VIA MEDICA

Nuclear Medicine Review 2001
Vol. 4, No. 2, pp. 65–68

ISSN 1506–9680

Editorial

Nuclear medicine technologists' training in different countries – a comparison

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Introduction

Education schemes for technologists of radiology and nuclear medicine (NM) (radiographers) considerably differ in particular countries, even in the European Union. Increasingly more often university-based technologist training is undertaken, but there is no international harmonisation of curricula and the international acceptance of diplomas may present a problem. This study compares the education schemes in the USA, Canada and selected European Union and Central and Eastern European countries. The sources of information were colleagues – radiology and nuclear medicine specialists, directly or indirectly involved in radiographer/ /technologist training (see Acknowledgements section for the list of contributors).

The USA

Nuclear medicine technology training programmes in the States are either:

1) University-based, admission is after high school and a 4-year teaching programme leads to a BSc degree. The first 2 years are usually general, shared with other Imaging Technology programmes. The curriculum of the studies includes: anatomy, biochemistry, biology, physics physiology, computer science and mathematics. The third and fourth year curriculum includes instrumentation, physics, radiopharmaceuticals, radiation protection and radiobiology, clinical applications, acquisition and processing of nuclear medicine studies. There are tutorial courses, as well as laboratory and clinical training at affiliated hospitals. Candidates must spend a minimum number of hours in clinical training, varying from 900–1200 hours. Students must be supervised by certified technologists and must complete a working manual for the various tests that they observed and performed.

2) Special training programmes which are sponsored by private hospitals leading not to a university degree but giving a completion certificate which will allow the candidates to work for one year as nuclear medicine technologists until they pass the licensing exam sponsored by either the Nuclear Medicine Technology Certifying Exam "CNMT" or the American Association of Radiology Technologists "AART". The pre-admission requirements for these programmes are at least two years of college education and candidates must have courses similar to the first two years of the university-based four-year programme. Candidates with diplomas from foreign universities must have their certificates evaluated by an independent body to ensure that their studies are equal to at least two years of US-based college programmes. The duration of these programmes varies from 12 to 18 months.

Students after an equivalent of a matriculation exam in Europe usually prefer the university route, where the course, although longer, leads to a Bachelor's or Associate degree. The second scheme is frequently chosen by professionals with some experience in medicine, such as nurses who want to upgrade their qualifications.

This degree is not necessary to work in this profession, but is rather necessary for advancement to higher positions.

Canada

In Quebec (where the educational system differs considerably from the rest of Canada) technologists are trained to a professional college degree level, finishing with a certificate. There is a lot of discussion about transferring this type of education to a university, but the Canadian government is resisting this, because it would mean a higher salary for the graduates.

In the rest of Canada training leads to an undergraduate University degree.

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The European Union
Germany

Germany is the homeland of the founder of radiology, W. C. Röntgen and the history of technologist training is almost as old as his discovery.

In Germany radiology/nuclear medicine technologists have the professional title of Medical-Technical Assistant of Radiology, the licence and title being issued by the regional government. They are qualified in diagnostic imaging, radiotherapy, nuclear medicine, radiation protection and measurement.

Theoretical and practical education takes place at the post-secondary education level in a technologists' school and the clinical training is given at the hospital. To the author's knowledge no titles like BSc and LicSc are awarded.

The length of education is 3 years with 4400 hours – 2600 hours of theoretical and practical education, 1800 of clinical education. This length is noteworthy, as for example in Poland the old curriculum was about 2400 hours in two years, the new one 3600 hours in three years.

Even more impressive is the duration of classes in nuclear medicine: a total of 720 hours (almost a quarter of the total curriculum), 120 hours of theoretical education, 300 hours of practical education and 300 hours of clinical education — in comparison in Poland 60 hours of lectures and classes in the old scheme and 120 hours in the new scheme.

The examination in nuclear medicine comprises a written examination with c. 170 multiple-choice questions, a practical examination (a recovery of a radionuclide, kit production, performing an investigation, etc.) and an oral exam.

Great Britain

Persons responsible for the practical imaging work are called either Radiographers or Medical Technical Officers (MTOs). There is, however, an overlap between the roles of many of these groups, as well as between departments. The title of Radiographer is protected in law and only therapy- or diagnostic-qualified workers can call themselves radiographers

Until 1990 the only way to qualify as a radiographer was to attend a three-year schools of radiographers, usually linked with one of the hospitals of the British National Health Service (NHS). In 1990 the radiographer's union, with the approval of the government, decided to transfer this training to the universities, leading to a BSc (Bachelor of Science) Degree in diagnostic and therapeutic radiography. Starting in 1994, this was fully transferred to 25 training centres at universities or closely associated with universities. The three-year training period covers around 2500 hours of theory and 2200 hours of clinical practice. Nuclear medicine curricula vary from centre to centre.

After graduation it is expected that radiographers normally gain 1–2 years' experience to consolidate their knowledge. During that period it is also expected that they participate in continual professional development (CPD). After this period of time many radiographers sub-specialise in different clinical fields. To do this they must complete a postgraduate degree, varying from a postgraduate certificate to a Master of Science degree. A growing specialisation is research and typically radiographers complete their training and education through doctorates and master of philosophy (research) degrees. Some radiographers specialise in nuclear medicine research.

Nuclear medicine awards are typically postgraduate diplomas or MSc degrees. The diplomas are normally 18 months in duration, amounting to 1100 hours of clinical practice and 1200 hours of theory. The Master's degree requires a further six months of study in addition to the Diploma course. Graduate and Postgraduate courses for Technologists are validated and regulated by CANME, the Consortium for the Accreditation of Nuclear Medicine Education, but this is voluntary and there is no requirement for staff to have undertaken such a course. An assessment of practical competence is a general requirement for the registration of a course by the CANME.

In nuclear medicine there are no agreed national standards for the basic education, training and continuing professional development of staff. There is no one professional body that oversees the affairs of Nuclear Medicine Technologists, the generic name for MTOs and radiographers working in nuclear medicine. There is no state registration required for NM practice and the minimum levels of training for operators under the Euratom Directive and National regulations are a matter for employers (Trusts) to decide.

MTOs come into jobs with a range of qualifications, some of which are subject-specific, like the Higher National Diploma in Medical Physics and Physiological Measurement (largely superseded now by a BSc in Clinical Physics), and some with a generic degree in a biological science. These then gain experience in-service and can undertake the same PG Diplomas as the radiographers if they and their departments are interested.

Currently hospitals in the UK are awarding consultant status to radiographers who are working to a high level of clinical responsibility. The consultant-level radiographer's (or technologist's) responsibilities for nuclear medicine have not yet been defined but it is likely they should be competent in all aspects of basic nuclear medicine practice. In addition to this it is highly likely that they should administer radiopharmaceuticals, perform computer analysis of the image data, demonstrate evidence-based practice, have an involvement in education and training of staff, interpret images and manage a team of clinical professionals in that field.

Greece

In Greece there is no special technologists' school for nuclear medicine. The technologists working in nuclear medicine originate from: a) public technology schools specialised in medical equipment, b) public technology schools specialised in medical analytics, c) private technology schools specialised in either medical equipment or medical laboratory work and d) one public technology School for Radiology Technologists in Athens where nuclear medicine technology is among the subjects studied. Most education for nuclear medicine technologists is actually acquired in everyday practice in the departments of nuclear medicine.

Central and Eastern Europe
Bulgaria

Training of technologists of radiology and nuclear medicine is carried out at a college, which belongs to a Medical University.

The studies last 3 years and lead to the degree of BSc. It is possible to continue those studies for an additional two years and graduate with a Master's degree. The curriculum for nuclear medicine includes 19 hours of lectures, 26 hours of tutorials (usually they are divided in 2–3 groups), 2 weeks of clinical training and another month of clinical training just before completing the College.

Croatia

There is no systematic study or general training of nuclear medicine technologists in Croatia. The nuclear medicine technologists do not need to have any written Licentiate to be permitted to work in the sphere of ionising radiation. It is up to each hospital or institution to educate its technologists how to work in the area of ionising radiation. The nuclear medicine technologists originate from high schools of nursing and/or clinical analytics technologists. There are some discussion plans of unifying the education for workers who will work in professions which require the handling of ionising radiation.

The Czech Republic

At present nurses and technologists are trained in specialised secondary schools leading to a professional accreditation as well as with a matriculation exam ("*maturita*"). This occurs either following the primary school, or in a form of supplementary two-year studies following a secondary school finished with accreditation ("*atestace*").

These studies last two years followed by graduation. After three years of professional practice, one can apply for a specialisation in radiology, radiotherapy or nuclear medicine. The specialisation takes one year (in the technologist's own workplace), including two weeks of practice in the Institute for Education in Health in Brno, followed by a theoretical oral exam.

At the present time a reform of this system is being implemented in two stages. First, the curriculum is being extended to three years. This school will be between high school and university and the graduate becomes a registered radiology assistant. Nevertheless, the teachers, books, schools and so on are the same as before — in fact only the name is different.

The Czech Ministry of Health is proposing a second stage of reform over eight years. A technologist in the Czech Republic will follow university studies leading to the title of Bachelor or Master. This is being experimented in Èeské Budìjovice. After three years they will graduate with a Bachelor's degree with a curriculum similar to that of "high secondary schools" of today; after five years — a Master's degree in 11 specialisations, like CT, MR, brachytherapy, SPECT and others.

Hungary

There is no radiology/radiotherapy or nuclear medicine technologist training at university level in Hungary. The training schemes in radiology, radiotherapy and nuclear medicine are separated from each other and there is a difference in their level as well. The training is conducted either within or outside the school system. Out of school means that the persons who have a state licence can educate, as long as they follow the examination requirements dictated by the Ministry of Health and which are compulsory in the whole country. Members of the examination committee are chosen officially.

There is only one officially recognised school in Budapest. There are two levels of nuclear medicine technologists training:

1. the basic level — two years' full-time study following secondary school;
2. the advanced level — one-year postgraduate training, simultaneously with professional work; students are required to have completed the basic level and four years of nuclear medicine practice.

In the field of radiology there is full-time training lasting 2.5 years, called diagnostic imaging and interventional radiology technology. Conventional radiology, CT, MRI, ultrasound, angiography and interventional radiology can be studied together this way. This does not include nuclear medicine and radiotherapy.

Some preliminary steps have been taken to create a unified system of training in diagnostic imaging. This is performed at the Universities of Debrecen and Szeged. The preliminary programme comprises 4200 hours of training during 3.5 years, the curriculum of nuclear medicine lasts 700 hours.

Poland

In Poland radiology/radiotherapy/nuclear medicine technologists presently are trained for two years in special schools following the secondary grammar schools. Those schools are not a part of the university system. After this training the title of radiology (electroradiology) technologist is awarded. In the past few years it has been possible to supplement this education to the Master's level at one or two medical universities by way of an *extra-mural* (correspondence) programme.

At present those schools are gradually being incorporated into medical universities, and in rare cases into general or technical universities. There are regional differences both in organisational schemes and curricula, but generally it is proposed to have a 5-year course with a title of Licentiate of Sciences (equivalent to BSc) after 3 years, with the option of a further two years leading to a Master's degree. This scheme is a new thing — those studies started in some medical universities in October 2001, in some cases preceding the existing law. Graduates will have a title of Licentiate of Public Health or Licentiate of Medical Techniques (equivalent to a BSc) with the option of specialising in radiology, radiotherapy, nuclear medicine or medical computer science.

The total curriculum is 900–1200 hours of lectures, classes and seminars per year (at the Medical University of Gdańsk a total of 3700 hours). The curriculum of Nuclear Medicine varies between 60 hours of lectures and classes in the old scheme to 120 hours in the new scheme.

Slovakia

In Slovakia there are two kinds of technologists. The "senior" ones have a university degree in engineering or physics and are called "physicists". The "junior" ones finish a secondary health care school in a class for radiology/nuclear medicine/radiotherapy. Both groups can pursue further education in the Postgraduate Medical Academy.

The Federation of Yugoslavia (Serbia & Montenegro)

Generally in Yugoslavia nuclear medicine departments as technical medical staff is still dominated by medical nurses. Permission to work with ionising radiation is obtained via 7 days of a theoretical and practical course covering general principles, held in a specialised school belonging to the Nuclear Institute "Vinca" near Belgrade. At the end of the course the students pass an exam and obtain a certificate. This is acquired by an administrative act, but nuclear medicine education is mainly acquired in everyday practice. The technologists come from a secondary radiology medical school, but they do not hold the title of nuclear medicine technologists. Nuclear medicine training consists of lectures and 120 hours of practical training. The graduates are licensed as Radiology Technologists.

Discussion

The overview given above is far from complete, both quantitatively and qualitatively. However, some conclusions can be drawn. First, each country has its own perspective and the training of technologists in Europe has no standards — so different are the schemes applied in particular countries. Schemes and curricula are different in every country and there appears to be little interest in setting international standards. On the other hand, some common trends and questions can be seen.

First, at least in some countries, there is a trend to transform post-secondary schools into university or university-linked studies. This is in agreement with a worldwide trend to extend university education to a growing number of young people. To quote the example of Poland — the number of students (*intra-* and *extra-mural*) has grown from about 300,000 at the beginning of the 1990s to almost 2,000,000 in 2001, a large portion studying in a BSc *extra-mural* scheme. This enables the youth to fulfil their ambitions and to upgrade their qualifications. There is of course the important question of quality — there is a danger that the general level of university standards will be going down. For example, in the USA — the country with the highest percentage of studying youth (about 1/3) — for financial reasons universities are diversifying into more and more technological areas which used to be taught in technical schools. Some critics ironically predict that in a few years it will be possible to graduate with a BSc in basket-weaving. Therefore it is the duty of the university authorities not to sacrifice quality for quantity.

The next two issues concern the particular situation in Central and Eastern European countries. The first issue is practical — in 2004/2005 the first group of CEE countries will probably join the European Union. After this, there will be a transition period of 2–7 years of employment restrictions, but sooner or later CEE radiology technologists/radiographers will be allowed to work in the EU. A Czech, Hungarian or Polish nuclear medicine technologist working in, for example, Sweden will become something normal. But how, in the face of such different training schemes, will it be possible to attain the multilateral recognition of diplomas? The challenge is for the CEE radiographer training systems to give their graduates knowledge and skills comparable to those of EU colleagues. The second issue is social. The main difference between EU/Western and CEE societies is the position of the middle class, a basis of social stability, which is strong in the Western world, but still too weak in CEE countries. The educational and social upgrading of hundreds of thousands of radiographers, nurses, physiotherapists, etc. is a major challenge for the educational system in CEE countries.

Last but not least, there is a question of practical solutions in the model of technologist training and the curriculum of studies. As regards the model, the author personally prefers the one applied in the USA. It's flexible. Anyone who aims at higher posts in the management hierarchy can aim for a Bachelor's or Associate degree. Others, who just want to upgrade their qualifications, can choose the shorter route. In Europe, interesting examples of flexibility are provided by the British and Hungarian schemes. They provide further post-graduate education at an advanced level. The second question is the curriculum of studies. Should it be focused on purely professional issues or should it be more general, with the assumption that purely professional skills will be gained during post-graduate training. The author definitely prefers the second model. The radiographers' training usually comprises the training of radiologists, radiotherapists and nuclear medicine technologists. Therefore studies, in the author's opinion, should give more general training (chemistry, physics, radiobiology, radioprotection, computer sciences, English and other languages, etc.) with the assumption that professional skills in particular branches of radiography can be developed during the post-graduate training period in the chosen specialisation. And then comes the question of postgraduate training, facing the growing trend of specialisation in radiography. An elegant solution provided by the British and Hungarian models is basic training, followed by a period of gaining professional experience. Than again training, in the form of advanced courses or specialisation.

The questions raised above should be a major subject of discussion of nuclear medicine professionals in both CEE and EU countries in the forthcoming years.

Acknowledgements

The author wishes to thank the following Professors and Doctors for their invaluable help in gathering the information necessary to write this paper: Hussein Abdel-Dayem (New York, USA), Jolanta Durski (Palo Alto, California, USA), Iván Földes (Budapest, Hungary), Philippos Grammaticos (Thessaloniki, Greece), Peter Hogg (Manchester, UK), Sue Huggett (London, UK), Daniel Janeba (Prague, the Czech Republic), Slobodan Ilić (Niš, Yugoslavia), Ljiljana Jauković (Belgrade, Yugoslavia), Irena Kostadinova (Sofia, Bulgaria), Jean Lette (Montreal, Canada), Pal Mikecz (Debrecen, Hungary), Anke Ohmstede (Oldenburg, Germany), Pavol Povinec (Bratislava, Slovakia), Nedeljko Topuzović (Osijek, Croatia), Vlastimil Valek (Brno, the Czech Republic).