TRAINEE SECTION

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Clinician-Scientist Trainee: A German Perspective

Abstract

Clinician-scientists are particularly well positioned to bring basic science findings to the patient's bedside; the ultimate objective of basic research in the health sciences. Concerns have recently been raised about the decreasing workforce of clinician-scientists in both the United States of America and in Canada; however, little is known about clinician-scientists elsewhere around the globe. The purpose of this article is two-fold: 1) to feature clinician-scientist training in Germany; and 2) to provide a comparison with the Canadian system. In a question/answer interview, Rory E. Morty, director of a leading clinician-scientist training program in Germany, and Katrin Milger, a physician and graduate from that program, draw a picture of clinician-scientist training and career opportunities in Germany, outlining the place of clinician-scientists in the German medical system, the advantages and drawbacks of this training, and government initiatives to promote training and career development of clinician-scientists. The interview is followed by a discussion comparing the German and Canadian clinician-scientist development programs, focusing on barriers to trainee recruitment and career progress, and efforts to eliminate the barriers encountered along this very demanding but also very rewarding career path.

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The transition of the results of research in basic science from the laboratory bench to the patient's bedside is of paramount importance to the improvement of patient care and treatment [1-3], and is undoubtedly one of the most satisfying realizations of basic research in the health sciences. Over the past decade, increasing emphasis has been placed on this type of translational approach to basic research in health sciences. An increasing awareness of the need for research in basic science to address clinical issues has intimately linked basic scientists and clinicians, creating an emerging population of "clinician-scientists", which represents a challenging marriage of these two careers [1]. Multiple paths may lead to a career as a clinician-scientist. In Canada, trainees generally interrupt their medical studies after two years to undertake further studies towards a higher degree in the molecular or clinical sciences, such as a M.Sc. or a Ph.D., prior to completing the remaining half of the primary medical degree.

Acquiring the necessary solid foundation in the basic sciences, while at the same time completing primary medical training, is extraordinarily demanding. This has resulted in the path to becoming a clinician-scientist being tread by the few, not the many. The demands of this career path have led many clinicians-in-training to seriously consider whether training and subsequently working as a clinician-scientist is indeed worth the effort, particularly since the apparent benefits of undertaking a clinician-scientist career-track - in terms of training, career prospects and international marketability - are not immediately clear. Likewise, there are major drawbacks to pursuing a career as a clinician-scientist: the prolonged training time, a reduced salary compared with full-time clinicians upon completion of training, the difficulty in competing with Ph.D. graduates for the first and subsequent grants, and the pressure of clinical burden in a healthcare system already short of physicians [4,5].

First and foremost, this article aims to examine the German perspective of clinician-scientists in an interview form, to feature aspects of their training, and to discuss everyday challenges faced by German clinician-scientists. Two of this paper's authors, Rory E. Morty, Director of the International Graduate Program "Molecular Biology and Medicine of the Lung" (MBML) at the University of Giessen in Germany, which fosters training of clinician-scientists in Germany, and Katrin Milger, a clinician at the University of Giessen who obtained her medical degree in 2007, and who is both currently specializing in Internal Medicine, and studying towards her Ph.D. degree within the framework of the MBML program in Giessen, were interviewed. The interviews are followed by a discussion that

compares and contrasts the Canadian and German routes to becoming a clinician-scientist.

Interview

Could you briefly outline medical training in Germany?

Dr. Morty responds: In Germany, medical students can begin medical training immediately after secondary school. Prospective students must have attained a minimum matriculation grade to be admitted to medical studies at one of our 36 medical faculties. The first two years of medical training are devoted to preclinical topics, and are followed by a national state examination, the *Erster Abschnitt der ärztlichen Prüfung* after which, students carry the status Candidate of Medicine (*cand. med.*) and may proceed to clinical studies, which last for an additional three years. Medical studies are completed by a sixth year of practical training, the *Praktisches Jahr*, and a second national state examination, the *Zweiter Abschnitt der ärztlichen Prüfung*, before the candidate receives a license to practice medicine.

Unlike in most countries, in Germany the ability to practice medicine does not entitle the candidate to the title "Doctor". Rather, the M.D. equivalent is the *Doctor medicinae*, abbreviated "*Dr. med.*", which is awarded only after the candidate has undertaken a period (usually between six months and two years) of research, which can be either a clinical study or a basic science study, for which a written thesis (a "medical thesis") is submitted, examined, and orally defended. Obtaining the *Dr. med.* qualification is not a pre-requisite for clinical practice or qualification as a specialist (*Facharzt*).

Are there specially designed M.D./Ph.D. programs in Germany, and if so, what is the classical pathway for a M.D. student to obtain a Ph.D. degree?

Dr. Milger responds: A classical German Ph.D. degree is called the *Doctor rerum naturalium*, (*Dr. rer. nat.*) and is conferred by a basic science faculty after a research period lasting three to five years. Ten years ago it was not possible to get a Ph.D. degree as medical graduate, even if the research work corresponded to a Ph.D. thesis in terms of duration and quality. Due to faculty affiliations, a medical student could only get medical degree, the *Dr. med.*, while the Ph.D. degree was reserved for students of biology and biomedical sciences. Today, students can obtain a Ph.D. either by pursuing Ph.D. studies after completing their medical degree, or by enrolling in a dual degree M.D./Ph.D. program. The dual-degree programs still require two, independent M.D. and Ph.D. theses, but offer a curriculum to integrate these into the studies more efficiently. Admis-

sion to these programs is limited and highly competitive given the limited number of places available. In contrast to a medical thesis, Ph.D. and M.D./Ph.D. programs include accompanying course-work and examinations, and offer scholarships to cover living expenses. The Ph.D. part of the program usually takes three years.

What positions are clinician-scientists taking inside the German medical system?

Dr. Milger responds: A senior clinician-scientist typically works in a university hospital, taking part in the clinical routine as an attending physician. More clinically-oriented clinician-scientists work with patient data and conduct clinical studies. In Germany, formal medical training is a prerequisite for investigators working on a clinical study. The more basic research-oriented clinician-scientist leads a research laboratory, sometimes together with a basic scientist, where team-work can help overcome problems with time restraints arising from clinical commitments, and provide basic-science expertise. Another important part of the work of a clinician-scientist is the training of young doctors and scientists. This includes lectures and bedside teaching for medical students, as well as supervising medical and doctoral theses. Many clinician-scientists have also found full- or part-time employment in the industrial sector, which offers larger salaries and better working hours.

What are the advantages and drawbacks of being a clinician-scientist in Germany?

Dr. Morty responds: The primary personal advantage – in my opinion – is career satisfaction. I think it tremendously rewarding for a clinician to understand at the molecular level what is wrong with a patient; and knowing that, to identify where further research is needed. The clinician-scientist can then perform this research in the laboratory. Armed with a strong background in both basic science and clinical medicine, the clinician-scientist knows which basic science questions need to be asked, and how to answer them in the laboratory. Germany has many hospitals and medical faculties, with strong collaboration with industry. The strategic alliance formed between my own hospital and Pfizer being a case in point. This collaboration drives developments in the diagnosis and treatment of disease, and clinician-scientists play a critical role in this process. Another advantage of the clinician-scientist track is career development. Any ambitious clinician or scientist in Germany will lament how competitive applying for even junior positions has become. In academic medical centers, career advancement, including that for clinical faculty, is linked to research produc-

tivity and the ability both perform and publish cutting-edge research and to secure research funding. In my opinion, by virtue of their ability to handle both the clinical and basic science aspects of a clinician-scientist career, a properly-trained clinician-scientist has the competitive edge!

In terms of drawbacks, it is the same everywhere: time. The work of a clinical-scientist is equivalent to two full-time jobs. Clinical medicine has a massive time-burden and this is particularly true in Germany, where doctor shortages and large administrative loads do not leave adequate time to maintain a productive and successful research program, particularly for young clinician-scientists who have limited staff to assist them. This is different in, for example, the United States of America, where clinician-scientists have large amounts of protected time set aside for research activities, and some of the administrative burden of clinical duties is relieved by physician assistants and nurses. In Germany, the answer to this crushing workload is to work as a clinician-scientist in a large academic hospital, where access to protected time is available; however, the situation in Germany is dynamic, and moving in the right direction, with increasing energy devoted to providing protected time for clinician-scientists. The German Research Foundation (the *Deutsche Forschungsgemeinschaft* ; DGF) has introduced *Rotationsstellen* (or *GEROK-Stellen*), which are designed to employ parttime replacement clinicians who take over clinical duties of clinician-scientists, freeing-up time for clinician-scientists to focus on research activities.

Dr. Milger responds: Being a clinician-scientist is very interesting and varied. As a trainee, it is especially important that I can bring in my own ideas and be creative. During clinical practice, the limitations of our current therapeutic options for some diseases quickly become obvious. By recognizing the unmet research needs and promoting advances in science, we can help to improve care not only for the individual patient, but possibly for all affected patients. Scientific work also offers academic freedom and the possibility to work on a given problem thoroughly, compared with the hospital work schedule that is imposed by clinical obligations. I agree with Dr. Morty's opinion that lack of time is the major drawback of the clinician-scientist career track. In practice, this may mean having to accept limitations in the spectrum of clinical work in order to pursue research.

Is there some initiative from government and medical authorities to increase the number of clinician-scientist trainees, and to increase general interest in this type of career?

Dr. Morty responds: Yes! The authorities drive clinician-scientist demand by demanding more “science” from clinicians. Career advancement in academic hospitals, such as my own, is linked to scientific productivity, and is measured by paper output and research grant acquisition. Our leading clinicians also have to be scientists. Just having the M.D./Ph.D. already puts you in the lead when competing with M.D.s or Ph.D.s. In addition, government authorities are making it increasingly easy to pursue clinician-scientist training. German funding agencies, such as the DFG, but also the European Union and the Max Planck Society, are providing increased support for integration of basic science doctoral studies into M.D./Ph.D. programs. This has led to multiple M.D./Ph.D. programs recently springing up in Germany, including in Berlin, Hannover, Göttingen and Würzburg, as well as here in my home institution in Gießen. Substantial government subsidization of medical studies in Germany also helps. Unlike in the United States of America, medical school tuition is almost free in Germany, and stipends for doctoral studies abound, although, I must also acknowledge that doctoral stipends are lower in Germany than they are in North America. Obtaining a clinical qualification almost for free means that clinician-scientists train, obtain their M.D./Ph.D. qualification, and leave the university without the debt-burden experienced by their colleagues in North America. I am unsure that this is a driving factor in recruiting more clinician-scientists, but it certainly represents an advantage of the German system in comparison with the situation in North America. In summary, I would conclude that there is a substantial drive to get more clinician-scientist trainees from the governmental and medical authorities.

Dr. Morty, from your experience in directing a M.D./Ph.D. program in Germany, what would you advise current and future trainees to do, to be successful?

Dr. Morty responds: My advice is: accept that it will take time. Many clinicians who come to me for advice about clinician-scientist training would like to perform some basic science studies, but are worried about taking time away from the clinic. Their primary concerns are that they will lose touch with how to handle patients, or lose time for their career development, particularly their specialization, which takes several more years after the medical degree. If a clinician would like to become a clinician-scientist, that clinician absolutely requires comprehensive training in basic science. This is a critical point and

cannot be underestimated. Clinicians and basic scientists think in different ways and have different skills. As with clinical training, this type of thinking and these skills cannot be acquired overnight and the candidate clinician-scientist must accept that this will take time. My recommendation to our clinician-scientist candidates is to take two or three years off from clinical duties after obtaining their M.D. degree and join a full-time Ph.D. program. The most important elements of the “scientist” component of the “clinician-scientist” package are acquiring scientific thinking, networking within the community, publishing and securing junior research grants. It is very difficult to achieve these things as a young scientist when working only part-time. Taking time off to complete a Ph.D. will mean that scientific thinking is acquired more quickly (without clinical distractions). Additionally, research will progress faster, which means that the candidate will obtain his/her own first-author papers faster, which lays the foundation for securing research grants. To a newly-graduated medical student, I appreciate that taking two to three years away from the clinic seems like a very long time. Some programs offer a “50:50” option, which theoretically is 50% clinical and 50% laboratory; however, in my experience this rarely works, with a ratio of 75:25 in favor of clinical time being the practical reality of the deal. Part time, it can be a frustrating, and even unpleasant, experience to try and successfully manage and publish a research project as a young investigator. I have watched several young clinician-scientist candidates fruitlessly battle for years trying to get their research careers moving part-time, only to give up, frustrated and de-motivated, having (unsuccessfully) tried to launch both clinical and basic science careers simultaneously. To answer your last – and, in my opinion, most important – question: clinicians who would like to establish careers as clinician-scientists should definitely take the necessary time to train (fulltime) as basic scientists.

Dr. Milger, from your experience as a clinician-scientist trainee, do you agree with Dr. Morty’s assessment, and what would you be your advice to current and future trainees?

Dr. Milger responds: I agree with Dr. Morty that, for career and research purposes, a full-time research period is desirable, however, there are practical drawbacks to a three-year research period immediately after medical studies. While German university fees are low compared with those in North America, students do still have living expenses, which may leave them with some debt. Given that research fellowships for Ph.D. studies are low, and might not contain social security and retirement benefits, it is little surprise that trainees interested in science opt for a purely clinical position, where salaries may be

three times higher. Another consideration is the desire to start working with the patients, after having studied medicine for six years exactly for this purpose. While it may be difficult to train as a basic scientist without full-time commitment, this is also true that it is impossible to complete training as a medical doctor without full-time clinical work.

As a trainee, I find it really exciting to combine clinical and basic aspects of disease, but this career choice requires enthusiasm, endurance and real interest in science. One must learn to be well organized: meeting all the appointments, which, on any one day, can include night-shifts, lab-meetings, research lectures and student courses. It is also crucial to find an environment where you receive the necessary mentorship and support. Finally, as in any challenging, time-consuming profession, it is important not to forget about yourself and spare a minimum of time for family, friends and hobbies.

Discussion

Multiple reports published over the past three decades have depicted clinician-scientists in both Canada and the United States of America as an endangered species [6-8]. Since then, multiple recommendations have been put forward by several experts to bolster clinician-scientist recruitment and career development in Canada. Notably, these recommendations have highlighted the necessity of increasing the exposure of medical trainees to basic research, and to favor scientist mentoring and role-modeling in Canadian universities [1]. Experts also recommended improving the accessibility to research awards and other forms of funding to clinician-scientist trainees, and the reduction of the debt burden inherent in the dual M.D./Ph.D. training. These recommendations are in line with the findings of Lander and colleagues, who have recently identified three distinct major drawbacks for Canadian medical trainees pursuing the clinician-scientist path: 1) research training, 2) research salaries and 3) research funding [4].

Research training, although essential for the formation of a competent clinician-scientist, is also a critical barrier in Germany. As related by Drs. Milger and Morty, the duration of the training itself, the fear of losing clinical skills and further delaying employment as a practicing clinician, are issues faced both in Canada and Germany, and have a negative impact on the outlook of prospective clinician-scientists. Canadian medical students with a serious interest in research, and who are hesitant to take a leave of absence from the clinic, may rely on the Royal College Clinical Investigator Program (CIP). This is a carefully structured program that combines research and clinical training in specialty training years [1]. The CIP fosters a well-established infrastructure within clinical departments and

encourages graduates towards scholarly research. These programs are growing and gaining in popularity, and may offer a more appealing path for graduates interested in research, but who are hesitant to undertake a Ph.D. degree or research fellowship separate from their clinical specialization training. Germany has also introduced unique temporary positions to allow the employment of clinicians in a part-time capacity who take over part of the clinical duties of clinician-scientists trainees, which frees up time for clinician-scientist trainees to focus on research activities, promoting research productivity and shortening the time required to establish themselves as junior researchers in the basic science arena.

Another important distinction of the German system is the debt burden upon completion of training, which remains significantly lower in Germany than in North America, where it has been demonstrated to be a deterrent - discouraging physicians from entering clinician-scientist trainee programs [1,9]. This deterrent does not exist in Germany, where relatively easy access to research stipends, combined with almost negligible student fees for both medical and postgraduate studies, mean that German graduates have a substantially reduced debt-burden upon completion of studies in comparison with their North American counterparts. While Canada has not directly addressed this issue, the Loan Repayment Program in place in the United States of America has had a positive effect on the decision of medical trainees to embark upon the clinician-scientist path [9,10]. The creation of the Canadian Institutes of Health Research (CIHR), the largest health research funding agency in Canada and successor of the Canadian Medical Research Council, has led to the creation of CIHR Clinician Scientist Awards and the M.D./Ph.D. studentships. The success of these programs has been mitigated by the recent reductions in available research funding in general, particularly in recent times, due to the poor economic climate [4]; a world-wide phenomenon that has impacted both Canada and Germany, although access to research funds appears to have been more recession-resistant in Germany. This reduced funding has directly resulted in job insecurity, which has led many clinician-scientists to seek employment in the industrial sector, or to return to full-time clinical work. This last point underscores the urgent need to make research funding easily accessible to clinician-scientist trainees, to encourage these very valuable and highly-trained individuals to commit long-term to a clinician-scientist career track.

Conclusion

The chasm between clinical and basic sciences is constantly widening. Dual-trained clinician-scientists are accredited as

being critically important players in maintaining dialog between these two worlds, and to direct the focus of basic research to clinical problems, both in Canada and in Germany. Germany is an excellent example of country that is adapting to this reality by promoting Ph.D. studies for clinicians, and by increasing the levels of funding from governmental agencies to support M.D./Ph.D. training, as well as developing infrastructural support for M.D./Ph.D. training programs. In both Canada and Germany, the shortages of physicians, the considerable time-burden placed on clinicians, and the wage discrepancies between clinician-scientists and full-time clinicians, act as brakes on the engagement of clinicians in basic science studies related to clinical problems. These issues should be addressed to allow Canadian and German trainees to pursue basic research studies after basic clinical training. Interestingly, the dilemma faced by Canadian clinicians embarking on clinician-scientist training is similar to that experienced by German clinicians, with trainees in both countries worried about spending up to three years away from the clinic to obtain a solid foundation in basic science. In Germany, most of the trainees start their Ph.D. during or after their clinical training, in contrast to the situation in Canada, where most trainees enrolled in M.D./Ph.D. programs engage in basic science studies before the clerkship associated with the M.D. degree. Finally, in both Germany and Canada, translation of basic science findings to the patient's bedside remains the most rewarding aspect of this career, and is a key element driving improved disease management and therapy, and hence, patient benefit from basic science.

References

1. CIHR, The Clinician Scientist: Yesterday, Today and Tomorrow - A Story Told and Recommendations from Canadian Researchers. CIHR, Institute for Circulatory and Respiratory Health. Ottawa 2002, Available from: <http://www.cihr-irsc.gc.ca/e/22030.html>. Accessed 2011, June 25
2. Goldstein JL, Brown MS, The clinical investigator: bewitched, bothered, and bewildered--but still beloved. *J Clin Invest* 1997;99: 2803-2812.
3. Rosenberg LE, The physician-scientist: an essential--and fragile--link in the medical research chain. *J Clin Invest* 1999;103: 1621-1626.
4. Lander B, Hanley GE, Atkinson-Grosjean J, Clinician-scientists in Canada: barriers to career entry and progress. *PLoS One* 2010;5.
5. Raghavan M, Sandham JD, Clinical research lags behind biomedical, population-based health, and health services research at multiple levels. *Clin Invest Med* 2007;30: E152-158.
6. Schafer AI, The vanishing physician-scientist? *Transl Res* 2010;155: 1-2.
7. Roy CC, Survival of clinician scientists. *Clin Invest Med* 1997;20: 283-288.
8. Wyngaarden JB, The clinical investigator as an endangered species. *N Engl J Med* 1979;301: 1254-1259.
9. Andriole DA, Whelan AJ, Jeffe DB, Characteristics and career intentions of the emerging MD/PhD workforce. *JAMA* 2008;300: 1165-1173.
10. Ley TJ, Rosenberg LE, The physician-scientist career pipeline in 2005: build it, and they will come. *JAMA* 2005;294: 1343-1351.