

Development of teaching and tuition in the specialty of neurology in the Netherlands

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After a short survey of the early history of neurology and psychiatry in the Netherlands, the development of the specialty of neurology is discussed. During the 20th century the training of neurologists and the certification of specialists evolved from an informal master-fellow organization towards a strongly regulated and legally based procedure. A nationwide Specialist Registration Commission supervises the quality of the training of specialists. Registered neurologists in the Netherlands are subject to a re-certification programme that controls the requirements to be fulfilled by the specialists such as their active involvement in patient care (for at least 16 h a week), attendance of the annual postgraduate courses in neurology (5-year cycle) and regular participation in international congresses of neurology. The undergraduate training in neurology, the neurology clerkship and the postgraduate training in neurosciences are described. Measures taken in order to maintain the balance between the supply of and the demand for neurological care in the near future are reported.

Introduction

In the time of upcoming integration of medicine throughout Europe, it is necessary to compare the various undergraduate and postgraduate curricula and to venture gradually towards the eventual harmonization of medical education (Bartoš *et al.*, 2001; Pontes and the Task Force members, 2001). The requirements for national board certification in neurology is described in order to facilitate comparison of the various national training schemes. In the present study a description is given of the historic development of the specialty of neurology in the Netherlands and of the way in which quality control of the training of residents has been realized from the early 20th century to the present time.

A short historical sketch of the development of the specialty is necessary to delineate the growing contours of the present situation and to understand the composition of the training scheme as in force today.

After an extensive description of the undergraduate and postgraduate education in neurology as practiced at the present time, the programme of continuous education in neurology and the re-certification of neurologists are explained.

The neurology manpower planning decisions made in the Netherlands on the brink of the 21st century are reported in order to give a quantitative perspective on future developments.

Early history of Dutch psychiatry and neurology

The specialty of neurology in the Netherlands traditionally developed within the confines of psychiatry according to German and French tradition. During the 19th century knowledge about neurology advanced as physicians were interested in the organic causes of psychiatric disorders. The coming-of-age of histopathological techniques in the second half of the century furthered interest in the particularities observed in the brains of autopsied patients with neurological dysfunction. This early neuropsychiatry aimed to disentangle the structural aspects of the nervous system and its expressions in terms of cognition, movement, emotion and behaviour. As a consequence, psychiatrists turned into neurologists [in psychiatric asylums] and became more and more specialized in the diagnostics of dysfunction of the nervous system.

The development of neurology as a specialty proceeded along different lines in the European continent and in the Anglo Saxon world (UK and USA).

In Austria, Meynert (1833–1892) laid the anatomical basis for analysis of the cerebral cortex and for the development of association psychology later on. In Germany, Von Gudden (1825–1893) and Wernicke (1848–1904) were active in the integrated teaching of neurology and psychiatry. In France the clinicopathological school of neurology founded by Charcot (1825–1893) laid the foundation for the localization-oriented theory of neurology that eventually was to become the basis of clinical diagnostics within the field. In England neurology developed by such early giants like Gowers

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(1845–1915) and John Hughlings Jackson (1835–1911), Brown-Séquard (1817–1894) was active on both sides of the Channel. The latter lectured in Dublin, London, New York and Harvard, before finally accepting the chair of medicine in Paris in 1878.

Against this international background Dutch physicians interested in the study of diseases of the nervous system in 1871 united to found 'the Netherlands Society of Psychiatry'. J.W. Ramaer (1817–1887) was the *primus inter pares* of the four founding fathers fostering this new scientific organization.

Soon a number of the Society's members showed their dissatisfaction with the lack of attention for neurological subjects during its meetings, and there were rumours of a separate neurological society to be established. G. Jelgersma (1859–1942) and C. Winkler (1855–1941), however, defended the idea to maintain an integrated Society of Psychiatry and Neurology. In 1895 the 'Society' indeed was renamed 'the Netherlands Society of Psychiatry and Neurology'. Since then for almost a century it was to remain the only Dutch national organization representing both psychiatrists and neurologists, despite repeated discussions during later years aiming to split the twin specialties into separate fields (and therefore to disband the society). The Netherlands Society for Psychiatry and Neurology continued its activities up to 1974 when, after the separation of the specialties, two new Societies were established.

The training of neurologists obviously always centred around the care of neurological patients, the analysis of their diseases and the development of appropriate therapeutic measures. Over the years, however, the format of this training showed important developmental changes.

In the beginning a neurologist was a physician consciously restricting himself to the diagnosis and treatment of neurological disorders and accumulating specialized knowledge in this field. A young doctor interested in acquiring neurological skills joined an experienced colleague and by working under the guidance of this elderly colleague developed his expertise in a master–fellow association.

This person-centred way of training neurologists developed into a more formal training scheme with the advent of academic chairs of neurology at the various universities (*vide infra*). Still, the training was largely identified with the Heads of the individual neurological University Hospital departments where the trainees fulfilled their training according to the schedules agreed upon by the board of neurologists. In later years the bi-annual scientific meetings of the Netherlands Society of Psychiatry and Neurology, were the main stage for

discussion of scientific presentations and case reports at the national level.

From the fact that the 'First International Congress for Psychiatry, Neurology, Psychology and Care for the Insane' was organized in Amsterdam in 1907, it may be concluded that psychiatry and neurology as twin specialties flourished in the low countries at that time. Actually chairs of (neuro-) psychiatry had been established or were being considered at all four universities by that time (Biemond, 1971; Koehler *et al.*, 1998).

In the Netherlands four universities functioned at the end of the 19th century and had medical faculties where 'Doctores Medicinae' were trained. At Utrecht State University, Professor Donders strove for the establishment of a chair of Psychiatry. Winkler was the first to fill this position in 1885. He was firmly convinced that neurology and psychiatry should be taught in conjunction, Wernicke being his great example. In 1896, Winkler, because of lack of facilities in Utrecht, moved to Amsterdam Municipal University where he was appointed to the chair of Psychiatry and Neurology.

In Leiden, Jelgersma was appointed to the chair of Psychiatry in 1899 but he taught both psychiatry and neurology. Finally, at Groningen State University, E.D. Wiersma was the first to accede to the chair of Psychiatry in 1903. In 1912 he also was appointed professor of neurology.

Although it had been decided repeatedly to maintain a unified Society of Psychiatry and Neurology, the differences between these disciplines created divergent forces and led to the establishment of a separate Society of neurologists in Amsterdam in 1907. This 'Amsterdamsche Neurologen Vereeniging' was to play a central role in the development of Dutch Neurology, serving as the fore for reporting on clinical neurological patient care and on new research findings in related sciences. It was also instrumental in the formation of a strong 'Amsterdam School' within Dutch neurology. Its membership was not restricted to neurologists practicing in Amsterdam and nowadays its fellows work all over the Netherlands (Winkler, 1921).

From this short historical overview it can be concluded that in 1913 the field of psychiatry and neurology was burgeoning at all four university medical schools in the Netherlands, where the training in clinical psychiatry and clinical neurology was given shape.

Before that time those interested in neurology, neuropathology or psychiatry mostly chose to be trained abroad in the famous medical schools of, for instance, Vienna, Paris or London.

Development of the speciality of Neurology

Although, during the first decade of the 20th century, the teaching of neurology and the training in clinical neurology in the Netherlands were intimately related to psychiatry, not every neurologist embraced this situation as an ideal one to be perpetuated indefinitely. Many neurologists wanted the subordination of neurology to psychiatry to come to an end. Scientific discussion papers appeared in the Dutch national medical journal. From the beginning, Ramaer had been stressing on the importance of creating independent neurological hospital departments and the advantages of practicing neurology as a specialty in its own right. Later L.J.J. Muskens (1872–1937) argued along the same lines. In his inaugural lecture (1906) as senior lecturer in neurology at Amsterdam Municipal University, he regarded the neurologist an organ specialist. The expansion of psychiatric and neurological knowledge exceeded the intellectual comprehension of the individual physician and Muskens thought the time to be ripe for the separation of the two specialities.

Specialist registration

The phenomenon of ‘a specialist physician’ had come about towards the end of the 19th century, when in medical practice a minority of physicians chose to restrict their practice to one particular part of the art. Before that time a physician licensed ‘*doctor medicinae*’ was allowed to practice the full range of medicine, surgery and obstetrics inclusive (Thorbecke’s law 1865). Those physicians practicing a small part of medicine concerning the medical aspects of a specific organ system only, were regarded with suspicion and in due course this led to a tense relationship between ‘Generalists’ and ‘Specialists’.

A third kind of physician developed in the mean time, the so called ‘half-specialist’. These physicians practiced medicine in the full sense of the word, including surgery and obstetrics, but at the same time showed special interest in a specific organ system. They thus played a double role and were suspected of neglecting either one or the other during their daily professional pursuits. Therefore many requested the establishment of qualification criteria that could serve as parameters for the level of skills and knowledge of either the generalist physician or the specialist, and that should guarantee a sufficient level of medical proficiency. From 1913 onwards, C.C. Nijhoff in the Netherlands *Journal of Medicine* defended the idea of establishing a specialty registry, the admittance to which should be controlled by a board of experts that was to judge the quality of the training of the specialist to be. This Specialist

Registry Committee should cooperate closely with the various specialty-specific scientific associations with a view to formulating specified requirements. Moreover, the scientific association should only allow Specialist Registry Committee certified specialists as members. At the time any legal statutory regulations were lacking as to the formal requirements to be fulfilled in order to be recognized as a specialist and the Government took no initiative to pass the necessary legislation (de Vink, 1996).

It was only in 1930 that Nijhoff, the then President of the national Dutch Medical Association, could propose his plan to the medical community at large. Thus a private organization, the Dutch Medical Association, took it upon itself to organize what public legislation had neglected and in 1931 the establishment of the Specialist Registration Committee (SRC) was a fact. It was to take some 30 more years, that in 1961, a more final legal structure incorporated this early private regulatory body into a semicorporate legal juridical institution, the Central College (CC; *vide infra*).

One of the first activities of the newly installed SRC in 1931 was to increase the training period for specialists from 2 to 3 years. From each scientific society, deputy members were designated to represent their specialty in the SRC, Doctor H.C. Rümke being the first representative of the Netherlands Society of Psychiatry and Neurology.

Originally the SRC registered nationwide all specialists on a single list in alphabetical order. But soon it was decided to create different registries for each specialty by itself.

As for the specialty, ‘Zenuw- en Zielsziekten’ or neuropsychiatry, the sector of the specialist’s main activities was to be added to his name (i.e. either neurology or psychiatry). The time established for training was 3 years and during these 3 years the candidate-specialist had to work in a university department or in a clinical department of neurology elsewhere, as a resident, living within the precincts of the hospital. In those days it was considered a matter of course that the resident in training for a specialty was unmarried and remained so whilst preparing for his future career.

Women only rarely finished a medical study and a female resident was seldomly met at the time. This contrasts strongly with the present situation, where over 60% of residents are female.

During World War II the German occupier tried to change the organization of Dutch medicine by installing a ‘Nederlandsche Artsen Kamer’. A majority of Dutch physicians refused to cooperate and as a consequence the Royal Dutch Medical Association was suspended. Medical students were forced by the Germans to sign a

so-called loyalty document in order to qualify for attending lectures. As most refused to do so, teaching activities in the universities shrunk to a precariously low level. As a consequence, many students were deported to Germany for forced labour in the war industry there.

It was decided by the 'Artsenkamer' that the specialty 'Zenuw- en Zielsziekten' would have a training of 4 years divided into two periods, i.e. 2 years of psychiatry and 2 years of neurology.

The SRC resumed its duties in August 1945, Professor Doctor J.G.G. Prick being the first representative of the Dutch Association of Neurology and Psychiatry. The year after, Doctor H.C. Rümke took over and continued his pre-war activities within the SRC. In 1949, the SRC officially increased the training period for neuropsychiatry from 3 to 4 years.

In 1950 the professional training of neurologists and psychiatrists was the subject of a symposium organized by the Netherlands Society of Psychiatry and Neurology. Discussion papers were proposed by leading members of the society, some favouring the complete separation of the training of neurologists and psychiatrists, others defending the *status quo*, i.e. the integrated neurologic-psychiatric training. In later years this discussion continued both in the Scientific Society and at the level of the board of the Central College, the regulatory body installed in 1961 (de Lange *et al.*, 2001).

The latter organization was to be the eventual juridical vehicle for the regulation of certification and training of medical specialists and was equally made up of representatives of the Specialist Scientific Societies, of the Medical Faculties and of representatives of the Ministers of Public Health and of Education. The latter had an advisory role and could veto an (intended) decision.

By that time the 4-year training period consisted of a composite scheme of neurology and psychiatry depending on whether one wanted to become a neurologist, a psychiatrist or a 'zenuwarts' (neuro-psychiatrist). The neurologist had to fulfil 2½ years of neurology and 1½ years of psychiatry; the psychiatrist 2½ years of psychiatry and 1½ years of neurology and, the neuro-psychiatrist 2 years neurology and 2 years psychiatry. The centrifugal tendencies of the twin specialties gained increasing impetus over the years and in 1962 the Netherlands Society of Psychiatry and Neurology established two separate departments, one for neurology and one for psychiatry under a common main board of governors but each with scientific meetings and professional organizations of their own. However, the progressive developments in both the fields of neurology and psychiatry, where a diversification of methods and techniques was taking place, inevitably led towards the splitting apart of the two

specialties. Therefore in 1972 the Central College decided to acknowledge psychiatry and neurology as separate specialism.

This development led the members of the Netherlands Society of Psychiatry and Neurology to split up the Society into two independent societies and the Netherlands Society of Neurology was established on 1 January 1974. Thus, after a century of sharing common interests and of developing complementary expertise, the separation between the twin specialties was a fact.

Present state

Training neurologists

This situation set the stage for the eventual training programmes in neurology as they were in force at the end of the 20th century.

At that time the training for both neurology and psychiatry was 4 years. For neurology it consisted of 3 years of neurological training and 1 year of psychiatric training; for psychiatry it was the other way round. The possibility to train as a 'zenuwarts' or neuropsychiatrist was maintained, with the training of 5 years duration consisting of 3 years in the specialty of the trainee's choice for his main direction and of 2 years in the twin specialism.

Up to that time the training in clinical neurophysiology was only open for SRC-certified specialists who had at least 2 years of training in clinical neurology. In general this meant that only neurologists were admitted. The training in clinical neurophysiology resulted in an 'endorsement' qualifying the specialist for the clinical neurophysiological diagnostic techniques.

The actual duration of the training of neurologists therefore comprised 5 years, if one includes the additional year of clinical neurophysiology training.

Later on changes in the basic training of physicians (shortening the training with 1 year, leading up to certification as basic physician, not qualified to independently practice medicine) necessitated the extension of the training period for neurology to 6 years, clinical neurophysiology included. This was all the more needed because of the amplification of the variety of subspecializations (child neurology, neuromuscular disorders, movement disorders, epileptology) and the necessity to become conversant with the usual techniques of neurosurgical and neurointensive care.

Teaching tools

Reporting on the teaching of neurology during the 20th century should be incomplete without mentioning at

least a number of tools used during teaching for reference and for self study.

In the first half of the 20th century, the neurological Handbook of Oppenheim formed the apex of neurological learning at that time. Later on it was succeeded by the multivolume handbook by Bumke and Foerster that was an amazing accomplishment, internationally held in high esteem. The second half of the century brought the unrivalled magnum opus of the Handbook of Clinical Neurology, a Dutch initiative launched by Vinken and Bruyn (1968) as editors, with the cooperation of hundreds of collaborators from all over the world.

For the instruction of undergraduate medical students, interns and residents a number of Dutch neurological textbooks were produced each of which dominated the field of neurological teaching and education for some decades. Before World War II the 'Leerboek der Zenuwziekten' by Bouman and Brouwer (1923, 1930) in two volumes gave 1000 pages of neurological instruction, the structure and function of the nervous system included. In 1954, Biemond (Amsterdam) published his 'Diagnostiek en therapie van Ruggemergs- en Periphere Zenuwziekten', followed in 1961 by 'Hersenziekten, diagnostiek en therapie' (Biemond, 1954; 1961). For the post-war generation of neurological residents this was to be a reliable guide for many years to come. From 1972 onwards, Oosterhuis' (first in Amsterdam, later in Groningen) 'Klinische Neurologie' was the didactic guide for medical students. With the expanding complexities in the field of neurological knowledge later on Dutch neurological textbooks became multi-authored products (Hydra *et al.*, 1994; Wolters and Groenewegen, 2001).

Preferentially the practical teaching of neurology is performed in close patient contact situations. The large number of students and the restricted availability of patients with the pertaining affliction, however, sometimes interfere with this type of patient contact bedside teaching.

Therefore, in support of the training in neurology of undergraduate medical students and interns an Interfaculty Working Group was formed in order to collect illustrative pictures of neurological disorders and to produce audio-visual teaching material. From all academic neurology departments and from the major Teaching Hospitals, neurologists joined forces in order to obtain consensus on the best possible instructive texts and on didactic illustrations of clinical neurological cases on video cassette. Here, again, Oosterhuis gave a major impetus to this collaborative effort. Thus a comprehensive library of video productions ($N = 35$) concerning a wide variety of neurological disorders was created that may be called

upon if life demonstrations of patients are not feasible.

Neurology training in undergraduate education at the end of the 20th century

In the Netherlands traditionally a hybrid situation existed as to the responsibilities for the teaching of neurology within the medical curriculum leading to the degree of physician on the one hand, and the training of residents leading to the certification as a neurologist on the other hand. The undergraduate teaching activity is largely restricted to the Medical Faculties of the Universities, whereas postgraduate neurological training is the responsibility of individual consultants who may be faculty professors of neurology but often are neurologists, heading large non-university teaching hospital departments of neurology.

Undergraduate medical education in the Netherlands traditionally is subdivided into two phases, one pre-clinical and one clinical. The duration of the first pre-clinical phase recently was reduced from 5 to 4 years. The second clinical phase consists of 2 years of rotating clinical clerkships in a number of specialties.

Originally preclinical teaching was organized in a traditional way. During the academic year in the morning, scheduled classes were given by faculty members teaching strictly along the lines of the discipline of their own specialty. In the afternoon students followed practical courses in, for instance, physics, biochemistry, organic chemistry, anatomy, physiology, etc. This discipline-orientated way of teaching was changed into a so-called organ-orientated or organ-system-orientated way of teaching. In this new curriculum an integration was attempted of all those disciplines involved in the study, analysis and treatment of diseases of one particular organ system. A considerable overlap between the disciplines in the previous curriculum was reduced by the rigorous pre-programming of the material presented during the teaching based on a consensus reached by the participating faculty.

Activities are underway in order to restructure this programme into a still more problem-orientated teaching programme in which the student learns to find his way in clinical reasoning on his own by solving a considerable number of pre-programmed clinical problems under the final supervision of a tutor (McMaster Model).

The place of neurology in the first 4 years of undergraduate education

Neurology teaching during this first phase is incorporated into three separate blocks of teaching during three

subsequent years. In theoretical courses integration of neurology teaching with basic neurosciences (neuro-anatomy, neurophysiology, neuropathology) is realized. The total number of lectures is about 50 for each of the three teaching blocks.

Parallel to this theoretical teaching, practical courses are provided in the field of neuro-anatomy, neuro-physiology and neuropathology. As far as the development of neurological skills is concerned, a short course of five afternoons is given for small groups of students ($n = 10$). This course consists of an elementary instruction and of exercises in neurological history taking and neurological physical examination. After a first demonstration of these skills by the instructor, the students practice them mutually on each other in groups of two under close supervision of the instructor. This first course in clinical neurological skills is called *Practisch Onderwijs in de Geneeskunde (POG)*. Live patients are used by the instructor in order to confront a student with the way in which these skills are applied and in order to discuss the neurological method of diagnosing disease (clinical reasoning, topical diagnosis, aetiological diagnosis).

The clinical neurology clerkship

During the second phase of undergraduate training a neurology clerkship has to be fulfilled. This clerkship is preceded by a 1-week half-day course of additional training in history taking and physical examination. Here the students brush up their knowledge and skills before entering the clinic. Emphasis during this course is on neurological syndromes and on clinical reasoning.

Next is an internship of 4–6 weeks duration. The student has daily practice in examining patients admitted to the clinical wards (first 2 weeks) or attending the outpatient department (2 weeks). The student is provided with a neurology clerkship workbook in which his or her day-to-day programme is laid down and his experiences are reported. In addition a list is provided of neurological syndromes that may be encountered and also a list of special ancillary investigations that have to be attended. After the first 2 weeks a mid-term evaluation is held for feedback purposes. At the end of the 4-week period a patient-orientated examination is taken by the student concluding his neurology clerkship.

Postgraduate training as a neurologist organization

Dutch undergraduate medical education nowadays is not intended to train doctors that are ready to perform fully and independently over the whole range of

medicine, surgery and obstetrics as was formerly the case. Now the product of undergraduate education is a 'basic doctor' who is ready to start his or her further professional training in a specialty of some kind, including the specialty of family physician. As to the specialty of neurology the new MD has to compete for a limited number of training posts (numbering in total *c.* 180 for the whole country). If he does not succeed in obtaining such a post, he may apply all the same for a clinical position where he will fulfil the same clinical duties but he will not be in the official training programme. If he succeeds in obtaining a post for training in neurology, a proposal with details of the intended training programme should be drafted by the trainee and his teacher and sent within 2 months to the SRC. This proposal has to be approved beforehand by the national board supervising the training and the registration of specialists (Specialist Registration Commission). This training of residents for their certification as a neurologist is not restricted to university neurology departments but a considerable degree is entrusted to neurology departments of general hospitals. Therefore the Netherlands Society of Neurology set up a committee consisting of all neurologists/heads of departments that are acknowledged as trainers for the profession, i.e. the 'Consilium Neurologicum'. At the end of the 20th century, 15 main fully certified training centres for clinical neurology were acknowledged. In addition eight secondary training centres were recognized where the resident may acquire practical experience in general neurology for 1 year. For the subject of clinical neurophysiology, the heads of 16 certified training centres form the 'Consilium Clinico-Neurophysiologicum'. The two committees discuss organizational questions concerning the training of neurologists and clinical neurophysiologists on a national level. The conclusions and decisions of these consilia are translated into advice to the board of the Netherlands Society of Neurology. If proposals for changes in the training of neurologists are accepted by the board and by the general assembly of members of the Netherlands Society of Neurology, this proposal is submitted to the Central College, which is the official organ to make the final decision. The SRC, as the executive instrument of the CC, sees to the maintenance and faithful application of the regulations and rules that are thus created.

The control of the quality of the training centres is entrusted to a Neurological Visitation Commission that is constituted of members of the Consilium Neurologicum and thus is able to give a peer judgement of the quality of the training centres and of the trainers neurologists. In order to exercise this supervisory responsibility, every 5 years a two-member subcommittee and a representative of the Union of Residents in

Neurology pays a visit to the centre in question and tests its quality according to the 'Prescriptions for visitations, visitation commissions and for the acknowledgement of trainers and training institutions' (i.e. guidelines from the SRC). An important part of this visit is a confidential interview of the subcommittee with all the residents. A written report is produced detailing points of criticism and recommendations for improvement. If these recommendations are not met by the training centre, the institution may lose its training certification.

The duration of the training of a neurologist is 6 years after passing the examination as a basic physician. During these 6 years the doctor fulfils 3 years of clinical duties in neurological patient care. Of these 3 years at least 12 months should comprise outpatient care. In addition to this 3-year period a training period in neurosurgery (3–6 months) is obligatory. Psychiatric expertise should be developed in close cooperation with a psychiatrist. The resident should become acquainted with all usual neurological and neuroradiological examinations and follows instructions in neuro-anatomy, neurophysiology and related basic sciences. He also should become familiar with the neurological aspects of pharmacology, toxicology, epidemiology and genetics. During an additional period of 21 months the resident may make a choice out of a number of optional training periods (psychiatry, 6 months maximum; internal medicine 6–12 months maximum, neuropathology 6 months maximum; intensive care 6 months maximum, neuroradiology 6 months maximum; neuropsychology 6 months maximum, neurorehabilitation 6 months maximum). Additionally a fellowship in child neurology can be included. The total of these training periods should not exceed 21 months. After this training period of 4 years and 9 months as described above, the resident follows a training of 1 year and 3 months in clinical neurophysiology, the requirements for which are explicitly described. During his training the resident has to prepare and present literature reviews and is stimulated to write a research paper. He may start the preparation of a PhD thesis. The 6-year training in neurology is not finished by a board examination; for certification the final approval of the certified trainer is required.

Clinical neurophysiology

Parallel to the training in neurology there is a training course in clinical neurophysiology, as many in the Netherlands consider this a specialist main direction within the specialism of Neurology. A first period consists of a training in clinical neurology during 3 years and 9 months similar to the training for neurologists. A second period consists of an additional

training of 2 years and 3 months in clinical neurophysiology. This second period consists of 1 year of training in basic clinical neurophysiological techniques and subsequently a period of 15 months during which a number of advanced and applied techniques are acquired.

Continuing medical education and recertification

After being licensed for the specialty of neurology the neurologist is subject to a re-certification programme. For this re-certification the neurologist has to apply. He should be able to demonstrate that he is actively involved in patient care for at least 16 h a week. In addition he should present evidence that he participates in (International) Congresses of Neurology and also in the bi-annual postgraduate courses organized by the Dutch Society of Neurologists. These postgraduate courses last 2 days and are held in a congress centre. They are intended for all neurologists but they are obligatory for residents. Two months after the course an examination takes place. The examination consists of 100 questions, two-third of them concerning the subject matter of two courses, and the remaining third on other neurological problems. The score of those participating in the examination serves as a feedback of their performance. This information is held confidential and is not revealed to peers. The scores of residents, however, are revealed to the Head of their training centre. At this moment the 5-year cycle (10 courses) consists of the following subjects: infections in neurology; extrapyramidal disorders; neuromuscular diseases; demyelinating diseases; epilepsy; neuro-oncology; neuro-ophthalmology/neuro-otology; pain syndromes and spinal neurology; neuro-trauma and cerebrovascular disease. The re-certification requirements and the continuing medical education efforts as discussed above are tools that may be employed for the harmonization of the board requirements throughout Europe (Pedley, 1999; Peck *et al.*, 2000).

Postgraduate training for PhD students in neurosciences

By order of the government Dutch Universities make an inventory of the various lines of research explored by every individual department of a medical faculty. The Royal Academy of Sciences sees to it that the main lines of research, of every specialty are distributed over the various universities. Thus an equilibrium is established in which any department of a certain discipline may develop its own research specialty in a particular field (discipline planning). All university departments of a particular specialty together thus cover the total of the

scientific field in question, but the points of emphasis in the various centres are different. Dutch science is financed by a variety of sources. The regular governmental financing supports the hard core of the medical faculty but only covers a limited number of scientific projects. However, there are a number of sources for additional funding. In order to obtain such funding a competition is organized to prioritize the various projects. The applicants for subsidies compete and their research proposals are judged by independent boards of peer scientists. A so-called third stream of funding issues from gifts, specialized charities or from the pharmaceutical industry. As Dutch Neurology is embedded in a well-organized national health care system a number of multicentre research programs involve the participation of many neurology departments in General Hospitals.

This type of research attracts young people eager to be trained as scientists and to prepare for a PhD thesis. These so called AIOs (assistent in opleiding = training) earn a relatively meager salary; in addition to performing research, they receive theoretical education and practical instruction in the field of their activity. These courses comprise 1 day a week and require a considerable effort from the staff of a training institution. Therefore the various university departments in the Netherlands have joined forces and founded 'Medical Research Schools' that provide high-standard education for this type of postgraduate students at the national level. Thus, the AIOs of the different institutes convene at different universities for parts of their national scientific education. The funding for AIO-PhD proposals in general is limited to 4 years and the project should be successfully completed within this period.

Future developments

At the end of this article some quantitative data should provide insight into the development of the neurological workforce in the Netherlands from 2000 onwards. A neurology workforce committee was installed in the 1980s in order to make an inventory of the current situation and to make recommendations on those measures to be taken to maintain the balance between supply and demand with respect to neurological care despite changing circumstances in a way similar to practice in the USA (Bradley, 2000).

The current situation of Dutch neurology at the beginning of the 21st century is that *c.* 600 neurologists are employed in practice, teaching, research and administration and that annually 33 residents start their neurological training. The Dutch with their 16 million inhabitants therefore have 3.7 neurologists per 100 000 population.

On the supply side the increasing share of women enrolling in the training programmes has implications for the future as the actual number of women beginning the training is no reliable indication of the number of functioning neurologists later on. Female neurologists often take part-time jobs, or leave the practice of neurology altogether in pursuit of a quite different life fulfilment.

Age- and sex-specific death and retirement rates are also important data for the calculation of the resulting number of neurologists as are the numbers of neurological residents that obtain their certification each year. On the demand side of neurological patient care, the ageing of the population and other population characteristics lead to more and more managed care, which requires the employment of more neurologists.

A number of scenarios has been formulated in order to predict the changes needed in the influx of new neurology trainees in order to keep a balance between demand and supply.

A basic scenario offered by the workforce committee calculates a shortage of 11% in the supply of neurologists FTE in 2017 if the actual influx of residents is maintained at the present level. In order to prevent such a shortfall the committee recommended to increase the yearly influx of trainees from 33 to 44 (33%). If a 5% loss of work time is calculated (to make up for neurologists intending to work part-time) the shortfall rises from 11 to 19% of the total number of FTE neurologists needed in 2017, and the yearly influx of neurological trainees should then be increased with 65% to 54 a year from 2002 onwards.

A recent re-evaluation of the numbers needed in the near future found that an extra 36 resident positions should fill the needs on the demand side of the balance; in other words, from 2002 onwards a yearly influx of 69 residents will increase the number of trainees in the 6-year residency programme from 198 (2001) to 414 (2008). The continual monitoring of all parameters at both the supply and the demand side will be necessary to avoid an overshoot of this increased training activity and to maintain a prudent balance between the two (Bradley, 2000).

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