The clinician-scientist pipeline: undergraduate and postgraduate supply, leaks and perspectives

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Chapter 6

Comparing medical PhD training programmes around the world: a matter of apples and oranges?

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Abstract

In this article article we explore and describe medical PhD programmes aiming to train medical doctors as clinician-scientists in ten leading countries in life sciences research (United States of America, United Kingdom, China, Germany, Japan, France, Canada, Australia, Switzerland, and The Netherlands). Although the number of agreements regarding mutual recognition of the medical doctoral degree increase, the structure, requirements and characteristics of these programmes highly differ between and even within countries. As such, transparency of the different medical PhD pathways is crucial, especially with the increasing pace of globalization and exchange in healthcare. Exchanging information about PhD programmes can improve international recognition and quality of medical PhD programmes and degrees and serves (future) PhD candidates, clinician-scientists, supervisors, graduate schools and others involved in medical PhD programmes. Lastly, this could help researchers as well as a global readership to be aware of the importance of context when sharing and interpreting research on medical PhD programmes. To improve interpretation and generalizability of research on this topic, the great diversity in PhD programmes requires authors to comprehensively describe the doctoral setting in future research.

Introduction

A medical PhD programme is a common educational track for medical doctors pursuing a clinician-scientist (MD-PhD) career. A PhD degree (Doctor of Philosophy) is an internationally recognized and highly valued qualification. PhD programmes enable graduates to develop and demonstrate academic leadership, independence, creativity and innovation in research. These programmes are also referred to as the third cycle in the Bologna Process, as a follow up to the first (bachelor) and second (master) cycle, in an attempt to standardize and harmonize higher education systems across Europe.[1] Although all medical PhD programmes around the world aim to train medical doctors as clinician-scientists and the relevance of transparency of medical training increases, insight in similarities and diversity of pathways towards a PhD is currently lacking.[1,2] In this article, we explore various pathways for medical doctoral training, aiming to contribute to transparency by describing generic characteristics and differences, of medical PhD programmes around the world. First, we will further clarify three main reasons why an international comparison of medical PhD programmes is useful.

The first reason is related to the increasing pace of globalization in healthcare, resulting in raising numbers of exchange and migration of medical students, graduates, and specialists.[3-5] This international academic mobility is also one of the main goals of the Bologna Process.[1,6] While many countries around the world have agreements regarding mutual recognition of medical degrees, it is not always clear whether educatitoral contexts can imonal programmes and graduation levels are equal among countries with different higher education systems and career trajectories.[7-11] Furthermore, when countries do not mutually recognize medical degrees, confusion arises when PhD candidates or clinician-scientists experience substantial differences in academic level and must adapt to different medical academic systems.

Another reason to compare medical PhD programmes is the ever evolving medical field as response to the changes in society, healthcare, and challenges of a global workforce, which requires medical education systems to adapt as well.[12,13] In addition, the number of (future) medical doctors that globally enrol in PhD programmes highly increased over the last few decades.[14-22] These developments have various implications for PhD programmes, e.g. regarding funding and academic outcomes.

Lastly, differences in doctoral contexts can impact the interpretation, relevance and transferability of studies on medical PhD candidates and PhD programmes. Hence, insight in medical PhD programmes around the globe can benefit researchers and readers of educational journals in interpreting research outcomes within the context in which they were obtained, and in determining whether the outcomes can be compared and translated to their own context.

Materials and Methods

We compared PhD programmes of the ten leading countries in life sciences research based on the Nature index, an indicator of institutional research performance.[23] The metrics of 'Count and Share' used to order Nature Index listings are based on an institution's or country's publication output (primary research articles) in 82 natural-science journals, selected on reputation by an independent panel of leading scientists. The top ten countries are the United States of America, United Kingdom, China, Germany, Japan, France, Canada, Australia, Switzerland, and The Netherlands. We involved medical experts from our network and used snowballing methods to reach well-informed informants. These key-informants were experienced and practicing medical doctors with almost all having a PhD degree, involved in and/or knowledgeable about medical PhD programmes in their country. In total, 17 medical education key informants (i.e. at least one expert per country) were invited by email between September 2021 and April 2022 to fill in an online survey with open-ended questions (*Appendix C*) on medical doctoral PhD programmes in their respective country.

The three questionnaire topics were:

1. Demographics and career positions of a medical PhD, including positions in the careers of (future) clinician-scientists, motivations and ambitions of doctoral students for research, and the value of a PhD degree within the medical field;
2. Medical PhD programme structures and content, including admission requirements, guidelines, duration, type of programme and employment, and required activities as part of the program;
3. Graduation requirements, including thesis and defense criteria, and degree obtained.

Content analysis was applied to the survey outcomes. All responses were screened independently by two reviewers (CRdB and AJdB) and any discrepancies were resolved by consensus. When answers were insufficient or unclear, participants were again consulted for further clarification.

To strengthen validity and credibility of the results, we additionally searched the literature for country-specific information, particularly context sections of research on medical PhD programmes. However, almost all included studies on medical PhD programmes and PhD candidates within our ten included countries were conducted in a single institute and often lacked a comprehensive description of the doctoral setting.[22, 24-34]
In the final stage, key informants were consulted to fact check the results on the situation in their respective country and in some cases for some additional questions for further clarification.

Results

1. Demographics and career position of a medical PhD

1.1 Timing in the clinician-scientist pathway and admission requirements Multiple entry points of a PhD programme within the medical career are described, but generally a PhD takes place during medical school (i.e. MD-PhD program) or early in the clinical career. Unlike in the USA, in most included European countries obtaining a master's degree was not necessarily part of the PhD program, but mostly an entrance requirement. The North American Medical-scientist training programmes (MSTPs) were the first combined MD-PhD programmes launched in 1964 to enhance recruitment to academic medicine. MSTPs are the most common and deemed successful pathway to become a clinician-scientist in North America.[2,32] Hereafter, the combined MD-PhD track (in the UK known as UCL MBPhD track) was incorporated in many medical curricula worldwide and most included countries nowadays offer PhD tracks for medical students as well (Japan, China, Switzerland, The Netherlands, France, the UK). However, in some countries (e.g. the Netherlands and Australia) the majority of doctors usually enter a PhD programme after obtaining a medical master's degree, which is a prerequisite before entering a PhD program. In the Netherlands and Australia a minority of doctors start a PhD programme later in their career, as resident (possible as combined residency-PhD track) or specialist. In France most medical doctors enter a PhD after residency and fellowship, as in the UK where a PhD will usually be undertaken during higher specialist training as final step of medical specialization.[33]

1.2 Ratio of clinicians with or without a PhD degree Key-informants estimate a minority (5% to 30%) of MDs holding a PhD degree. Mostly, the PhD/no-PhD degree ratio differs between specialties (USA, China, Australia, Netherlands, UK). In some countries, for example Australia and the Netherlands, a PhD degree was valued as a selection criterion to get into specialty training. In addition, big differences in PhD degree rates between specialties are described, with highly competitive specialties having more MD-PhDs. Key-informants state that in these countries a subset of medical PhD candidates not pursues a career as clinician-scientist. In Switzerland, up to 20-30 years ago a PhD degree was mandatory to obtain a medical specialty position. Nowadays many Swiss hospitals still expect a PhD for a senior clinical position. Also in the UK many postgraduate medical specialties require a PhD degree for consultant applications. Simultaneously, in some other countries (e.g. Japan) no differences in PhD ratio between specialties exist. In China, the ratio of PhD degrees not only depends on specialty but also highly relies on the degree of urban development, and tiers and types of hospitals. For example up to 90% specialists with PhD degrees are in first-tier city hospitals and none in community hospitals. Also in Canada, many doctors have to do a PhD besides their specialty training to get a job in an urban teaching hospital.

1.3 Motivation for, value of a PhD, and ambition of PhD candidates In all countries a medical PhD for MDs is considered a first step in a clinician-scientist career. Furthermore, also for clinical careers it is highly valued to improve career prospects e.g. salary, job positions, and learning opportunities. Most respondents indicate that they believe a subset of PhD candidates have a strong interest in research, for example in the USA PhD candidates mainly aspire a career as clinician-scientist. However, in other countries (e.g. the Netherlands, Australia, Switzerland, and Germany) it is assumed that a substantial number of PhD candidates is motivated to obtain a PhD as adds to their CV and improve job opportunities (e.g. residency positions) without clinician-scientist career ambitions.[34]

2. Medical PhD programme structures and content

2.1 National guidelines None of the included countries has national guidelines for medical PhD programmes. However, some, e.g. France and UK have a framework for PhD programmes in general. Medical PhD programmes are usually regulated locally, which means that universities have a certain degree of freedom. Almost all institutes incorporate graduate schools that provide guidelines for PhD programmes. Consequently, available guidelines not only varied between countries but also within countries.

2.2 Duration, employment, and (core) activities The duration of medical PhD programmes has no fixed duration and varies by country, with a median time-to-degree of three to five years (full-time) or seven to nine years when combined with an MD degree.[2] For example in Germany, France, and China, the minimum of a PhD programme is three years. China as only country has a maximum duration of five to six years. In the Netherlands, duration of a PhD programme can vary without a fixed duration and depending on multiple variables as funding, type of employment (e.g. full time versus part time or in spare time next to residency), and research type (e.g. laboratory research and clinical research, as well as using an already existing database or set up research studies from scratch). PhD candidates typically receive a monthly income coming from grants, scholarship or salary from the government, graduate school or hospital. Only in Japan a PhD is usually unpaid. In Australia, the Netherlands, and Switzerland a PhD programme can be paid and unpaid, and are often paid less compared to clinical jobs. However, in the Netherlands, a PhD programme in medicine is a higher paying job compared to PhD programmes in other domains. Research is the core activity of PhD programmes. Compulsory educational courses or activities (e.g. teaching) are mostly part of the doctoral requirements. PhD candidates sometimes must complete courses totalling 30 credits during the PhD program. Some PhD candidates are also expected to be involved in clinical tasks, varying between countries, as well

as institutes and even departments. In Switzerland, the typical medical PhD is done alongside a clinical training (residency). In the Netherlands a minority of PhD candidates obtains their PhD in their 'spare time' alongside a clinical job as junior doctor, resident, or specialist. In Canada and the USA, the first two years of MD-PhD tracks involve coursework and comprehensive examinations. Hereafter, the PhD students becomes a PhD candidate and most of the remaining time will be devoted to their own research.

2.3 Supervision PhD candidates are always supervised by at least one, but mostly two thesis supervisor(s) and a thesis committee. Most supervisors are professors and/or clinical doctors. The supervisor(s) is/are responsible for mentoring, progress, quality of output, equipment sources, and often funding. Irrespective of availability of supervision criteria, in practice, supervision varies between supervisors.

3. Dissertation & defense

3.1 Requirements for completion In most included countries the dissertation or thesis, as final product of the PhD program, consists of an introduction, multiple published peer-review research articles, and a concluding chapter. However, there are no national dissertation requirements in any of the included countries. Consequently, requirements are determined by institutes and sometimes even depend on the supervisor and, thus, vary in the extent to which requirements with respect to dissertation content are documented.[33] Some countries (e.g. Japan and France) require a minimum of peer-reviewed publications, while other countries have no publication requirements. In addition, most, but not all, institutes have format rules. Sometimes there is a word requirement (e.g. Australia) for the dissertation. In some countries usually one (e.g. China) or three (e.g. the UK) research papers are included as chapter, while other countries require a minimum of four research papers for the thesis. Furthermore, in addition to the freedom institutes have in defining thesis requirements, some supervisors demand more (published papers) (e.g. China and the Netherlands) than required by institutional guidelines. As these are implicit norms and values, it is hard to capture to what extent requirements are determined by the supervisor.

3.2 Dissertation and defense process Dissertation and defense processes of medical PhD trajectories vary from a summative assessment to a formality without failure options. Yet, all defences aim at evaluating the thesis and the candidate's competencies, require the candidate to answer questions, test academic skills, and form the final (ceremonial) test of the PhD. In most countries, a panel of experts questions the candidate during a traditional oral defense ceremony, in some countries (e.g. the UK) called 'viva voce' (Latin for 'living voice'). The performance during the defence is part of the overall assessment

of the thesis. Mostly, e.g. in China, France, and the Netherlands, an (sometimes blinded) examination prior to the oral defense is done to assess if all requirements have been met, with the decision whether the dissertation meets the institutional standard. This assessment of the dissertation is done by a reading committee of experts in the field of interest and critically study and approve the thesis. Hereafter, it is unusual to fail during the oral defense, as the thesis supervisor, research team and reading committee usually warrant the quality of the research. The oral dissertation is open to the public in some but not all universities and lasts one or more hours. Other countries (e.g. the UK) consider the dissertation and defense as an assessment of learning (summative assessment) with dissertation outcomes as pass or fail possibly with minor or major revisions and resubmission of the thesis.

3.3 Names of degree obtained Medical PhD programmes award different degrees in different countries, with some countries awarding a Doctor of Philosophy (PhD) degree, which is similar to the PhD degree (e.g. USA, the Netherlands, and China). In Australia and the UK, an alternative degree (Master of Philosophy) can be awarded depending on the quality of the thesis and dissertation. The Master of Philosophy (MPhil) is also a research degree, but its scope is more limited. In Japan a successful dissertation leads to a teaching assistant degree. Even so, in Germany and German speaking universities in Switzerland different degrees exist. Thus, medical PhD programmes include different pathways with different degrees in some countries while being considered as synonyms in other countries. Unlike in the Anglo-Saxon model, German medical doctors do not receive a default MD degree with graduation. The Doctor degree (Dr. Med.) is in Germany awarded after a medical PhD programme and most medical doctors obtain this degree. However, this is not comparable to a Doctor degree in other countries, as it is obtained during medicine school consisting of mostly one research paper which generally takes 6–12 months. Therefore, usually, this degree is not recognized in the USA or elsewhere as a PhD degree. After the Dr. Med. degree, medical doctors can obtain a PhD (Dr. Phil.), which requires multiple years of research and publications. As we aimed to compare medical PhD programmes we included information regarding the German PhD programme that is rewarded with a Dr.Phil. degree only and excluded information on the doctoral training programme leading to a Dr.Med. degree.

Discussion

The purpose of this paper was to explore and describe pathways of doctoral training in medicine. Medical PhD programmes around the world intend to train clinician-scientists and several agreements on mutual recognition of a PhD degree exist. Nevertheless, our results show a rich variety in the structure, content, length of and timing in the medical career, and in thesis criteria. Institutions have a high degree of freedom in designing their PhD programmes and by that each programme can be unique and may have its own specific requirements and focus. Consequently, different pathways may lead to different qualities and outcomes, but are rewarded with a similar degree (i.e. PhD). Accordingly, not *all roads may lead to Rome* and the definition and value of 'the medical PhD' is challenging to capture on national level, let alone on an international level.

It is important to realize that the variety of medical PhD programmes mirrors the diversity of MD training programmes and specialty training programmes around the globe. Wijnen-Meijer et al. provided an overview of medical training formats across over 100 different countries to address issues regarding increasing globalization in healthcare and mutual recognition of medical professional diploma.[9,10] The authors conclude that, even when countries mutually recognize diplomas, names of stages and degrees do not fully explain the education received and final level of training at graduation. This is in line with our results showing a great variety in medical PhD pathways. Thus, a PhD degree does not necessarily imply equivalency of learning outcomes of all qualifications at the same medical education level.

Within the European Union, there is a push towards developing a uniform format for the doctoral defence.[35] After the Brexit, these discussions are resumed. A study by Lantsoght on differences and similarities of general doctoral defence formats included 26 countries and, in line with our study based on 10 countries, found a great variety in defence formats, also between EU countries participating in the Bologna Process.[36] The large difference between the 'viva voca' format in the UK and the continental public defence is considered a barrier in developing a uniform format. Lantsoght revealed four main building blocks of doctoral defences as explanation for differences observed between defence formats. In addition the authors conclude that these blocks may contribute to the discussion on a (more) uniform defence format with the EU, including defences within the medical field. These building blocks include (1) publication of the thesis before or after the defence, (2) number of steps in the defence (e.g. private defence followed by a public defence), (3) public defence or behind closed doors, and (4) fixed time schedule for the defence or examination until satisfaction of the committee.

Despite attempts to harmonize medical education interesting one could question whether it is desirable and possible to increase the uniformity of medical doctoral training and if uniformity is a prerequisite for international mobility.[1,7,8,37,38] März and colleagues studied intended learning outcomes for all three Bologna cycles and found a high degree of consensus, especially for the third Bologna cycle (PhD).[39] Yet, we observed a large diversity in PhD programmes around the globe which underlines the relevancy to explicitly communicate differences. We believe the observed diversity in PhD programmes around the globe underlines the relevancy to explicitly communicate differences. Furthermore, this transparency should be the foundation for migration and globalization. In this way, quality of PhD programmes, mutual recognition, exchange of (future) clinician-scientists, and generalizability of research on medical PhD candidates and PhD programmes can be improved.

This study has some limitations. Our study was a first attempt to make an overview and comparison between training pathways of clinician-scientists in ten leading countries in life sciences research. However, the wealth and variety in conceptual, practical, and structural aspects of PhD programmes, including the (apparent) large variety, cannot be done fully justice within the space limitations of a descriptive article like ours. Our article describes medical PhD pathways at this moment, while medical education keeps changing. Furthermore, a limited number of key-informants, with some countries only including one key-informant, may lead to a certain level of subjectivity. However, we believe that the conclusion of our paper will hardly change after including more informants. We suggest future research providing an in-depth overview of differences and similarities including more countries and other aspects of PhD programmes (e.g. achieved competencies) in medical education.

To summarize, despite medical PhD programmes share a common goal (i.e. training clinician-scientists), the pathway to a PhD degree highly varies among countries. Even between institutes of countries, between departments within institutes, and between research teams within departments, PhD pathways differ. This also applies in countries that mutually recognize each other's degrees, for example those participating in the Bologna Process. This great diversity in pathways towards a PhD degree require improved transparency of PhD programmes to benefit mutual recognition of PhD degrees, quality of PhD programmes, and mobility of the medical academic workforce as a response to globalization. Furthermore, it requires awareness of both the global readership and researchers regarding the importance of context when sharing and interpreting previous and future research on medical PhD programmes.

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