

Swiss national MD-PhD program: an outcome analysis

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Summary

Purpose: This study aims at a first evaluation of the outcome of the Swiss national MD-PhD program during the last 16 years.

Method: One hundred and twenty six former and current students in the Swiss national MD-PhD program were surveyed via a Web-based questionnaire in September 2007. Twenty-four questions assessed information regarding participant demographics, information on the PhD thesis and publication activity, current positions and research activity, as well as participant's opinions, attitudes and career goals.

Results: Eighty questionnaires were received from 126 MD-PhD students and graduates (63.5% response rate). The responders consisted of present students (36%), former graduates (56%), and dropouts (8%). The percentage of women in the program was 23%, and the average duration of the program was 4.2 ± 1.4 years. Research interests were predominantly in the fields of neuroscience, immunology, molecular biology and cancer research. A considerable portion of the MD-PhD graduates had an excellent publication record stemming from their PhD research work,

and 89% were planning to continue a research-orientated career. Over 50% of those MD-PhD graduates completing their thesis before 2002 had already reached an assistant or full professor position at the time of the survey. Nearly all participants considered the MD-PhD training helpful to their career and high quality standards were assigned to the acquired practical and intellectual skills. However, criticism was expressed concerning the general mentoring and the career related mentoring. Moreover, general mentoring and career related mentoring were significantly less well perceived in research groups employing more than seven PhD students at the same time.

Conclusions: The MD-PhD students and graduates surveyed were satisfied with their education and most of them continued a research-orientated career. Regarding the overall positive evaluation, this study supports the view that MD-PhD graduates are well qualified for a successful career in academic medicine.

Key words: MD-PhD program; physician scientists; dual degree; career track; translational research

Foundations supporting the Swiss national MD-PhD program since 1992: SNSF (1992-), SAMS (1992-), Fondation Carlos et Elsie de Reuter (1995-1998), Fondation Louis Jeantet (1992-), Fondation Suisse de recherches sur les maladies musculaires (1992-) Helmut Horton Stiftung (1992-1995; 1998-2004), Maurice E. Müller Stiftung (1994-2003), OncoSuisse (2002-), Roche Research Foundation (1994-2008), Swiss Foundation for Excellence and Talent in Biomedical Research (2008-), Schweiz. Krebsliga/Robert Wenner-Fonds (1997-2001), Stiftung Dr. Max Cloetta (1993-), Velux Stiftung (2005-).

Introduction

The Swiss interuniversity (now called national) MD-PhD program was created in 1992 by the Swiss National Science Foundation (SNSF), the Swiss Academy of Medical Sciences (SAMS) and a group of private research foundations. This program supports research-orientated physicians with outstanding credentials and potential who are motivated to undertake a second university course, leading to a PhD at a faculty of natural sciences. Students of the national program participate in the local programs of graduate training in the biomedical sciences offered through medical schools and the faculties of natural sciences.

The Swiss national program initiated the first dual degree program in Europe and followed the successful concept of combined medical and scientific training programs initiated in the early

1960s in the USA. At that time it became apparent that scientific training fertilizes the growth of medical knowledge and patient care, and, vice versa, medical training clearly influences the focus and clinical relevance of scientific research. This concept developed into the National Institutes of Health initiative called the Medical Scientist Training Program (MSTP), which has funded numerous MD-PhD training programs in the U.S. since 1970 [1-3]. Similar training programs were started in Canada in the eighties and more recently in Europe including Germany, where the first MD-PhD training program was created at the University of Würzburg in 1997 [4]. Hence, despite the recent emphasis in clinically orientated research, a combined MD-PhD training is still regarded as the most useful training for a re-

search-orientated career in academic medicine [5]. In fact, the philosophy of the MD-PhD training has remained the same and should also provide the scientific background for a later shift into more clinically orientated research. MD-PhD trainees are especially well suited for translational research, i.e., for bringing important bench discoveries to the patient bedside and/or taking important clinical questions back to molecular research.

Since 1992 the MD-PhD programs in Switzerland have evolved and developed into indispensable scientific training programs for talented young physicians. All Swiss universities with medical faculties participate in the Swiss national program (Basel, Berne, Geneva, Lausanne, and Zurich). Their local MD-PhD commissions preselect qualified candidates and propose them to the national expert commission, which is constituted by representatives of the actual supporting foundations, for final evaluation. Medical students can enter the program either during (Track 1) or after their medical studies (Track 2). Final selection criteria for the program include above average marks during medical studies, high scientific commitment, a convincing individual career plan, a scientifically sound research project, high quality of the chosen research laboratory, positive support letters by scientific supervisors and peers, and a convincing personal interview. Between 1992 and 2004 an average of nine fellowships were available per year. During the latter years, additional foundations joined the Swiss national program and the SNSF increased the number of annually supported fellowships from four to seven in 2005. Thus, between 13 and 15 fellowships per

year can nowadays be awarded to qualified candidates by the national expert commission.

In recent years the training program has been harmonised between all participating faculties in order to guarantee similar selection procedures, to early identify and preselect talented candidates during their medical studies, to reorientate the training program more towards clinical research without neglecting basic research and to create uniformly structured training programs with adequate quality assurance [6]. Moreover, the program has recently been opened to other fields of academic medicine, including biomedical ethics, epidemiology and public health. Every other year the current MD-PhD students participate in a scientific MD-PhD meeting, where they present their research and discuss additional matters of common interests such as ethical and political issues of modern biomedical and clinical research. And finally, the Swiss MD-PhD Association (SMPA; www.smpa.org) has been founded as an alumni organisation for all Swiss MD-PhD graduates and students.

This study aims at a first evaluation of the outcome of the program during the last sixteen years. A detailed survey was performed in September 2007 among former graduates and current MD-PhD students of the Swiss national program investigating participant personal and demographic characteristics, research interests and publication activity, as well as participant opinions on the program, attitudes, success, and career goals. Moreover, the career track of former graduates was assessed, including their current positions, research activity and postgraduate training.

Methods

The study encompasses the time period between 1992 and 2007. An anonymous survey was conducted among all attendees of the Swiss national MD-PhD program, including those who had already completed their training (graduates) and those who were still enrolled in the program (students) at the time of the survey (autumn 2007). During the whole study period a total of 142 MD-PhD fellowships had been awarded to selected candidates. Eleven new MD-PhD students, who had just started their PhD in autumn 2007, were not included in the survey. Moreover, five persons could not be contacted due to the lack of address information. Thus, the structured questionnaire was sent to a total of 126 MD-PhD graduates/students.

The survey was carried out anonymously employing the Internet service 2ask (www.2ask.ch). An access code was used making it impossible to assign the returned questionnaires to the individual participant. The online questionnaire was available for completion via the link in an invitation e-mail from September 7th until September

30th, 2007. Two reminder e-mails were sent only to those addressees who did not return the questionnaire.

The questionnaire was made up of twenty closed, two open and two Table/Matrix questions, collecting information regarding participant demographics, statistical data, field of PhD thesis, current position and activity, career track, career goals, publications, supervision, and satisfaction with various aspects of the MD-PhD program and the educational experience.

We used descriptive statistics to summarise the statements of the responders. Where probabilities are indicated, chi-square tests were applied to compare observed results with expected results. With respect to the completion of their MD-PhD thesis, responders were grouped into a student and a graduate group. Since there was no obligation to answer every single question of the survey, the total number of given answers to the individual questions varies. Percentages were always calculated according to the total amount (n) of given answers to the individual questions.

Results

The 126 MD-PhD graduates and students included in this study originated from the universities of Basel (19 [15%]), Berne (12 [10%]), Geneva (28 [22%]), Lausanne (39 [31%]) and Zurich (28 [22%]). Compared to the number of applications, the highest number of supported candidates originated from the university of

Zurich, followed by the universities of Lausanne, Basel, Geneva and Berne. The total number of yearly distributable fellowships varied depending on the number of associated private foundations and the available funds at the SAMS and the SNSF.

Demographic characteristics and MD-PhD training

Surveys from 80 participants were returned (63.5% response rate). Among them 29 (36%) students, who were still enrolled in the program, 45 (56%) graduates, who had completed the program, and 6 (8%) dropouts, who did not complete the program.

By the time of the survey, most of the students were between 26 and 30 years old, with the graduates distributed in the older age classes (table 1). The proportion of women in the program was 23%. The average duration of the program was 4.2 ± 1.4 years (calculated from the graduates-group, $n = 46$). While 24% entered the program during and 54% directly after medical school, 21% had gained experience in research or clinical work before entering the program (table 1).

Research interests were predominantly in the fields of neuroscience/psychiatry (26%), immunology/infectious diseases (23%), molecular biology/genetics (19%), oncology/cancer research/haematology (14%), gastroenterology/hepatology (4%), cardiology/vascular diseases (3%), endocrinology/metabolism (3%), allergology/dermatology (1%), biochemistry (1%), physiology (1%), other (5%) ($n = 74$).

The majority of the students and graduates (99%) considered the MD-PhD training as helpful for their personal careers (very helpful or helpful as opposed to rather hindering or very hindering, $n = 74$). High quality standards were assigned

to the aspects of acquired practical skills (96%) and acquired knowledge (97%) during the MD-PhD program (high or rather high quality standards as opposed to rather low or low quality standards, $n = 73$).

When asked to rate different aspects of the national MD-PhD program, 74% of the respondents stated that there is a good information flow about the program in Switzerland, 79% were satisfied with the organisational aspects of the program, 85% assessed the procedure for candidate selection as good, and 99% rated the quality of offered courses within the program as good (very good or rather good as opposed to rather bad or very bad, $n = 68-73$). Room for improvement was seen particularly with respect to communication and information about the program at the local level. Specifically, medical students should be informed about the opportunity to start the MD-PhD program earlier during their studies. Furthermore, it was mentioned that the required criteria to receive a national fellowship could be made clearer to the applicants. Some respondents suggested broadening of the course contents and regular evaluation of all courses offered within the five local programs. Concerning a convention of students, 68% of the responders approved a biennial meeting for all Swiss MD-PhD students, as has already been established since eight years.

Table 1
Demographic characteristics and background of all (80) responders.

Characteristic (measure)	All responders	Students	Graduates	Dropouts
Number of responders	80 (100%)	29 (36%)	45 (56%)	6 (8%)
Age-class I (26–30 years)	31 (39%)	26	5	0
Age-class II (31–35 years)	18 (23%)	2	14	2
Age-class III (36–40 years)	19 (24%)	1	15	3
Age-class IV (41–45 years)	12 (15%)	0	11	1
Women	18 (23%)	8	9	1
Men	62 (78%)	21	36	5
Program length (years \pm SD)	–	–	4.2 ± 1.4	–
Entrance during medical school	19 (24%)	11	7	1
Entrance after medical school	43 (54%)	14	25	4
Entrance after clinical experience	13 (16%)	3	10	0
Entrance after research experience	5 (6%)	1	3	1

Quality of supervision

During their MD-PhD training, 88% of the students were supervised directly by a full or an assistant professor, while 12% were supervised by a group leader, and 1% were coached by a postdoc (n = 73). While 85% of the students obtained scientific supervision, 75% obtained general mentoring and 56% obtained personal mentoring regarding their future career planning (yes and rather yes as opposed to rather not and no, n = 73). Reasons for suboptimal supervision and mentoring were mainly seen in the time pressure of the supervisors, especially in laboratories where the same mentor supervised many PhD students.

The numbers of PhD students in the various research groups varied between one and three (42% of all research groups [n = 73]), four and six (29%), seven and twelve (23%), and more than thirteen (5%). There was a relation between the number of PhD students in the same laboratory and the type and quality of support that the students received from their supervisor. Hence,

whilst the scientific supervision was similar between small (one to six PhD students) and big research groups (more than seven PhD students), the more time consuming forms of supervision such as general mentoring and career advice were significantly less satisfactory in large research groups (table 2).

Suggestions for improvement particularly included the need for mandatory minimal standards for MD-PhD supervisors including better project-related supervision, more extensive mentoring and more help with respect to career planning. Despite these deficiencies, a majority of 80% of MD-PhD students and graduates (n = 65) would recommend their actual or past supervisors or research groups to future MD-PhD students; only a minority of 20% cannot recommend their training environments for future newcomers (n = 65). The most frequent complaints were poor supervision and/or mentoring and poor teaching.

Table 2

Evaluation of supervision and mentoring with respect to the number of fellow PhDs in the laboratories.

	Scientific supervision		General mentoring		Mentoring or advice regarding the future career planning	
	1-6	>7	1-6	>7	1-6	>7
Number of PhD students per lab						
Yes / rather yes	87% (n = 45)	81% (n = 17)	83% (n = 43)	57% (n = 12)	63% (n = 33)	38% (n = 8)
Rather not / no	13% (n = 7)	19% (n = 4)	17% (n = 9)	43% (n = 9)	37% (n = 19)	62% (n = 13)
Chi-square test	†0.546†		†0.022†		†0.048†	

Publication activity

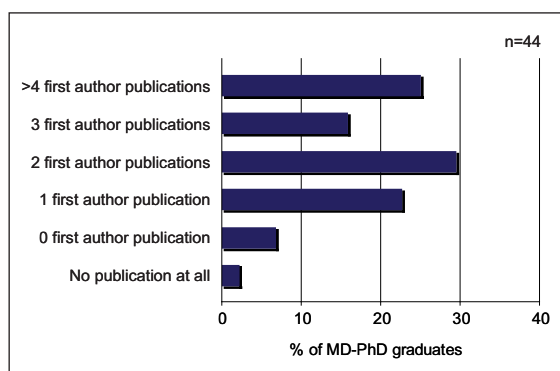
Twenty five percent of the MD-PhD graduates published more than four first-author papers originating from their MD-PhD thesis, 16% published three papers, 30% two papers, 23% one paper, and 7% of the graduates did not have any first author publications resulting from their MD-PhD work (fig. 1, n = 44). Moreover, 11% of the graduates co-authored more than six papers, 18% exhibited between four and six co-authorships, 59% between one and three, and 11% had no co-

authorship papers at all. Only one graduate student (2%) had neither a first author nor a co-authorship paper resulting from the MD-PhD thesis. Among graduates with a positive publication record (first author and/or co-author), 52% were satisfied with the number and quality of their publications, 30% were “rather” satisfied, 16% were “rather not” satisfied and 2% (one student) were completely unsatisfied. Reasons for an unsatisfactory publication record included the (too) high complexity of the project (20%), poor scientific supervision (16%) and bad luck (14%).

When asked whether, based on their publication record, they feel competitive for an academic career, 42% (18) of the graduates answered with a clear “yes”, 37% (16) with “rather yes”, 9% (4) with “rather not” and 12% (5) did feel “not at all” competitive for an academic career. Interestingly, nearly half of the responders, who felt “rather not” or “not at all” competitive for an academic career, nevertheless searched for a position in clinical medicine with significant research activity or for a position in biomedical research after completion of their MD-PhD training.

Figure 1

Publication record resulting from the PhD research work.



Career track and research activity

To evaluate the career track of MD-PhD graduates, participants were asked about their

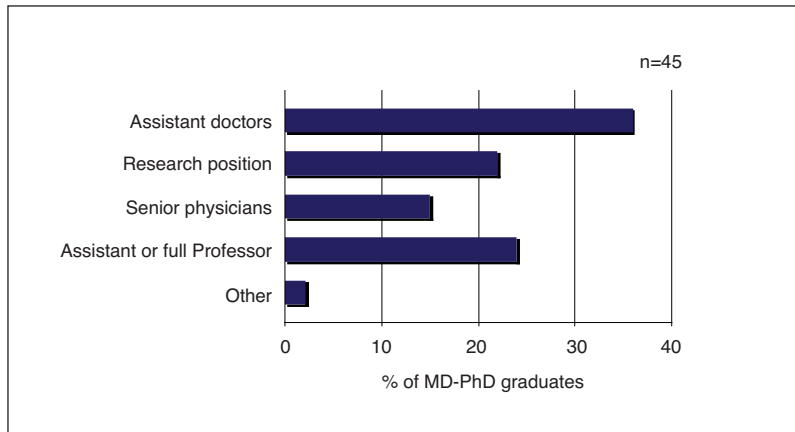


Figure 2

Career track: Current employment of MD-PhD graduates.

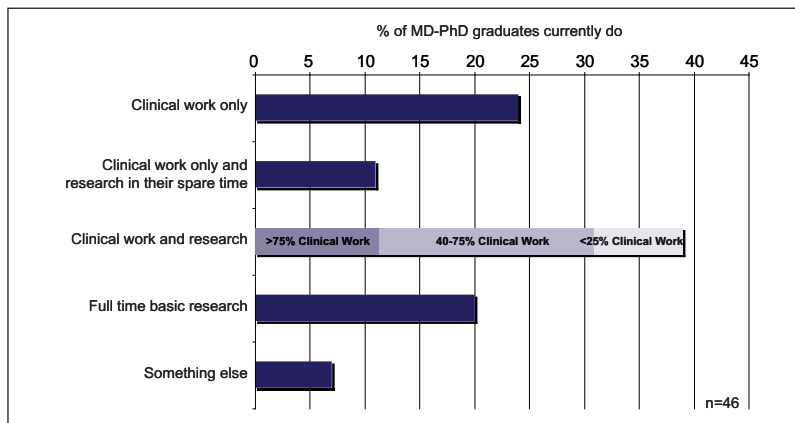


Figure 3

Professional time allotment of MD-PhD graduates.

current position and their daily activities. Among the 45 graduates, who had completed their MD-PhD training by the time of the survey, 35% (16) were still in the course of their clinical speciality training as resident physicians, 22% (10) held postdoctoral positions in industry or research institutes, 15% (7) were senior physicians, 2% (1) were in full-time private practice, and 24% (11) had already been promoted to assistant or even full professor (fig. 2). Hence, considering that medical specialisation takes about five to six years to complete, more than 50% of the graduates, who finished their MD-PhD training by 2002, were already well underway in their academic career at the time of the survey.

Regarding their daily activities, 24% of the graduates (11) were doing clinical work only, 11% (5) were doing full-time clinical work combined with some "spare time" research, 39% (18) were engaged in clinical work with different proportions of research activities, 20% (9) were doing full-time basic research, and 7% (3) performed various other, not directly research related, activities (fig. 3).

With respect to further postdoctoral training after completion of the MD-PhD thesis, 58% (26) of the MD-PhD graduates completed their clinical specialisation before they started a postdoctoral research fellowship abroad, 13% (6) started a postdoctoral research fellowship directly after completion of the MD-PhD program, 2% (1) did a postdoc before entering the program, and 27% (12) had neither started nor plan to perform postdoctoral research training abroad (n = 45).

Future career goals

The study participants were also asked as to their initial career goal, i.e., at the time they entered the MD-PhD program, and their actual career goal, i.e., at the time of the survey. The results showed that the MD-PhD training hardly influenced the students' and graduates' long-term professional goals. At entry to the MD-PhD training, 82% of the students wanted to follow a career in clinical medicine with significant research activity and 12% aspired to a career in biomedical research without clinical activity (n = 74). When asked for their actual professional goals, 78% of

student and graduates still wanted to pursue or had already started a clinical career with significant research activity, and 11% sought a career in biomedical research (n = 72). However, a considerable increase was seen in the group that aspired to a position in private industry: Only 1% named a position in private industry as his/her long-term professional goal when entering the MD-PhD-program, while 7% of the participants stated a career in industry as their actual professional goal. Hence, the MD-PhD program appears to sensibilise the students for a future career in industry.

Discussion

Our study demonstrates that MD-PhD graduates and students of the Swiss national program are satisfied overall with their education and most of them are/were planning research-oriented careers. Although the Swiss national MD-PhD program is still very young, 50% of the graduates who completed the program before 2002 have already become assistant or full professors, clearly indicating the success of this program in producing successful physician scientists with sustained academic careers.

We contacted 126 MD-PhDs who are/were enrolled in the Swiss national program, but due to possible outdated addresses we do not know how many persons actually received our e-mail containing the survey. Apart from that, our response rate was consistent with the mean response rate among mail surveys published in medical journals [7]. Since we did not try to re-contact non responders we cannot rule out non responder-based bias. However, the dropout rate of 8% evaluated by the survey approximately corresponds to the registered dropout rate in our database (9%).

Our results show that females were underrepresented in the Swiss national MD-PhD program between 1992 and 2007 with an average female to male ratio of 1:4.4. However, the gap is steadily closing: in 2007 and 2008, women made up an average 45% of all MD-PhD students of the national program.

“The international measure for the quality of research is the quality of the publications that result from it”, stated *Nature Medicine* frankly in an editorial in 2007 [8], and MD-PhD students are under an even higher pressure to publish than their PhD colleagues in biology due to the curriculum for medical specialists and the limited time for research activity during their continuing education. Our data show that most MD-PhD students become assistant doctors and enter clinical specialisation after having completed the program. The data also show that during the time of clinical specialisation their publication activity is low. However, during the MD-PhD training a substantial percentage of students of the Swiss national program have an excellent publication record. Moreover, the corresponding self-assessment indicates that most of them feel competitive for an academic career. Interestingly, individual analysis revealed that the expectations and also the self-perception differed considerably between the participants; while some MD-PhDs feel able to compete following a single publication, others do not feel competitive although they completed the program with three first-author papers.

One major point of criticism that was mentioned by several participants concerned the mentoring they had received during their training period. Interestingly, general mentoring and men-

toring concerning the future career planning was significantly less well perceived in research groups where more than seven PhD students were employed at the same time. Moreover, poor supervision and mentoring was mentioned as the most frequent reason for inefficacy and frustration in research, which further emphasises the importance of peer and administrative support throughout the training process. However, there were no significant differences found between the number of papers published in small (one to six PhD students) and in large (more than seven PhD students) research groups, indicating that the project related scientific supervision was adequate in small and large research groups. Nevertheless, to guarantee optimal supervision for all MD-PhD students the national commission has formulated minimal standards for the supervision of MD-PhD students. These guidelines summarise the main responsibilities of the local commissions, supervisors and thesis committees. In particular, a special surveillance of the progress of the PhD student made after the first year should help to identify potential problems and give the opportunity to refine or realign the project goals. Moreover, the supervision – intellectual and methodological – has to be guaranteed, and, if necessary, substituted, in case the direct supervisor is frequently absent. The General Secretariat of the SAMS offers to serve as an independent office where MD-PhD students can deposit possible problems and complaints regarding insufficient supervision/mentoring (“Ombudsstelle”).

In order to make the Swiss national program financially more competitive regarding alternative career schemes for young MD graduates, MD-PhD stipends of our program are substantially higher compared to SNSF-stipends for PhD students from other biological and biomedical research disciplines. Although the scientific motivation and career aspirations of the candidates should be the primary incentives for entering into the program, an appropriate salary for the fellowship holders appears more than justified considering the substantial higher salaries of other MD graduates who enter a clinical specialisation directly after medical school.

To attract the best talents for a scientific career in basic and/or clinical medical sciences the structure of the MD-PhD training program has to be continuously adapted to the changing landscape of medical education. Most importantly, the recently harmonised training program [6] has to be streamlined with the Bologna study reform, which offers unique opportunities for early scientific training and early identification and channelling of talented students into the MD-PhD program [9]. Furthermore, the MD-PhD training program has recently been opened to other fields of academic medicine including public health and

biomedical ethics. And finally, qualified and motivated MD-PhD graduates should be accepted into the best clinical training programs in order to prevent unnecessary delays in their future career. Since the majority of MD-PhD graduates follow a combined career in research and clinical medicine, they acquire special expertise in translational medicine and, thus, can bridge basic and clinical research in an optimal manner. In this regard a well structured MD-PhD training appears superior to the more “classical” training of physician scientists, where a talented MD starts a research project outside a structured training program, although this more “hands on” research training might also remain a valid alternative in the future.

Basic research is flourishing as never before, and basic scientists provide continuously new discoveries and tools with great potential for diagnosis and therapy of devastating diseases. It requires well-trained physician-scientists to bring these basic discoveries into clinical medicine and to test their potential to the benefit of the patients. However, if translational medicine is to flourish physician-scientists need fruitful collaborations with their full-time clinical colleagues. There are famous examples of successful partnerships where one partner plays the role of the scientist and the other the role of the physician [10]. As pointed out by Goldstein and Brown “such collaborations work best when each of the partners has some

training and experience in the discipline of the other so that they can readily exchange ideas and insights” [10]. Due to their dual training in basic research and clinical medicine, physician-scientists are exceptionally well-suited for *tandem* partnerships and “dual leadership” in academic medicine. Since “dual leadership” has been proposed as a prerequisite for the further advancement of scientific medicine in our university hospitals [11], well-trained physician-scientists are required to realise this suggestion. Hence, besides the more traditional career opportunities in biomedical sciences and industry, the potential of physician-scientists can help to realise new organisational structures in academic medicine such as, for example, the creation of “Clinical Research Centres” at all Swiss university hospitals [11]. Indeed, there are many reasons to keep the national MD-PhD program flourishing and to continue and even extend our support for the best scientific training of our young talents motivated for a scientific career in medicine.

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