievement of the mentioned goals. (EMPA, 2019, s/p).

The institutional website of the association offers a huge variety of tools and tips for students, from events and courses to scholarship opportunities, in addition to an inspirational list of professionals graduated by the MD/PhD structure that are highlights in their areas of expertise. Another interesting point is the mapping of MD/PhD programs in Europe, in addition to the countries already mentioned in this work, it is possible to observe that other nations such as the Netherlands, Italy, Austria, the Czech Republic and Croatia also have the medical research training program.

Figure 3. MD/PhD in Europe



Source: EMPA (2019)

Africa

To talk about health and health workers in Africa is to touch on a sensitive subject. This continent concentrates the largest portion of neglected diseases and neglected peoples on the planet. In this context, "increasing clinical research capacity is essential for the well-being of its growing population and for development as a whole" (KATZ; MAYOSI, 2014, p. 111).

We found almost no references on the occurrence of MD/PHD in Africa, our reporting source being the article "The intercalated BSc (Med) Honours/MB ChB and integrated MB ChB/PhD tracks at the University of Cape Town: Models for a national medical student research training programme" - "The intercalated BSc (Med) Honors/MB ChB and integrated MB ChB/PhD tracks at the University of Cape Town: Models for a national medical student research training programme", published in 2014 in the Medical Journal of South Africa, and available for open access through SciELO.

This paper reports on the experience of MD/PHD as a joint effort between the government, university, and private sector in Cape Town to increase the number of clinical scientists by introducing research training at the undergraduate and postgraduate levels.

In the medical school classes, the opportunity to join the MD/PhD is offered to the best students, who begin the program with a year of molecular medicine concurrent with their third year of undergraduate study. Courses are offered "theoretical and practical, as well as basic biochemical and molecular laboratory techniques, with outcomes equivalent to a bachelor's degree." (KATZ; MAYOSI, 2014, p. 112). Then, students go through a clinical studies stage unique to the MD/PhD program and another "Honors" stage that prepares them for master's or doctoral laboratory dissertations.

Asia

Of the 50 countries that make up the Asian Continent, we address the particularities of the MD/PhD in China, South Korea, India, Japan, and Singapore.

In China, Shandong University, Shanghai Jiao Tong University School of Medicine, and Tongji University offer the MD/PhD in an exchange format. After the 2nd year of medical school, students can receive training in medical research in the United States, more specifically at the University of Nebraska Medical Center (UNMC), for 4 or 5 years, to obtain the PhD degree, then the MD training is completed by another 2 years of studies and clinical practice in China, to obtain the MD degree.

It is an integrated program with clinical medicine training and scientific research between selected Chinese institutions (MD) and UNMC (PhD). This joint program of medical education in medical research will help meet the need for better Chinese medical care, higher quality health professionals and better medical products for the people of China in this new century. (UNIVERSITY OF NEBRASKA MEDICAL CENTER, 2020, s/p).

In a recent structure, thought up since 2008, the Department of Biomedical Sciences, Graduate School of Seoul National University, in South Korea, has seen the MD/PhD as a tool to strengthen graduate education in the medical sciences and to produce numerous outstanding and world-visible biomedical scientists.

The Korean Ministry of Education, which was seeking the effective use of medical talents, finally adopted the joint MD/PhD program ... to produce more medical scientists than just clinicians. The MD/PhD program allows students to complete MD and PhD degrees during the course of study in the graduate school of medicine; it consists of the first 2 years of basic medicine, 3 ~ 4 years of doctoral program, and the next 3 ~ 4 years of clinical medicine courses, followed by graduation with both MD and PhD degrees. (SEOUL NATIONAL UNIVERSITY, 2014, s/p).

In the case of India, there is an explicit linkage of MD/PhD implementation with issues of the country's economic and social development, in view of the successful implementation in developed countries like the United States and England.

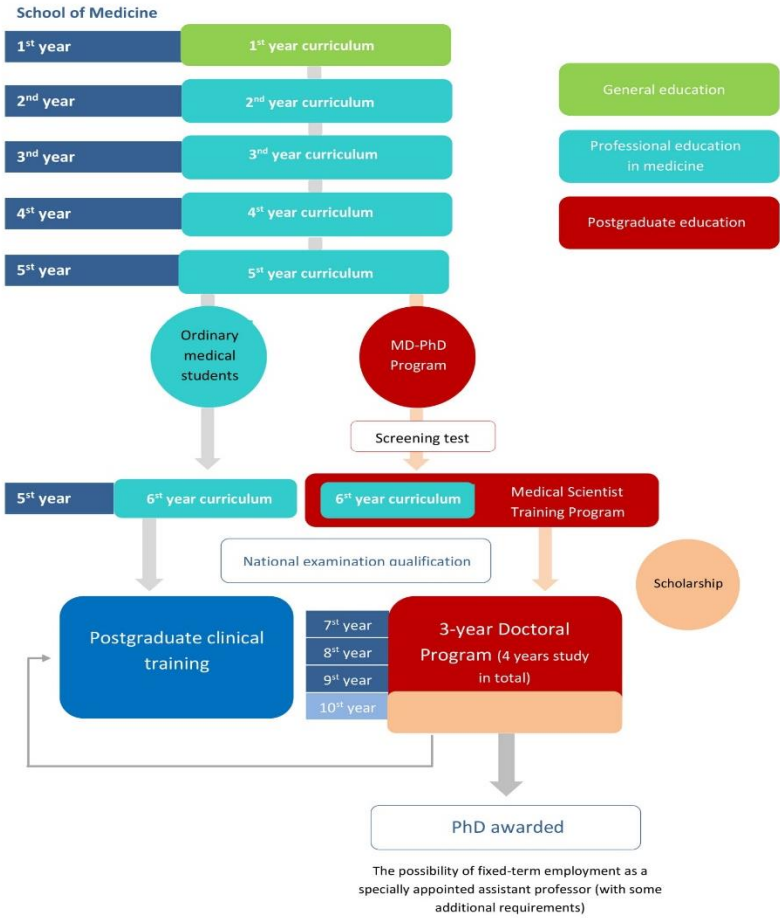
Launching the PhD/MD program is also economically feasible for developing countries like India, which needs to develop quality care physicians based on research record than quality researchers based on sound medical knowledge. (ANAND; RAO, 2013, p. 85)

The "Indian Council of Medical Research (ICMR), New Delhi, the apex body in India for the formulation, coordination and promotion of biomedical research" (ICMR, 2019) is responsible for the implementation and regulation of the MD/PhD. At the beginning of the process, medical students must pass a national-level exam and 25 students are chosen each year

to participate in the program at one of three partner centers: King George's Medical University (KGMU), National Institute of Mental Health and Neuroscience (NIMHANS) and Ramachandra University (SRI). The council provides full support for 5 years to the selected candidates with scholarship and grant funding.

In Japan, the Hokkaido University School of Medicine aims to "develop aspiring researchers in basic medicine who are able to respond to rapid advances in medicine and health care, and to social changes" (HOKKAIDO UNIVERSITY, 2020, p.??). In the Japanese MD/PhD Program, as in the Brazilian experience, 5th year medical students have the opportunity to enter the MD/PhD with financial support to subsidize their research:

Figure 4. MD/PhD structure of Hokkaido University



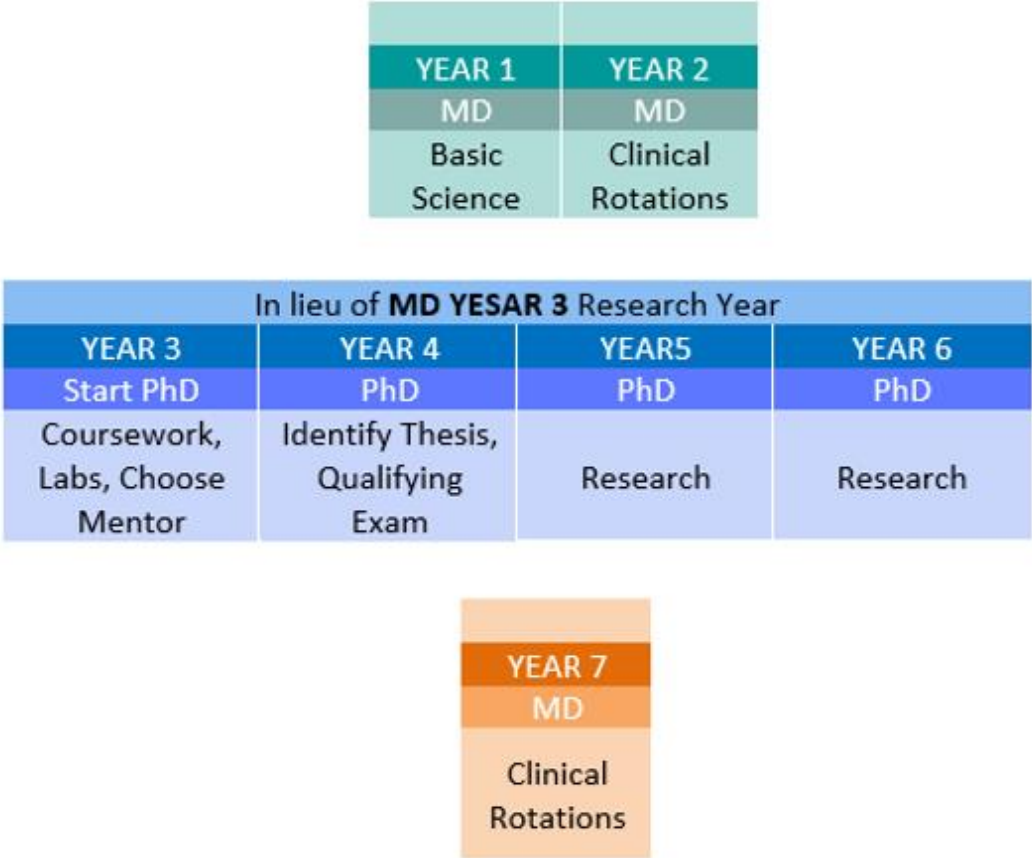
Source: Hokkaido University (2020)

In total, there are ten years of training. At the end of the 5th year of medical school, the PhD cycle begins, and the 6th year is dedicated to the initial training of the researcher physician. In the next three years, the student must dedicate himself to doctoral projects, and finally, in the 10th year, the student returns to the final phase of medical school, which ordinarily corresponds to the 7th year for regular undergraduates.

The MD/PhD structure offered by Duke-NUS Medical School, in partnership with the

University of Singapore, is shorter than the above structure, with only seven years of training:

Figure 5. Duke-NUS Medical School MD/PhD structure



Source: Duke-Nus, (2020)

In this arrangement (2+4+1+1), MD/PhD students must indicate their intention to participate in the program at undergraduate matriculation, and by the end of the 2nd year of MD, between 15% and 20% of students get a place in the program. All receive a full scholarship until they obtain the double degree.

And on the continental border we also find reports of the MD/PhD experience in Eurasian countries such as Turkey:

Hacettepe University, School of Medicine offers (MD/PhD) joint program by application of the Council of Higher Education Act 15273 on July 15, 2003. This program started in the academic year 2003-2004. This program is a special program whose graduate program in basic and clinical sciences is integrated with standard education. Outstanding students receive Doctor of Philosophy degrees upon graduation from this institution (HACETTEPE UNIVERSITY, 2003, s/p).

Oceania

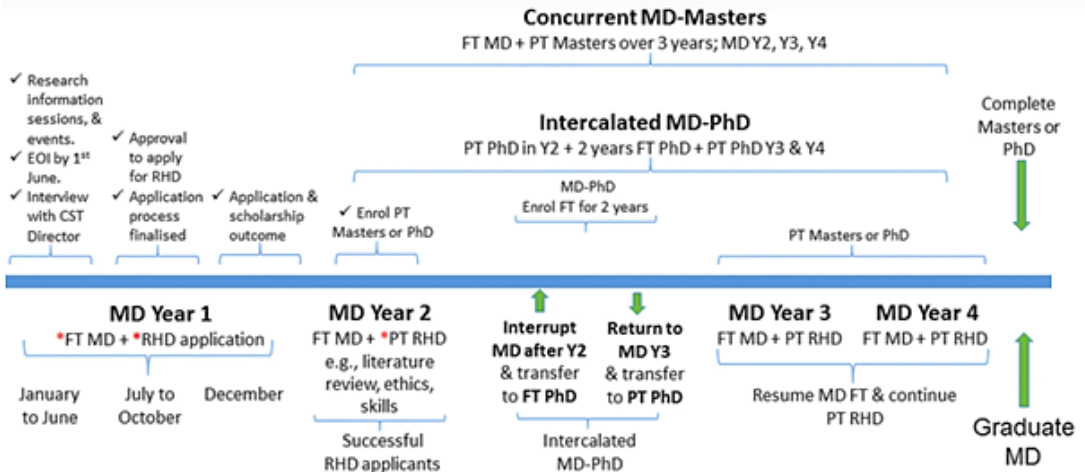
On this continent of Oceania, both Australia and New Zealand already have MD/PhD courses:

in Australia, there is no national approach to clinical-science training, either in the undergraduate or postgraduate years. There is no clear path to higher degree research training for medical students (ELEY, 2018, p. 2).

Thus, universities have autonomy to compose their curricula. As an example of Australian institutions that offer the MD/PhD, we find the University of Auckland, the University of Sydney, the University of Queensland, and Monash University.

At the University of Queensland, the research doctor enters a training system called Clinician-Scientist Track (CST) and can follow the path of specialization at the master's or doctoral level with complementary and concomitant studies to the medical degree:

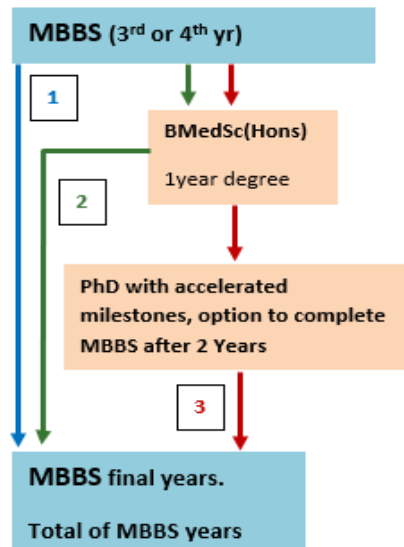
Figure 6. MD/PhD structure of the University of Queensland



Source: The author (2020), adapted from Monash University (2020a)

At Monash University, the MD/PhD takes on the nomenclature MBBS/MD/PhD and has the following flow:

Figure 7. Monash University MD/PhD structure



Source: The author (2020) adapted from Monash University (2020a)

The 1st option depicted in the flow of Figure 7, by the blue arrow, is the 5-year medical degree, MBBS.

The 2nd pathway, the green arrow, is the combination of the medical degree, MBBS, with the Bachelor of Medical Sciences with honors, BMedSc (Hons). Here, the student interrupts the degree, in the 3rd or 4th year, to take two semesters of the bachelor's degree and then resumes the medical degree. In the Bachelor of Medical Sciences, the student:

will undertake training in research methodology and conduct an independent research project on the selected topic, working closely with a supervisor who will provide individual guidance and academic advice. (MONASH UNIVERSITY, 2020b, w/w).

Finally, the third alternative, the red arrow, corresponds to the MBBS/MD-PhD. After the bachelor's degree, there are two more years of doctoral studies with a thesis defense, to finally resume the undergraduate studies and complete the studies for the double degree.

And following the same formative model, the University of Otago in New Zealand allows "in exceptional circumstances, for a medical student to upgrade from a BMedSc (Hons) to the intercalated MBChB/PhD" (UNIVERSITY OF OTAGO, 2020).

Final Considerations

The MD/PhD program is undoubtedly a differentiated structure in the standard of higher medical education with global reach that is associated with the economic and social development of countries, as well as the training of high-level professionals.

As a highlight, we observe that different scientific articles and institutional websites bring some common points when addressing the MD/PhD Program:

- a) one of the main motivations for the implementation of the MD/PhD was the identification of obstacles that are largely the result of insufficient articulation between medical and scientific training;
- b) Sometimes, the program is considered a tool to stimulate the formation of professionals for dual performance: clinical and research;
- c) There has been a growing interest in the implementation of the program;
- d) Most of the programs are inspired by the MD/PhD programs of renowned universities in the United States;
- e) Partnerships with institute associations for student funding are recurrent;
- f) Only high achieving students get this opportunity and
- g) The result of this program is excellence in professional training.

In Brazil, as well as in countries of recent implementation, the program still lacks studies on the impacts of MD/PhD.

The observation of the characteristics and peculiarities of the MD/PhD in different continents and countries of the world allows us to glimpse some tools that can be used to strengthen and expand the program in Brazil. As an example, we cite the associations created and managed by MD/PhD students and the training model with exchange to universities of international prominence.

As in Europe and Canada, the creation of an association can strengthen the MD/PhD program in Brazil. Apparently, the association works to capillarize the program seeking partnerships with national and international universities, disseminates actions to enhance the professionals with this training and works for the constant supply of funding. In Brazil, the numbers involved in MD/PhD are shy when looking at the National Post-Graduation System (SNPG) as a whole. Moreover, the last call for proposals for this program dates back to 2014 and there is no evidence of new calls to support the MD/PhD in the country.

The exchange adopted in China seems to us an excellent opportunity to access new knowledge and experiences, with the possibility of forming research and collaboration networks, strengthening internationalization in the SNPG and possible sources of funding.

We believe that investing in the MD/PhD program is to advance in combating the lack of interest of medical students in scientific research, while at the same time it is a means of strengthening higher medical education with regard to the training of excellent and scientifically productive professionals.

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