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# The MD-PhD programme: a key investment for academic medical centres

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Modern medicine increasingly relies on elucidating mechanisms that underlie disease, thereby allowing the conceptualisation and design of rational, targeted therapeutic strategies. While such evolution holds promise for markedly improved outcomes in the clinic, it poses new challenges regarding training medical students and young physicians. Therefore, medical schools must adjust their curricula toward providing students with an in-depth understanding of disease biology to prepare them for the increasingly mechanism-oriented, personalised medicine that, as physicians, they will be expected to implement. Medical schools should also provide interested students with the means to engage in experimental research and pursue a research career path, should they be inclined to do so. Accordingly, academic medical centres must train and nurture a core faculty of physician-scientists who can bridge the divide between clinical and basic science by guiding and conducting clinically relevant research and helping design clinical trials based on disease biology. Such physician-scientists should play a major role in shaping modern academic medicine by leading the quest to improve patient management based on comprehending the molecular events that underlie disease.

MD-PhD programmes provide academic medical centres with the means to rise to these challenges by selecting and nurturing students interested in a career that combines clinical medicine and experimental research. Such programmes attract students who have a genuine curiosity toward unravelling the mechanisms of disease and, by substantially extending the duration of training before bestowing a degree, naturally select highly motivated individuals. In Switzerland, the MD-PhD programme offers two possible tracks. The most common (Track I) comprises six years of medical school, immediately followed by four years (on average) of doctoral research (table 1). The alternative (Track II) allows students to embark upon their doctoral research after completing two to three (and possibly more) years of residency training (table 1).

The success of either track hinges on two essential premises: a well-designed research project, which, in addition to its contribution to its field, allows the candidate to acquire substantial scientific maturity and independence; and a smooth transition to residency that allows maintenance of limited, but nonetheless significant, research activity throughout clinical training.

MD-PhD students are expected to generate an original and relevant study that can compete for publication in a highly visible and widely read scientific journal and to acquire the technical skills and scientific knowledge necessary to provide the foundation for their subsequent progression to full-fledged physician-scientists. Their doctoral training is designed to help MD-PhD candidates acquire as broad a knowledge of disease biology as possible to enable them to address fundamental disease-centred questions beyond the boundaries of their thesis project. Upon obtaining their degree, MD-PhDs are expected to be able to view clinical problems from a scientific perspective and constitute an added value not only in clinical services but also in basic research departments.

The transition from laboratory to clinical training is delicate. An obvious danger is that MD-PhDs become employed as regular beginner residents, disregarding the knowledge and skills they have gained throughout their doctoral training. This typically results in them losing motivation for research and pursuing a purely clinical career, rendering their investment in experimental research obsolete. Such outcomes can be avoided if academic clinical services value MD-PhDs for their knowledge and experience and view them as long-term investments. A practical way of doing so is to provide them with limited protected time for research during their clinical training. Realistically, such protected time cannot exceed 25% of their effort. However, it plays a vital role in preserving young physician-scientists-in-training by helping them maintain the skills they acquired at the bench and the experimental research mindset they developed in the laboratory. Ideally, the research activity may be conducted in the laboratory where they obtained their degree, where they may be able to engage in projects related to or arising from their doctoral work. Naturally, providing MD-PhDs with protected research time during their residency and speciality training is challenging for clinical services and requires careful, personalised training design. However, such foresight on the part of academic clinical service leaders is likely to pay long-term dividends since they will have trained physician-scientists whose ability to bridge clinical and basic science will be invaluable not only to the service itself but also to the wider institution.

Academic career paths for MD-PhDs who have completed their clinical training in their chosen speciality are based mainly on the percentage of clinical and research effort. Three such options that are most likely to be successful are (table 2):

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– Engagement in full-time research.
– Engagement in research for 80% of their time and clinical consults for the remaining 20%.
– Engagement in clinical work as the principal activity and maintenance of a 20-30% research effort in an established research laboratory.

The first option requires a postdoctoral fellowship following clinical training to become competitive for an independent research principal investigator (PI) position. It is a challenging but feasible path for highly motivated individuals wholly committed to experimental research. Their clinical training will have provided them with a background distinct from that of non-medical life science researchers, giving them unique insight into which disease-related questions are important and how best to address them. MD-PhD trainees in the Lausanne programme who have chosen this option have been highly successful, and some hold leadership positions in prestigious institutions in the USA and Switzerland. However, this remains a career path that only a minority of MD-PhDs will select. Upon obtaining their degree, MD-PhDs may choose to skip clinical training altogether and pursue a research career after completing a postdoctoral fellowship. However, such a choice bypasses obtaining the unique insight into important disease-related questions that clinical training provides, thereby falling short of fully validating their investment in medical studies.

The second option is common in academic hospitals in the USA but less so in Switzerland. Similar to the first option, research is the primary long-term activity, where the physician-scientist runs their laboratory as a PI and largely depends on extramural funding. However, it allows 20% of their effort to be devoted to clinical duties, which many researchers find highly beneficial. One potential issue with such a path is that whereas MD-PhDs can contribute their extensive knowledge of biology to clinical problems, their ability to keep abreast of the evolution of clinical care is more limited. Their clinical activities should therefore be appropriately adjusted to cover specific diseases or disease subsets related to their research to which they can contribute significantly. Although this model is currently uncommon in Switzerland, it is possible that, depending on institutional structures and philosophy, significant evolution in such a direction may occur in the coming years.

The third option is the most natural one for most MD-PhDs in Switzerland. Here, the fully trained MD-PhD physician-scientist invests 70–80% of their effort in clinical activities within their speciality but maintains a relevant research effort for the remaining time. Since they cannot be expected to build their own laboratory within the permitted 20–30% time investment, their research should be conducted within an established laboratory with common interests, which could be the one where they trained. They can apply for grants to fund their own small research team that will benefit from the infrastructure and scientific environment of the host laboratory. In such a context, the physician-scientist can direct their own research project, using their clinical expertise to bring relevant disease-related questions to the bench. On the clinical front, the MD-PhD can influence their environment, especially young clinicians-in-training, by providing scientific insight into clinical problems and clinical trial design. It should be underscored that MD-PhDs who select this career path must strive for clinical excellence. Mediocrity in the clinic cannot be compensated for by their research activity or MD-PhD status. Original and competitive disease-oriented research conducted by these individuals must be built on a foundation of clinical excellence.

**Table 1:**
MD-PhD programme tracks. A summary of the features and the pros and cons of Tracks I and II.

| Track | Timeline | Pros | Cons |
|---|---|---|---|
| I | MD-PhD thesis begins immediately after completion of medical studies. The average duration is four years. | A linear transition from medical studies to research before engaging in clinical training. This path is arguably the simplest. | There are no major cons; occasional students may not yet have decided on their clinical field of interest and may engage in a thesis project that is somewhat remote from their ultimate speciality. |
| II | MD-PhD thesis begins after 2–3 years of clinical training after completing medical studies. The average duration is four years. | It allows students to select their thesis project based on their clinical experience and a possibly better sense of their long-term goals. An option for students who, at the end of their studies, are unsure which field they want to pursue in the clinic. | A less linear path than Track I. The (mainly psychological) issue of dealing with peers' progression to more senior clinical positions while returning to "square one" for research training. |

**Table 2:**
Long-term academic career options for MD-PhDs. A non-exhaustive summary of the possible academic career paths for physician-scientists. The most common path pursued by MD-PhDs in Switzerland is the one consisting of 70–80% clinical and 20–30% research effort.

| Career type | Training requirements post MD-PhD | Pros | Cons |
|---|---|---|---|
| Pure research (no clinical duties) | Postdoctoral research (3–5 years) after completing the MD-PhD thesis. | A linear progression toward a research career in biomedicine. | The omission of clinical experience. A reduced distinction from PhDs. |
| Pure research (no clinical duties) | 2–5 years of clinical training followed by 3–5 years of postdoctoral research. | Validation of investment in medical studies and acquisition of clinical experience that provides invaluable insight into disease-oriented basic research. | There are no major cons other than the duration of training before becoming an independent researcher. |
| 80% research: 20% clinical duties | Many (at least 5–7) years of clinical training, depending on the speciality. 25% protected research time during clinical training. 3–5 years of postdoctoral training. | Allows MD-PhDs to compete with pure researchers on the cutting edge of biomedical research while being active in their clinical speciality. | The duration of training. Depending on the departmental philosophy, MD-PhDs with this profile may risk marginalisation in the clinic. |
| 20–30% research: 70–80% clinical duties | 5–7 years of clinical training to qualify in the selected speciality, with 25% protected time for research. | The most linear path for training physician-scientists whose goal is to build a bridge between the clinic and the bench. | The research scope is more limited. |

Federal funding has been the cornerstone of the Swiss National MD-PhD programme. Currently, no more than five MD-PhD candidates from each medical school in Switzerland can be selected to compete for federal funding each year. Therefore, each university's MD-PhD Committee must select candidates eligible for the national competition based on the quality, feasibility, and novelty of their project. Federal MD-PhD scholarships are highly competitive, with no more than 10–12 awarded annually. Candidates who do not obtain a scholarship must seek support from their institution, host laboratory, or diverse foundations. While only a fraction of MD-PhD candidates successfully obtain a Federal scholarship, the competition, in which the selected MD-PhD candidates present their projects to a federally-appointed scientific committee, sets a standard that is key in shaping the programme and maintaining its quality. The recent decision by the Swiss National Science Foundation to discontinue federal funding of the MD-PhD programme is alarming and should be reconsidered, particularly given its growth and success. Moreover, the continued efforts of the five medical schools to strengthen the programme and render it more attractive warrant support at the national level and one of the best ways to provide such support is to maintain competitive scholarships that help ensure its excellence.

## The MD-PhD programme in Lausanne

The Lausanne MD-PhD programme has become much more attractive over the past 15 years. It started in the 1990s with 1–3 candidates pursuing a PhD thesis; it now has 30 graduate students, amounting to a roughly tenfold increase in student numbers. The increased interest in the programme stems from early sensitisation of medical students to research with continued illustration of the range of research possibilities and the encouragement of interested students to engage in laboratory-based electives throughout their medical studies.

This programme is run by a committee presided over by a senior UNIL faculty member and composed of clinical and basic science faculty from the Faculty of Biology and Medicine of the UNIL and the Faculty of Life Sciences of the Swiss Federal Institute of Technology Lausanne (EPFL). Students are introduced to the programme during their second year of studies, and those interested in obtaining an MD-PhD can apply to join the programme as of their third year. Acceptance to the programme is based primarily on the student's motivation and demonstration of a genuine interest in becoming a physician-scientist. Each accepted student is followed by a committee member who serves as an advisor to help them define their research direction, find the most suitable laboratory, and prepare their project presentation toward obtaining a scholarship.

The committee also encourages students to seek research electives during their studies and identify laboratories where they can conduct their master's projects. In Europe, medical students must complete a master's project, allowing them to become acquainted with research. However, master's programmes in medicine vary widely among medical schools. In Lausanne, where comparatively little time is dedicated to the master's project, a substantial portion of the work must be done parallel to courses and electives. Students who choose to engage in an experimental research project typically do so during the summer vacation months following their fourth year, allowing them to work in a laboratory continuously for 2–3 months. While what they can accomplish in the laboratory is limited, this time investment does allow them to become familiarised with laboratory work, and it can be invaluable in helping them determine whether or not they are suited for experimental research. By the time they engage in their MD-PhD thesis, most candidates will have completed at least three and sometimes up to four or five months of laboratory work during their studies.

After completing their medical curriculum, MD-PhD candidates embark upon their research project along one of the two possible tracks. Most students engage in Track I, meaning they start their graduate work immediately after completing their final medical exams. Their thesis work takes four years on average. It is conducted according to the rules of the Doctoral School, which correspond to those of most graduate schools, with the appointment of a thesis committee, a mid-term exam, a selection of accredited courses/seminars, and a final private and public thesis defence. Upon obtaining their degree, MD-PhDs transition into their chosen clinical service to engage in the corresponding residency programme. At this point, in agreement with the heads of the clinical services that engaged them, they are encouraged to apply for a fellowship that covers 25% of their salary for two years (renewable at least once) and guarantees protected time for research during their residency. Fellowships are provided on a competitive basis by the faculty and by several foundations. As discussed above, they are essential in enabling continuity, albeit limited, in research, which is crucial to prevent an abrupt and prolonged break that could result in them losing motivation and reverting to a purely clinical track. Currently, most clinical services that engage MD-PhDs in their residency programme provide them with three continuous months of protected research time per year. This approach has proven highly beneficial not only to the MD-PhDs but also to their host laboratory, where they can continue to participate in the continuation of their research project and its offshoots.

Students who follow Track II typically pursue a residency for two to three years before joining their selected laboratory. While this is a less "linear" track, it can have advantages since the clinical experience that the MD-PhD candidates have gained can guide them toward selecting the scientific questions they want to address along with the laboratory in which to address them. Their clinical experience and maturity can also benefit host laboratories working on medically related problems.

Of the 126 MD-PhD candidates to date, 124 have obtained their degrees, and most are now working at academic institutions. At least 20 hold professorships in Switzerland, the USA, or Canada. The vast majority found the MD-PhD experience highly beneficial, particularly for pursuing an academic career. The recent introduction of protected research time during the residency should go a long way toward rendering the programme even more attractive and, most importantly, facilitating MD-PhDs' development of a competitive research programme after completing their residency training. Our goal is to generate, within the University Hospital, a backbone of physician-scientists who

will bridge the divide between basic and clinical science and respond to the demands of modern medicine by bringing a scientific approach to clinical problems and by leading the effort toward new discoveries in disease mechanisms and disease management. The MD-PhD programme is vital for the success of such an effort.

**Potential competing interests**
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