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REVIEW

Neurosurgical education in Europe and the United States of America

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Abstract Training in neurological surgery is one of the most competitive and demanding specializations in medicine. It therefore demands careful planning in both the scientific and clinical neurosurgery arena to finally turn out physicians that can be clinically sound and scientifically competitive. National and international training and career options are pointed out, based on the available relevant literature, with the objective of comparing the neurosurgical training in Europe and the USA. Despite clear European Association of Neurosurgical Societies guidelines, every

country in Europe maintains its own board requirements, which is reflected in an institutional curriculum that is specific to the professional society of that particular country. In contrast, the residency program in the USA is required to comply with the Accreditation Council for Graduate Medical Education guidelines. Rather similar guidelines exist for the education of neurosurgical residents in the USA and Europe; their translation into the practical hospital setting and the resulting clinical lifestyle of a resident diverges enormously. Since neurosurgical education remains heterogeneous worldwide, we argue that a more standardized curriculum across different nations would greatly facilitate the interaction of different centers, allow a direct comparison of available services, and support the exchange of vital information for quality control and future improvements. Furthermore, the exchange of residents between different training centers may improve education by increasing their knowledge base, both technically as well as intellectually.

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Introduction

Both Europe and the USA have a long tradition in biomedical education in neurosurgery [15]. It was Dr. W. Halsted in the early twentieth century who introduced the format of a residency program to America as a tool to improve clinical practice. As a surgeon teaching at Johns Hopkins Medical School in Baltimore, his aim was to guarantee a well-organized training period for young medical doctors to finally become qualified surgeons—and this model is still considered the standard for education

in any medical specialization [14]. However, a vast range of different neurosurgical education programs have developed worldwide ever since [12, 21, 25]. Consequentially, the structure and quality of residency programs vary between different countries and teaching centers [12, 21]. In both professional societies as well as pertinent literature, there is clear evidence for a continued interest in optimizing neurosurgical residency [15, 24]. To shine a light on the available options in neurosurgical education, this review will, in general, focus on resident education in Europe and the USA.

We are aware that comparing one single country, such as the USA, with the 47 countries in Europe is a challenging endeavor. This review, therefore, rather focuses on basic principles and does not provide in-depth analyses of every country or state. However, the authors would like to initiate a constructive discussion and are looking forward to comments from neurosurgical centers around the world regarding their neurosurgical training structure and options.

Neurosurgical residency and training in Europe

Looking at the literature, many proposals and guidelines have been published and recommended for neurosurgical training in Europe [17, 20, 23, 26]. The European Association of Neurosurgical Societies (EANS) [9] and the European Union of Medical Specialists (UEMS) [10] hold regular meetings with the goal of evaluating and improving neurosurgical education throughout Europe. The UEMS [10] is responsible to guarantee quality and improvement of medical specialties in Europe [23], whereas the EANS is an independent multinational association of both European neurosurgical societies and individual members [9]. Despite these efforts, it remains difficult to establish a consensus and find a commonly accepted concept for the education of European neurosurgical residents.

Although there is a comparable duration of 4 to 6 years of neurosurgical residency across Europe, the content thereof varies widely [24]. The reason for these diverse training conditions could be explained by (1) the number of sovereign countries in Europe (47 countries), (2) the unique historical educational concept in each of the European countries, and (3) the different socioeconomical setting of these countries [24]. Another cause can be found in the cultural autonomy of each country and hence the ability of each country's specific neurosurgical society to implement recommendations of the EANS for resident training [5] only to a varying degree. There rarely is any specific or mandatory neurosurgical curriculum for any teaching hospital.

Examination

In the USA, the final board examination after neurosurgical residency is said to be competitive [25]. Although not yet fully implemented in every European country, a common final board examination was proposed by the EANS. This examination consists of two parts: the primary examination (written multiple choice questions) and the oral examination. They take place annually, since 1970, at the European neurosurgical training course [9]. Various European neurosurgical associations have their residents taking the annual EANS written board examination (primary examination) as well as a country-specific oral examination [22]. However, there are neurosurgical societies in Europe which do not require their neurosurgical candidates to take part in the final examination as proposed by the EANS. In contrast, those candidates are tested by means of state-specific oral examination only [7]. The written EANS exam consists of approximately 200 multiple choice questions in English covering neurosurgery, neuroanatomy, neuropathophysiology, neuropathology, neurology, neuroradiology, fundamental clinical skills, and other disciplines as deemed suitable and important. The examination takes 3 h and is administered annually [9]. The oral examination is a clinical problem-solving and patient management test. Case histories are given and candidates explain sequential steps in the management of the cases and the plan and performance of proposed operations, if indicated. The oral examination is held in English and consists of three parts (3 h in total), with about five to eight cases per hour. After passing the second exam, the candidate will be granted with the European Diploma in Neurosurgery; however, up to now, it does not constitute a license to practice neurosurgery in any European country [9].

Content and research

In Europe, the amount of research neurosurgical residents are required to complete varies widely. Although in most countries an educational plan is provided for the resident, research is not a compulsory part of residency. Different time frames for the implementation of a research component during training in Europe are possible. Post-MD research and MD–PhD programs are accessible in many academic institutions. Research can be done alongside the clinical work, within a temporary halt of the neurosurgical training or at the beginning or the end of the clinical work. In several countries, a 1-year break may be counted toward the required residency time. Established MD–PhD programs in many academic European training centers are a promising chance to integrate research with neurosurgical clinical training at an early point in education, and most

commonly, the PhD is completed before starting a residency or early after beginning it.

Work hours

Since 2006, the European work time directive (EWTD) [8] has clearly mandated acceptable work hours for medical staff [24]. The weekly load should not exceed 48 h. Some exceptions in countries with delayed implementation of the latter guidelines do exist. A comprehensive but controversial discussion can be found within the new EWTD [3, 19].

Neurosurgical residency and training in the United States of America

There is no standardized neurosurgical curriculum in the USA, although the proposal for a neurosurgical residency program as outlined by the American Board of Neurological Surgery (ABNS) [2] is commonly put into practice. Martin and Burn [17] reported that a representative US curriculum in neurosurgery at the most competent centers is well structured and routinely contains 1 or 2 years of research. The aim of a comprehensive neuroscience education is not only to turn out residents for future clinical demands and to prepare them for work the operating room but also to educate the next generation of neurosurgeons for competitive and state-of-the-art scientific demands. Residents who have undergone such an academic education during their residency are found to be heavily recruited from the public as well as from private institutions. The very important scientific part of the education in the USA favors the academic thinking and prepares the trainees for future leading positions in the academic neurosurgical settings.

Neurological surgery training in general

A general clinical surgical internship of 12 months should be completed before starting the residency and must be completed prior to beginning the third year of residency training [2]. Each resident must complete a minimum of 60 months of training as full-time resident in an Accreditation Council for Graduate Medical Education (ACGME) [1] accredited neurosurgical training program. The years are called post-graduate years (PGY), and contents are based on a well-planned curriculum [13, 16, 18]. At least 36 months must be devoted to a core of clinical neurosurgery with progressive responsibilities culminating in the last 12 months as most senior resident. At least 24 months of training in core clinical neurosurgery must be

obtained in one institution [2]. The remaining 24 months must be devoted to aspects of the basic or clinical neurological sciences, which may include neuropathology, neuroradiology, and research.

As pre-structured and rather rigid as those guidelines may appear, there is the option for the program director to formulate modifications to fulfill specific training goals for an individual resident, the so-called Special Considerations clause [2]. Prior to acceptance of a candidate for oral examination, the ABNS [2] requires a “pass” on a challenging written board examination as well as statement from his or her program director to the effect that the candidate meets all necessary criteria to enlist for the oral part of the exam, which is taken 2–3 years later to include longitudinal practice data.

Examination

Each applicant for certification must first successfully pass the written “Primary Examination for credit toward certification.” This examination is prepared by the ABNS [2] and includes extensive material on fundamental clinical skills, critical care, neuroanatomy, neurobiology, neurology, neuropathology, neuropharmacology, neuroradiology, neurosurgery, and other relevant disciplines deemed suitable and appropriate by the Board [2]. The final ABNS Board Certification examination then consists of an oral part which lasts about 3 h and covers the diagnosis, management, and outcome of surgical and medical diseases of the nervous system. Notwithstanding, given the growing tendency toward sub-specialization, the examination covers all of neurosurgery and questions from all aspects of the discipline must be answered. The primary thrust relates to clinical practice via a case history format, including symptoms, findings, and results of diagnostic tests. Work-up, differential diagnosis, and management are evaluated. Particular attention is given to relevant anatomy, pathology, and physiological mechanisms, as well as descriptions of how operations should be performed, if clinically indicated. The examination is structured to focus on problems which neurosurgeons may expect to encounter and manage in general practice [2]. Once the examinee passes this oral examination, he is fully credentialed.

Work hours

The ACGME [1] requirements regarding a limit of resident work hours to below 80 per week have been implemented since July 2003 [11]. In 2005, already over 92% of the centers were found to comply with those guidelines [6]. Although it remains unclear how well institutions control

resident work hours in detail and how accurately residents report overtime, the workload of residents has significantly decreased since its inception. Of note is the concept that taking calls from home is not considered to add to the 80 h of officially permitted workload of the week.

Women in Neurosurgery [27]

In the USA, compared to Europe, the development of the female role in medicine at large as well as in the field of neurosurgery is better documented and analyzed, but nonetheless far from being better established. The number of women in 2008 US neurosurgery remains notably below the 15% threshold required to achieve even “minority” status within a field [5]. The first woman obtaining neurosurgical board certification did so in 1960. The overall statistics in the USA reveal that only 179 (3%) of the 5,854 ABNS [2] certified neurosurgeons are women.

Since 1970, the number of female medical students has steadily increased and finally outnumbered its male counterparts in 1995. A similar effect was not seen in the field of neurosurgery where we still find an ongoing disparity between the percentage of medical students, who are female, and the number of women entering neurosurgery training programs becoming ABNS-certified US neurosurgeons [5]. As discussed in the “white paper on the recruitment and retention of women in neurosurgery” [5], a presumed reason for the latter phenomenon is the lack of female role models and leaders in the field of neurosurgery as well as the lack of direct recruitment of female medical students during medical studies and internships. Women in Neurosurgery [27] has been active since 1989, having a women’s advocacy and networking group. The aim of this organization is to attract women to the medical profession and to give recognition to female neurosurgeons who are bright, competent, and highly committed to the profession. In contrast to the USA, no similar networking group has been established in Europe.

Discussion

Organization of curricula in general

Although rules and guidelines by national neurosurgical parent organizations in the respective countries do exist, the different neurosurgical residency programs worldwide are independently organized by corresponding training centers. Exceptions from the mandated requirements for individual residents may be granted under the “special consideration” clause, and education can thus be modified individually.

Therefore, despite the recommendations for a collective training in Europe [9] and strict guidelines by the ABNS [2] in the USA, an absolute and standardized curriculum has not been implemented. In general, neurosurgical residency curricula in the different States of the USA, when compared to Europe, tend to be more standardized, with a focus on well-structured monthly and yearly rotations based on the guidelines by the ABNS [2]. Each US ACGME-accredited neurosurgical institution has a designated residency program director overseeing the process of guideline implementation and quality control. This is no different in Europe, although not commonly established. However, there are a few centers in Europe having as structured neurosurgical training programs as counterparts in the USA. Beyond this, in the USA, the caseload of neuroendovascular procedures is shared between neurosurgery, interventional radiology, and neurology. Another neurosurgical subdivision in the USA having a multidisciplinary approach is radiosurgery. Due to the active involvement of neurosurgery within the latter two subdivisions [12, 21], their content is also reflected in the US residency training [13, 16, 18]. Since in Europe these subspecialties are rarely shared in a multidisciplinary approach, but rather belong solely to neuroradiology or radiation oncology, they are generally not part of neurosurgical training.

Research as a part of the residency

In neurosurgery, clinical and basic research is an essential tool for residents and young surgeons to learn key concepts of existing therapy. Beyond that, it is essential to acquire necessary skills to be part of the evolution of science and to ultimately contribute and co-shape future treatment strategies. Establishing and consolidating individual research interests and gaining expertise in a scientific field of interest offers the necessary skills to become a principal investigator. In the author’s opinion, research expertise will become increasingly important in the competition for academic positions in neurosurgery. A major difference between Europe and the USA is the implementation of a 2-year research period in most of the US curricula, whereas in Europe and thus in most of the residency programs within the different countries in Europe, research activity is still considered as an additional and voluntary activity. However, given the 40- to 50-h week in Europe, there should be ample time to engage in ongoing research throughout the neurosurgical education, which obviously is more difficult to establish a more rigid organizational structure than in the American system. However, the US system allows for a period of undistracted and protected research time which creates the opportunity to participate in more “in-depth research activity,” which often generates a body of substantial publishable data.

Work hours

In general, the work load (measured as the number of hours per week spent in the hospital) remains much higher in the USA (80 h in the USA compared to 40–50 h per week in Europe [6, 11]). However, a considerable number of residents in Europe do take advantage of their non-clinical=out of hospital time (e.g., from overtime compensation), and this time is used to do clinical and/or basic/translational research. Obviously, less in-hospital time per week also means less neurosurgical operative or clinical teaching [6]. Indeed, the advantages for the US trainees stemming from work weeks in excess of 80 h are reflected in a consistently higher case load and thus faster acquisition of the required skills for successful completion of residency. It remains a matter of debate what a suitable case load during residency is to acquire those essential skills.

Role of women in neurosurgery

Neurosurgery as a field remains dominated by men, as the recently published white paper by Benzil et al. [27] demonstrates. Comparison of the percentage of female neurosurgeons practicing in the USA and Europe is currently not possible due to missing European data. On the other side, the female role in the professional activity of neurosurgery in the USA is well documented and remarkably reported below 15% [5]. Unless substantial changes in work hours and in the content of the neurosurgical curriculum is not implemented, with the specific goal of creating programs favoring female role models as leaders in the field, a dramatic raise of the percentage of female neurosurgeons is not to be expected in the near future.

Although work hours in Europe would seem to facilitate integration of neurosurgery and family life, the truth is that academic neurosurgery remains one of the most time-consuming and competitive professions, just as it is in the USA. This is most likely due to the general perception that a certain amount of experience in a given time (=case load) is necessary to perform well in such a highly demanding profession, which has the life of others at hand. Further studies and better evaluation of women in neurosurgery in Europe are warranted.

Conclusions

The US residency programs overall tend to be more structured when compared to the corresponding curricula in Europe, although exceptions may apply. This is evident especially via the well-organized monthly and/or yearly rotations, which advance the resident during the consecutive PGYs [2]. Work hours for residents in most European

countries remain limited to 40 to 50 h a week compared to at least 80 h per week in the USA. The lesser work load in Europe permits an ongoing research activity during several years of neurosurgical education. However, a 50-h work week also means lower case load, often leading to a longer acquisition time of the required skills to complete the residency. Choosing the right institution for the neurosurgical education has to be planned individually and should take into account different aims of the candidate. No general rule applies, but one does not necessarily need to go far to become a good surgeon. In case of pursuing an academic career, research at an early point, either within the MD–PhD program or as a postdoctoral candidate, is considered a must and facilitated in large academic institutions.

Integration of women into neurosurgery remains a major goal as proposed by the organization “Women in Neurosurgery” [27]. The lower rate of female residents compared to residents of other surgical disciplines remains striking and needs to be addressed in the future.

Cross talk between different neurosurgical centers is critical for a neurosurgical training, at present and much more in future, as globalization increases. For instance, currently over 90% of neurosurgery residency positions in the USA are held by American citizen [4]. There are no comparable data for Europe, but this tendency with country-specific residents seems to be present in European neurosurgical centers as well. A better standardization in the neurosurgical curriculum (worldwide and nationally) would facilitate the exchange of in-field specific knowledge. It would also allow for a mutual exchange of personnel in such a fashion that national and international research collaborations will greatly profit. To create a more effective system of neurosurgical education worldwide, from our point of view, a multinational governing body might guide and even control education in neurosurgery, thereby granting excellent education through collaboration of residents and surgeons from a heterogeneous background.

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Comments

Miguel A. Arraez, Malaga, Spain

Burkhardt and colleagues have made a comprehensive and very interesting comparative review of the different training system in USA and Europe. There are several issues of interest, as the curriculum, work load/work hours, how to control the learning process (examinations: how and when), length of the residence program, and finally the role of women in neurosurgery. Education of the future neurosurgeons is of crucial interest, and the ideal teaching should include the preparation for the work in the clinical grounds, but also teaching and research are very important. The residence program in USA has the advantage of including a research period (usually at least 1 year), making a total of 6 years. As it seems obvious, it is difficult to compare with the “average” of the training programs in Europe that varies from country to country in contents, duration, and control of the training process. Herefrom, the first consideration: The UEMS (with the proper advice of the EANS) should keep trying to establish uniform guidelines and curriculum for the residence program and criteria for accreditation of training centers. The European Union has dictated several regulations in medical matters (i.e., the EWTD to limit the work hours), but none has been done in the above mentioned aspects of the specialty fields. This is important taking into account that nowadays, there is a free circulation of neurosurgeons in Europe, with similar title of specialist but after following very different programs in content and length.

A second issue of interest is about how neurosurgery has been losing ground among the preferences of the young doctors to become specialists in favor of “more comfortable fields.” This phenomenon is evident in Western countries in which the health system does not make distinctions among different specialties irrespective of the difficulty or how distressing they are. This reality should be considered not only for neurosurgeons but also for medical care authorities in Europe.

Hildo Azevedo-Filho, Recife, Brazil

Neurosurgical education must be one of the most important issues of an academic neurosurgical department in the world; that is why I became extremely pleased to review this paper written Dr Burkhardt et al. from the University Hospital, Zurich.

The authors have produced an overview of the differences between neurosurgical education and training in Europe and USA. They emphasized the different ways of training in Europe, mainly due to the proper socio-cultural–economical aspects that exist amongst the more than 20 countries participating of the European Union. These differences represent an obstacle to establish and implement a standard training program in Europe. In general, the European programs vary between 4 and 6 years and they lack a basic uniformity.

Although agreeing that is rather difficult to focus on this issue in the whole Europe, I would like very much to have seen the authors elaborating a bit further on the programs adopted on their continent because certainly, it would provide great help to academic neurosurgeons working around the world, mainly in Latin America and Africa.

Regarding examination in Europe, Dr Burkhardt et al. pointed out, the EANS is making tremendous effort to have its diet accepted by all. However, in many countries, after taking the primary EANS examination, young neurosurgeons are allowed to sit for their national final exam and later on do not bother to take the EANS' final one. On the other hand, they remarked, obtaining the European certificate in neurosurgery does not necessarily constitute a license to practice the specialty in every European country.

In Europe, because of the EWTD, where the weekly load should not exceed 48 h, theoretically there would be more available time for the trainee to be engaged on research projects and they recommended that this should be much stimulated by the academic leaders of the field. In USA, training is much standardized, varying from 6 to 7 years, with the

resident exposed to a higher number of surgical cases because the weekly contractual working time is 80 hours. The authors commented on the examination run by the ABNS which is divided into two parts, the primary that is multiple choice questions and the final that is taken orally. After passing the final examination, the candidate is allowed to practice neurosurgery in the United States of America. The research activity is more contemplated in the USA's program, and this engagement also would differentiate and prepare young neurosurgeons to embrace academic careers.

The role of women in neurosurgical residency and practice in the USA is analyzed, and representing half of the medical students presently, they only reach around 3% of the board-certified neurosurgeons.

In the end, Dr Burkhardt et al. proposed to create a multinational system of neurosurgical education worldwide, enabled to establish guidelines and to control the teaching of our trainees in the several and heterogeneous parts of the globe.

In Brazil, with more than 170 medical schools for a population of 192 million inhabitants, we have 55 neurosurgical residency programs approved by the Brazilian Society of Neurosurgery and the Minister of Education. After attending the medical school for 6 years, the young doctor embarks on a training program of 5 years. The first year is mostly spent on neurology, the second year is dedicated to activities on neurosurgical wards, and during the three last years the resident is gradually exposed to neurosurgical pathologies of crescent complexity.

Apart from continuously updating the log book, essential condition to take examinations every year, all residents in the country (first Friday of December) have to undertake a written examination, type multiple choice questions, and they have to reach at least 60% of correct responses. On average, 35% of them fail on the first attempt, but they are allowed to sit for a recovery test as many times as necessary. Once approved on the 5-year examinations and after finishing the residency, the candidate is entitled to sit for the final exam, which consists of analysis of the CV (20%), a multiple choice question test (40%), and an oral examination (40%), when they are examined by at least three examiners. Again, the approval average should be 60% or more, and the approved candidate is granted the Diploma of Specialist in Neurosurgery. This exam is held once a year and the candidate can sit as many times as necessary. Around 30–40% of them fail on each diet.

The Latin American Federation of Neurosurgical Societies (FLANC) is planning to adapt our protocol to the many countries in our continent where there is no organized training programs.

Together with the information added from Brazil, I do consider that this is an important paper which raises the discussion of how we are teaching neurosurgery around the world and how different each environment can be. Certainly, these differences reflect the quality and type of neurosurgeons that we are educating. Of course, I could not agree more with the authors when they state that a multinational body should be developed to care for the training of neurosurgeons in the world, and to my impression, the most appropriate entity to perform this task is the World Federation of Neurosurgical Societies (WFNS).

Alessandro Ducati, Torino, Italy

The analysis of Neurosurgical curricula in Europe and in the USA is very interesting to read, both for residents and for teachers. It gives the opportunity to choose the school fitting better to one's needs, now that mobility is no longer a problem for students. On the other hand, it offers useful suggestions to improve teaching methods for professors.

If relevant, I would like to inform the authors that in Italy, research is mandatory, at least officially, in the residency program set up by the Ministry of Education. Every student must demonstrate that he took part, as a minimum, into two prospective randomized trials before the final exam.

Moreover, there is a different and further possibility to improve neurosurgical education, called the post-residency Master. It consists of a 2-year program treating in details a specific field of neurosurgery (i.e., microneurosurgery, skull base, spine), both theoretically and

practically (namely, attending live surgery and hands-on cadaver dissection courses). This program, not a full-time one, is coordinated by one university (the title is an academic one) and may/must involve other universities and teaching hospitals.

Graham Fieggen, Cape Town, South Africa

This review succinctly analyzes a number of key differences between neurosurgical training in Europe and the USA. Whether it succeeds in its aim of "overcoming the lack of information about different training programs" is debatable as the focus is rather narrow, but it is a worthwhile contribution to the literature on neurosurgical education.

After noting the genesis of the residency concept in Baltimore a century ago, there is no comment as to the contemporary practice in Europe—surely somewhere on the continent, surgeons had been trained in the era before Halsted? Diversity presents the UEMS with a much greater challenge than the ACGME in striving for uniformity in training and outlining the relative roles of the EANS and the ABNS is examining candidates is perhaps the strength of this article.

A strong argument is made for a greater commitment to scientific training and research in the European context, and a timely opportunity to pursue this in the wake of the EWTD is identified. Surgical training requires many intensive hours "on the job" (Gladwell's rather simple notion [1] of the "10,000-hours rule" does not seem too far off the mark here!), and it seems quite obvious that a training system that limits activity to 48 h a week is going to require a very different approach to one that allows up to 80 h.

The authors bravely tackle our collective failure to attract more women into a neurosurgical career, suggesting that time constraints are not the only disincentive; this imbalance is striking given the demographics of medical schools around the world.

Although the authors conclude with a plea that a greater degree of standardization in the neurosurgical curriculum (i.e., bringing European training closer to the US model) would enhance educational and scientific exchange, they do concede that "one does not necessarily need to go far to become a good surgeon." A greater focus on the strengths within Europe, and there must be many given the diversity and rich educational traditions, may also point the way to improving practice.

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Kazuhiro Hongo, Matsumoto, Japan

The authors nicely described the neurosurgical education system both in Europe and the United States of America. As the authors introduced, neurosurgical training system varies among countries. In Japan, we have also a different training system from that of either Europe or the United States of America. It is difficult to simply apply those systems to each country, also difficult to standardize the neurosurgical education system. However, knowing these differences, societies or directors of each training center can establish each training system more efficiently. Another important point is that this paper is playing the role to give information to those who wish to study neurosurgery in different countries. For the abovementioned reasons, this paper is worth reading for all the neurosurgeons including directors and young residents.

Hans Landolt, Aarau, Switzerland

This review of training modalities in Europe compared with those in the USA is a reminder of the lack of implementation of the European charter on neurosurgical training in Europe 2004.

Reasons are numerous as the differences between European nations compared with North American states. Mechanisms and motivation for implementation down to individual training programs are dependent on endless national and regional regulations, the EU being a new confederation *statu nascendi* compared with an operational union of states as the USA.

Clinical programs in Europe adapted to the UEMS charter are similar to the American ones, except that in the execution, the European working rules neutralize many of the aims, specially the ratio between the number of trainees and of teachers. Through the reduction of working hours, assistant positions have been created to fulfill them and “misused” as training position. This is because of the lack of physicians interested in non-neurosurgical training in a neurosurgical unit. This problem may be partly solved by offering useful and competitive additional training for, e.g., generalists, neurologists, psychiatrists, ent-, maxillar-orthopedic surgeons, etc.

Quality of specific training by reduced case load and clinical exposition will also be lower, but less than the additional duration of training to accomplish program aims. More and more, the required 5 years of specific training are not sufficient for that.

Another solution is to differentiate between working hours, training hours, and compensation time, the latter being a new chance for trainees to progress competitively in theoretical, research-related, and even clinical training without patient-related responsibilities. A chance program directors should propose and allow.

In case of training or research abroad, the initial center should plan and offer a position when candidates return. Otherwise, they will contribute to the brain drain of their institutions

Examinations should rather be a proof of efficient selection, coaching and training of motivated, capacitated, and competent individuals for each training center, then a sanctioning procedure to exclude failed trainees on the end of such an important and for both sides costly period of life.

I suggest strongly all trainees to select centers according to a published program, to support director’s efforts for teaching by showing motivation and endurance, and to propose spontaneously individual aims. Responsibles are able to improve their programs much easier when supported and pushed by active young people with clear devotion to neurosurgery then by those waiting passively to be trained.

For program directors, I suggest to read and interpret once attentively the UEMS charter for neurosurgical training, to assess their own position, to check national charters, and to arrange what is good for their neurosurgical trainees. They will thank you.

Tiit Mathiesen, Stockholm, Sweden

Education is what forms the future neurosurgeons, and hence, training determines to a large extent the future of neurosurgery. We have a vision of neurosurgeons as master scientists, innovators, empathic physicians, and superb technical surgeons; we want to determine how to achieve this goal.

Training is determined among others by its formal structure, contents, methods of assessing quality, and by its controlling bodies, but also by informal structures, patients, colleagues, and national idiosyncrasies. It is necessary to compare different educational systems in order to find pros and cons and to discuss whether a unified training system for all residents or a smorgasbord of different systems best serves the future of our trade.

The first step in such an analysis is to describe existing systems, then to analyze and compare. This article has aimed for a description of training in Europe and the USA. Unfortunately, I cannot find a solid description of either system in the article. Value statements, superficial comparisons, and scattered facts fail to form a comprehensive totality or sets of comparable parameters. I would favor a comparison of a number of predetermined parameters that would lead to an analysis of pros and cons and finally lead to a logically argued conclusion. The authors unfortunately fail to recognize that different systems may exist because of their different pros and cons—but may still have more similarities than differences.

Michael W. McDermott, San Francisco, USA

The article by Burkhardt et al. compares and contrasts training in Europe with the USA. In the abstract for this review, the authors argue

that a more standardized curriculum internationally would have a variety of educational and practical advantages and that an exchange of residents between centers would improve training by expanding both a knowledge base and technical skills. In the body of the article, there are no data provided or analysis of advantages and disadvantages to support their “arguments.”

Ideally, since we are human and have the same nervous system controlling us, the diagnosis and treatment of nervous system diseases should be the same no matter where we reside. However, we all know that different cultures place different values on physical and mental health and the cost of maintaining that health. Even within North America, there is a stark contrast in how two different countries, let alone the 47 in Europe, prioritize and pay for different areas of neurologic health. Standardizing training within a multitude of different health delivery systems seems impractical as the delivery of neurosurgical care may differ based on governmental and societal pressures. I agree that the exchange of residents is valuable, and at our institution, we encourage international visitors who, while not performing hands-on work, can observe every aspect of academic neurosurgical practice and take home valuable new knowledge and technical information, if not skills.

I agree that “cross talk” between neurosurgeons in different countries is a valuable thing, and many of our professional societies encourage this now. Given all the differences between states, provinces, and countries, I cannot imagine one single governing body for the world of neurosurgeons. For the time being, we should continue our frequent interactions and dialogue. Once most of us have our own national neurosurgical houses in order, it will be time to talk more globally about academic, training, and governance integration.

Laura Snyder, Robert F. Spetzler, Phoenix, Arizona, USA

This article compares and contrasts neurosurgical education in the USA and Europe. The article focuses on four elements of neurosurgical training: board certification, work hours, research, and female residents. The article suggests that both residents and patients may be better served if neurosurgical residency curricula were standardized. It is an interesting topic and one that is informative for both the neurosurgical community specifically and the public in general by explaining the wide range of techniques, practices, and levels of abilities among neurosurgeons across the world.

Standardization of neurosurgical training may be difficult because medical system differences across countries can be pronounced. For example, the article describes how radiosurgery and endovascular treatments are more often the realm of a department other than neurosurgery in Europe. Should European residents be tested in depth on these treatments on a standardized board examinations common to both Europe and America? Or is their time better spent studying in depth different knowledge that they will put to more use in their respective countries? On the other hand, should neurosurgical residents in both Europe and the USA have rotations in radiosurgery and endovascular so that the options for treating certain disorders are better understood—regardless of whether the information will be commonly used in their future career? As differences in medical systems across countries are unlikely to be changed soon, they must be considered in attempts to promote standardization in neurosurgery.

Work hour limitations vary widely across countries, and the issue is presented in this article as a major factor in how research is pursued. One can see both the benefits to a dedicated research year in programs with longer work hours and increasing the amount of research one produces in every residency year in programs with fewer hours. Thus, it is difficult to say which of these options would be better pursued in standardization. However, as work hours are often a cultural issue, they may be difficult to change one way or other in a given country regardless of the neurosurgical perspective.

Work hours are also presented in this article as a major impasse to recruiting more female neurosurgeons; however, female recruitment is also a cultural issue. Women working outside the home, especially when there are young children inside the home, are viewed more kindly in some countries than others. Moreover, the lack of female neurosurgical residents may reflect the culture of neurosurgery itself because the percentage of female residents in other surgical disciplines remains significantly higher, even in those with extensive work hours. Decreasing work hours alone will not develop female neurosurgeons regardless of whether it helps “family life.” Developing female

neurosurgeons requires a culture of both male and female mentorship from inside the specialty itself.

To produce more capable attending neurosurgeons, United States residency programs could learn from European programs and vice versa. It is important to continue dialogue, as this article does, on programmatic format and changes to curricula as neurosurgery grows. However, true standardization of neurosurgical residency may be impossible due to cultural and medical system differences between the USA and the many diverse European countries.