
Insights About Nuclear Medicine Technology: Findings from a 2006 Survey of NMT Education Program Directors

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This is the second in a series of reports analyzing an aspect of the nuclear medicine profession. This study is one of a series commissioned by SNM and performed by the Center for Health Workforce Studies. The final report, now posted on the SNM Web site (www.snm.org) under the RESEARCH AND DATA link, is freely available to all interested parties. The executive summary of this report and the preface to the complete document are published here in their entirety.

Preface

In the spring and summer of 2006, the Center for Health Workforce Studies at the School of Public Health, University at Albany (the Center), under a contract with the Society of Nuclear Medicine (SNM), conducted a survey of nuclear medicine technology education program directors to learn about both their personal careers and the education programs for which they are responsible. This report summarizes the responses to this survey and presents a variety of insights about this important group of individuals and programs.

This report is the third in a series of seven to be produced by this major study of the nuclear medicine workforce. The initial report, prepared in 2005, was based solely on then existing sources of data and information about nuclear medicine. The second focused on nuclear medicine technologists (NMTs) based on a 2005 survey of certified NMTs from across the U.S. Subsequent reports will be prepared on a national survey of nuclear medicine scientists conducted in 2006, a national survey of physicians involved in nuclear medicine planned for 2007, and national surveys of nuclear medicine educators and students conducted in 2007 and 2008. A final report will also be prepared synthesizing the findings and conclusions from the several component reports and presenting a series of recommendations about both the field of nuclear medicine and the several nuclear medicine professions.

The report was prepared by Margaret Langelier and Paul Wing of the Center staff, with assistance from Ajita De. The authors acknowledge the contributions of Joanna Spahr, the project officer from SNM, to both the survey and the

report. The contributions of an informal advisory committee are also gratefully acknowledged. Responsibility for the accuracy of the report rests solely with the authors.

The Center was established in 1996 to collect, analyze, and present data about health care workers to inform provider, professional, government, and education organizations; policy makers; and the public. Today, the Center is a national leader in the field of health workforce studies. It supports and improves health workforce planning and access to quality health care through its capacity to collect, track, evaluate, and disseminate information about health care personnel at the national, state, and local levels. Additional information about the Center can be found on its website, <http://chws.albany.edu>.

Questions about this report, the larger study, or the Center can be directed to Langelier or Wing at 518-402-0250.

Executive Summary

Nuclear medicine technology (NMT) education programs are fundamental to the preparation of a competent, consistent, professional NMT workforce. NMT education programs are critical change agents, playing central roles in introducing innovations in the profession through both entry level and continuing education programs. They are also key players in maintaining the skills and professional standing of practicing NMTs. For that reason, understanding the current education programs in NMT is essential to a full understanding of the NMT workforce.

In the fall of 2005, as part of a larger study of the nuclear medicine workforce, a survey of a random sample of 4,000

actively practicing NMTs was conducted and in August 2005, a summary report on that survey was submitted to the Society of Nuclear Medicine. A companion survey of NMT education program directors was conducted in May 2006. The findings and recommendations based on that survey are detailed in this report.

THE SURVEY OF NMT EDUCATION PROGRAM DIRECTORS

The survey of NMT education program directors was conducted in the late spring and summer of 2006. The directors of all 127 accredited and un-accredited programs were surveyed, most using an on-line questionnaire and a few using a paper version. Ultimately, 60 program directors responded for a response rate of 47.2%. A copy of the questionnaire is provided in Appendix A.

KEY ISSUES FOR NMT EDUCATION PROGRAMS

The survey responses provide a variety of basic data about education programs as well as data that supplement the findings from the NMT survey conducted eight months earlier. The survey responses also provide unique insights about NMT education programs and the attitudes of the program directors about the future. Data gathered from a survey of graduating students will provide further depth to the study of NMTs when it is completed in mid-2007. There will also be important opportunities for cross-survey analyses.

A number of issues were identified based on the responses to the NMT Education Program Director Survey. These include:

- Lack of a standard in entry-level education for the profession;
- Lack of NMT education programs in many parts of the country;
- Lack of articulation agreements among education programs to support advanced education;
- Lack of continuing education opportunities for active NMTs in many academic programs;
- Difficulty recruiting faculty for NMT education programs;
- Non-competitive faculty salaries;
- Lack of flexible programming for non-traditional NMT students; and
- Gaps in educational curricula especially related to new and emerging technologies.

KEY FINDINGS

Some of the findings from this survey most relevant to the future of the NMT profession are provided below. The statistics provided are based primarily on the 60 responses to the survey. The findings are organized according to the structure of the survey questionnaire.

Personal Demographics and Characteristics of Program Directors

- NMT program directors had roughly the same gender mix (57% women) as the NMT profession (64% women).

- NMT program directors in younger age groups were more likely to be women.
- NMT program directors were much less racially/ethnically diverse than the U.S. population.
- Nearly three of five (58%) of NMT program directors held Master's degrees. The second most common education level was the Bachelor's degree (28%).
- A high percentage of NMT education program directors (72%) were appointed as full-time faculty members in the sponsoring organizations.
- About two-thirds (65%) of NMT education program directors were not eligible for tenure in their institution. Of the 35% of program directors occupying tenure track positions, about two-thirds were tenured.
- Among the 60 responding program directors, 45 carried the title of NMT program director and seven were department chairs. Few program directors carried the title of professor (five), and most of those who did worked in four-year colleges/universities and hospital education programs with university affiliations.
- On average, salaries of NMT education program directors (\$63,000) were about 10% lower than those of active NMT professionals (\$70,470).
- Program directors with doctoral degrees had a mean annual salary of \$72,600 while those with bachelor's degrees had a mean annual salary of \$58,200. The mean annual salary for program directors with master's degrees was \$64,000.
- Many current program directors have pursued additional education after becoming program directors. Nearly three of five (58%) of survey respondents indicated their intent to pursue further education in the future, with 40% of those already enrolled in an academic program.
- Departures of education program directors will create demand for replacements to fill their vacant positions. Among all program directors responding to the survey, 16.9% reported plans to retire in the next five years.
- Although many program directors expected to remain in their current position over the next five years, all program directors between 60 and 64 years old expected to retire within that time period, as did 20% of those aged 50 to 59.

About Your NMT Program

- One third (33%) of the programs represented by the survey respondents were located in universities or four-year colleges, and 30% were in community/junior colleges. Another 15% of the programs were located in hospitals with university affiliations.
- The largest percentage (40%) of NMT education programs were located in nuclear medicine departments in the sponsoring institutions in which they were located.
- More than one-third (36%) of survey respondents indicated that their NMT program was located in a

department other than nuclear medicine, radiologic technology, or biology. "Other" was described variously as allied health department, medical radiation science department, biotechnical and clinical laboratory science department, etc.

- More than one third (35%) of NMT education programs awarded a bachelor's degree at the completion of the program. A larger percentage (42%) awarded certificates at program completion, some of which are post-bachelor's certificates.
- The academic award in community/junior colleges varied. In 53% of community college programs an associate's degree was awarded. Certificates were awarded in 40% of programs.
- More than three-quarters (76%) of NMT education programs awarded degrees/certificates in nuclear medicine technology. Only 10% awarded degrees/certificates in radiation science. About one in eight (12%) awarded degrees in "Other" disciplines including advanced medical imaging technology, health science, and radiologic and imaging science.
- Most NMT education programs (82%) were JRCNMT accredited. Among those not JRCNMT accredited, 8% were accredited by regional agencies and JRCNMT accreditation was therefore viewed by those program directors as unnecessary.
- Nearly seven of ten (69%) NMT program directors rated funding for their program as "secure." An additional 29% rate funding as "somewhat secure." Programs with 20 or more graduates were rated as secure more often by their program directors (70%) than programs with five or fewer graduates in 2006 (60%).
- Most (92.7%) of NMT education programs offered day classes for their students. Only 6% of programs offered evening classes, and 2% of programs offered weekend classes.
- Most (77%) NMT education programs offered no distance learning opportunities. Of the 23% of responding NMT programs with distance learning courses, most (18%) offered less than 25% of their curriculum on-line. Only one program offered 100% of coursework on-line, and two programs offered more than 75% of coursework on line.
- Only 18% of respondents indicated intent to increase the availability of on-line coursework in their education programs over the next two years.
- Most NMT programs offered both didactic (57 of 60 programs) and clinical (55 of 60 programs) instruction in PET technology. Fewer programs offered CT instruction (31 offered didactic and 23 offered clinical instruction in CT). Although half of the education programs.
- Thirty offered didactic instruction in cross sectional anatomy, only 13 offered any clinical instruction in the subject. MRI is not addressed in most NMT programs. Only 10 programs provide didactic instruction in MRI, with only eight providing clinical instruction.

- A majority of NMT programs (54%) required 120 credit hours or more in classroom/ laboratory instruction for completion of NMT program requirements (39% of programs required more than 120 credit hours and 14% of programs required 120 credits hours of classroom/laboratory instruction). Only 14% of programs required 60 or fewer hours of classroom/ laboratory instruction.
- Most programs requiring 120 hours or greater of classroom/laboratory instruction were located in universities or four-year colleges, academic medical centers, or hospitals with university affiliations. More than half (56%) of community/junior colleges required 75 or more hours of classroom/lab instruction for completion suggesting that the NMT education programs in those settings are typically longer than many other associate degree programs.
- The number of credit hours in the professional component of the NMT education program averaged 44.7 hours as reported by responding directors. Programs in academic medical centers (60 hours), universities or four-year colleges (average 46.6 hours), and hospitals with university affiliation (45.2 hours) exceeded the average. Programs in community/junior colleges (39.7) and "Other" settings were below the average (44.7).
- A majority (59%) of NMT education programs required more than 1,200 hours of clinical practicum for completion of the NMT program. Although only 10% of NMT programs required fewer than 1,000 hours of clinical practicum, 22% of community college education programs required fewer than 1,000 hours.
- Among the 60 survey respondents, only 11 program directors (18%) indicated that they offered continuing education courses to already certified nuclear medicine technologists. The subjects covered in these CE courses varied and included PET, CT, and MRI technology, radiation safety instruction, radiopharmacy, and cross-sectional anatomy. With the advent of the recertification process for NMTCB and implementation of recertification for ARRT, demand for academic programs to provide CE curriculum should increase.

Program Faculty

- NMT education programs are small, generally having two or fewer faculty and a program director. Most (42%) NMT programs reported one faculty line (other than the program director position) budgeted and filled for their educational program. Twenty-three percent of programs had two faculty lines budgeted and filled to staff their NMT programs. Only 8% of programs had six or more faculty lines other than the program director budgeted and filled.
- Among faculty other than program directors, the number of tenured faculty is also small. Five program directors indicated there was one other faculty member

in their program with tenure. Two program directors had two faculty members with tenure, one program had three, and two programs had five, in addition to the program director.

- Among program directors, 23% were tenured. Among other faculty, 20% were tenured.
- The 60 survey respondents indicated having a total of 97 faculty members other than program directors with faculty ranks in their programs. Twenty-five other faculty were professors, seven were associate professors, 12 were assistant professors, and 53 were instructors.
- Among the 109 faculty members who were not program directors, 34 held doctoral degrees, 29 held master's degrees, 33 held bachelor's degrees, eight had associate degrees, and five had certificates. Proportionately, there were more doctoral degrees among program faculty than among program directors (31% of program faculty versus 8% of program directors).
- The estimated number of years of service of full-time faculty (excluding program directors) in NMT education programs was 9.4 years. This varied from 8.0 in community colleges to 11.2 in "other" institutions.
- The estimated average age of full-time faculty (excluding program directors) in NMT education programs was 44.3.
- To supplement budgeted faculty lines, a few programs borrowed faculty from other departments within their common institutions. Borrowing faculty occurred mostly in university/four-year college settings and in hospital programs with university affiliations.
- On average, the student/faculty ratio for nuclear medicine technology education programs was 3.4:1. The lowest student faculty ratios were found in hospital programs with university affiliations (1.5:1), and the highest were found in university/four year colleges (5.4:1).
- Overall, program directors rated recruitment of faculty for nuclear medicine technology education programs as difficult (3.06 on a scale of 1 [very easy] to 4 [very difficult]).
- Program directors in all settings except academic medical centers ranked recruitment of faculty as difficult. On average, NMT education program directors in academic medical centers ranked recruitment as somewhat difficult to difficult (2.67).
- Among the 12 NMT programs with current vacancies, the main reason cited for difficulty in filling faculty positions was non-competitive salaries. The second most cited reason for difficulty in recruiting was that candidates lack the academic qualifications necessary for employment in an educational program.
- When asked to rank the top three issues facing NMT education programs in the near future, program directors overwhelmingly cited fitting new content into an already crowded curriculum as their main concern, followed by recruitment of qualified faculty, and

concerns about the institutional budget. Student recruitment and enrollments ranked low among concerns, suggesting that interest in and demand for education programs remains strong.

- Most NMT education programs (52) had only one graduating class each year. Five programs had two graduating classes, and one program had three.

About NMT Students

- On average, the number of NMT graduates in all settings has increased since 2004, although there were declines in some settings from 2005 to 2006. These figures are consistent with long-term trend data from the Federal IPEDS system.
- Enrollment in programs has also increased since 2004. There has been little relative change in the number of enrollments between 2005 and 2006, although in some settings there has been a small decrease in new enrollees.
- Program directors attribute high student demand primarily to the relatively high salaries for nuclear medicine technologists (28%), more student awareness of the NMT profession (27%), and increased market demand for NMTs (22%).
- Other reasons for increased enrollment cited by program directors included the addition of a clinical site, increased availability of instructors, and the attractiveness of the NMT credential.
- Twenty-two of 60 program directors dismissed students in 2005 for poor academic performance. The number of dismissals among programs for poor academic performance was most frequently one student, although one program dismissed eight students and another program dismissed six. Seven program directors reported dismissing students for poor clinical performance.
- Many NMT education programs have enrollment caps imposed by either their institutions and/or by their accrediting agency.
- Among the 60 survey respondents, 46 indicated an enrollment cap imposed by JRCNMT and 23 indicate an institutionally imposed enrollment cap. Nine programs have enrollment limitations imposed by both their institutions and JRCNMT.
- Respondents overwhelmingly (93%) reported that their admissions policies were competitive. Only 7% of directors indicated that admission was open to any candidate who met minimum qualifications.
- Since the number of applicants to programs exceeded available student slots, 48% of NMT program directors maintained a waiting list for the next available spot. Because demand for admission remains high, most programs can maintain competitive admission standards. Both of these indicators suggest that there is

a healthy demand for NMT education among potential students.

- The number of qualified applicants for admission to NMT education programs exceeds available slots for admission for all types of programs. The ratio of applicants to slots is especially high in community/junior colleges and “Other” institutions (including technical colleges). University/four year colleges had the lowest ratio of applicants for admission to available student slots. Since these programs are typically four years in length, these figures suggest a student preference for shorter program durations.
- Many students enter academic institutions before deciding on a concentration in NMT. This suggests the importance of internal marketing to newly enrolled students within an institution to inform them of professional and career opportunities in NMT.
- Many program directors (46% of respondents) indicated that the majority of students enter the institution as freshmen without knowing they want to pursue a nuclear medicine education program. Only 13% of program directors indicated that 76% to 100% of their students entered their institution as freshmen/first year students with the intent of enrolling in the NMT education program. This percentage has not changed dramatically over the past few years, declining slightly for hospitals with university affiliation, and increasing slightly for community colleges and four-year colleges.
- Two-thirds (67%) of programs reported that 100% of graduating students in 2005 had taken a certification examination. Three program directors reported that none of their graduates from 2005 had yet taken a certification examination.
- More than two thirds of program directors (68% of respondents) indicated that 100% of 2005 graduating students in their programs had passed the certification examination the first time. An additional 24% of program directors indicated that between 76% and 99% of their 2005 graduating students passed the exam the first time they took it. This high pass rate suggests that education programs overall are providing appropriate academic preparation for NMT students entering the profession.
- Second career students were reported in nearly all (96.4%) NMT education programs. Only two of 56 responding program directors indicated that there were no second career students currently enrolled in the NMT education program. Four respondents indicated that 100% of their students were second career students.
- The median age of students currently enrolled in NMT programs was higher than might be expected for college students. About half (49%) of directors estimated the median age of students currently enrolled in NMT programs at between 26 and 30 years of age. An additional 18.6% estimated the median age at between 31 and 35 years of age. Program directors estimated that the

age of students had increased slightly over the past few years.

- Nearly half (49%) of respondents estimated that between 1% and 25% of students enrolling in NMT programs over the past five years already had a bachelor’s degree. An additional 30% of current program directors (17) indicated that between 26% and 50% of students over the past five years already had a bachelor’s degree.
- Of particular interest is that program directors in university/four year college programs indicate that even in their bachelor’s degree programs, students have enrolled despite already having a bachelor’s degree. These findings are supported in the NMT workforce survey showing a high percentage of active NMTs with a previously obtained bachelor’s degree in another area of study. Taken together, these two findings suggest the need for post bachelor’s certificate or entry-level master’s programs for the NMT profession.

Program Marketing

- When NMT program directors were asked to identify the most effective marketing strategies for their programs, word of mouth/referral of students was the most often selected primary and secondary strategy. The next most effective primary and secondary strategy was advertisement on websites or use of Internet resources.
- Most NMT programs (68%) reported marketing budgets under \$500 and 26% reported marketing budgets between \$500 and \$1,500. Only 5% of programs had marketing budgets over \$1,500 and those programs were all located in university/four year colleges.

NMT Job Market for Students

- Most NMT program directors reported average to no difficulty for graduating students in finding employment after graduation. On a scale of +2 (very easy) to -2 very difficult, on average program directors indicated a level of difficulty (+0.66) between average and easy. Only 8% of responding program directors reported that finding employment after graduation was either difficult or very difficult for their students. The Pacific and Northeast regions had the best job market scores based on survey responses.
- Hospital medical centers and mobile imaging units were identified by many program directors across institutional settings as having the most job openings. Cardiology specialty centers were also rated consistently high by program directors in all institutional settings, as were outpatient hospital clinics/centers. The recent NMT workforce survey revealed that over 15% of active NMTs worked in cardiology specialty centers as of 2005.
- Staffing organizations were also consistently selected by program directors as having some NMT positions

with little variation across the types of institutions. The availability of employment with staffing organizations may be indicative of some level of shortage in nuclear medicine departments. Staffing organizations are often contracted by health care providers to cover vacancies, vacations, and shortages until positions can be filled.

- Of interest is that program directors in university/four year college programs selected pharmaceutical company, technology company, and consulting company as having jobs more frequently than program directors in other settings.
- Hospitals/medical centers were rated as the employer type that hired the most new NMT graduates in all regions of the country. Outpatient hospital clinics/centers and cardiology specialty centers were rated second and third, respectively.
- Program directors indicated that most of their graduates found good jobs after graduation. About seven of eight (88%) respondents indicated that all or most of their graduates obtained good jobs following graduation. Some program directors (10%) indicated that some graduates had difficulty finding jobs after graduation. Difficulty in the job market was most often cited by program directors from community/junior colleges.
- Finding a job was rated fastest for students in academic medical center (86% of students find jobs within one month of graduation) and “Other” programs (83%). Overall, 94.8% of program directors indicate that new graduates find jobs within three months of graduation from their NMT program. Only a small percentage of program directors (5%) indicated that it took four months or longer for their graduates to find jobs after graduation.
- Most NMT program directors reported that only a small percentage or no graduates take *non-NMT* jobs immediately after graduation or within five years of graduation. Almost three of five (60%) of program directors indicated that no graduating technologists took jobs outside the profession.
- Many NMT graduates pursue graduate degrees at some point in their careers. Almost two-thirds (66%) of program directors indicate that between 1% and 25% of their graduates in the last five years pursued graduate education in some discipline.

Attitudes

- Opinions varied among NMT program directors about the importance of establishing the bachelor’s degree as the entry-level requirement for NMTs. Overall, 66.1% of program directors felt it is somewhat important, very important, or imperative to move the entry-level academic credential for NMTs to the bachelor’s degree level. Most of the program directors who indicated that it was not important to migrate entry level to the bachelor’s degree were from community colleges.

- There was little disagreement among program directors on the importance of universal licensure to the NMT profession. More than nine of ten (92%) of respondents indicated that it is either important or imperative that NMTs be licensed in all states. Only 3% of program directors ranked licensure for NMTs in all states as unimportant.
- Across all types of sponsoring institutions for NMT education programs, 34% currently offered graduate education in some discipline. As would be expected, sponsoring institutions with graduate education in any discipline were generally those with four-year NMT programs. Among sponsoring university/four year colleges, 63% had existing opportunities for graduate study. Likewise, 44.4% of sponsoring hospitals with university affiliations and 57.1% of sponsoring academic medical centers had existing graduate degree programs in some discipline. These statistics suggest that there might be possibilities for establishing graduate programs in some of these sponsoring institutions, since required infrastructure to support graduate education currently exists.
- There was less consensus among program directors about the importance of creating a curriculum for a nuclear medicine practitioner (NMP) program, with 24% of respondents indicating that it was not important, 39% indicating that it was somewhat important, 27% indicating that it was very important, and 10% indicating it was imperative.

RECOMMENDATIONS

The recommendations presented below flow primarily from the survey responses, including the open-ended comments presented in Appendix B, supplemented by conversations with practitioners and leaders in the NMT profession. The recommendations are based in part on the impressions of the authors that NMT education program directors appear to be somewhat complacent about the future. Major transformations of nuclear medicine—including all nuclear medicine professions—seem almost certain over the next five to ten years. If nothing is done to ensure an orderly transition into the future, there is a real risk that individual NMTs, the NMT profession more generally, NMT education programs, and SNM may lose some of their current ability to lead NMT into the future.

- **Standardize the learning objectives, curricula, and education levels for NMTs in all fifty states.** This is an important element in the professionalization of this health profession. The standardization process should include a single entry-level credential for the profession. Current patterns and trends in the health care system suggest that this credential should be a minimum of a bachelor’s degree.

There is evidence from within the NMT profession that a bachelor's education is in demand. The survey described in this report revealed that many NMT education program directors have expressed concerns about the difficulty of fitting necessary coursework into the two-year curriculum at many programs. A continual stream of advances in nuclear medicine technology drives the need to incorporate new competencies (e.g., cross sectional anatomy and imaging) into NMT curriculums. In addition, the demand for supervisory/management education suggested by the high number of NMTs in supervisory roles (33%) all support the need for bachelor's education.

In their responses to the NMT practitioner survey conducted in late 2005, NMTs cited high levels of current education (49.5% currently possess a Bachelor's degree and 7% a Master's degree). Among actively practicing NMTs 31% possessed a bachelor's degree before entering their NMT education program. In addition, many currently active NMTs (29.2%) expect to continue their academic education in the future.

- **Extend the NMT curricula to encompass cross-sectional imaging.** As nuclear medicine becomes more pervasive in all types of settings and as fusion hardware becomes commonplace in imaging centers across the country, employers in all settings will give preference to technologists who can bridge the worlds of nuclear medicine and cross-sectional imaging. Fusion technology represents an important crossroads for the NMT profession. Since fusion technology requires competence in both nuclear medicine and traditional radiologic imaging, there are important opportunities for cross training. Any NMTs not fully competent in both imaging arenas risk being supplanted by other professions who do have these dual competencies.

Maintaining competence with emerging technologies is critical to maintaining relevance to employers. Just as there are concerns in jurisdictions that lack sufficient geographic penetration of NMTs that other professions will substitute for NMTs, there are concerns that other professions will substitute professionals with competencies in the new fusion technologies.

Position NMT programs as the preferred place to obtain continuing education on NMT technologies and techniques. This is an especially timely and increasingly important recommendation as NMTCB and ARRT begin the recertification process. The need for CEUs in CT technology and in cross sectional anatomy noted in the NMT workforce survey supports initiatives among current academic programs to build CE curriculum in those subject areas. Among active NMTs, 23% cited the need for further training in CT, and 44% cited the need for further training in PET/CT. If NMT programs do not offer these programs, other programs will.

- **Establish formal articulation agreements to permit students to complete degrees.** This is a significant

issue for the NMT profession, especially in consideration of the stated strategic objective of moving entry-level education to the bachelor's level. Currently, only 35% of NMT education programs award a bachelor's degree. It is especially important that programs in community colleges articulate with other academic institutions to permit their students to complete a bachelor's degree. Four-year colleges and universities have an outstanding opportunity to work with these institutions as feeders into their programs. This will be a win-win situation for those institutions that negotiate articulation agreements with willing partners.

Established education programs have achieved excellence in the core NMT curriculum, as demonstrated by the fact that 78% of currently active NMTs who graduated in the last five years indicated that their education programs had provided adequate training for current practice. It is important now to extend NMT competencies to include fusion, management, and new technologies.

Develop programs that meet the needs of non-traditional students. Most current NMT education programs are traditional educational programs with courses offered during the day. Educators reported in this survey that a significant proportion of their students are older (median age across programs is 26 years to 30 years) and second-career students. These types of students often prefer programs in the evening or on-line to give them the opportunity to earn a living and support a family while learning new skills. Many health professional education programs in other disciplines that have sought out these students are currently flourishing by providing a flexible and accommodating learning environment.

- **Even out the geographic penetration of NMTs across the fifty states.** In this report and in the NMT workforce report, dramatic differences in the penetration of both NMTs and NMT education programs have been observed across the U.S. Although the differences in NMT to population ratio may be explained by a variety of factors, it is extremely important to have a sufficient NMT workforce in all jurisdictions to avoid the necessity of substitution of other professionals for NMTs in locations where the NMT workforce is sparse.
- **Develop more on-line options for NMT education.** Other health professions have shown that on-line didactic education programs with local clinical affiliates are an effective strategy for resolving geographic variations in program availability. Online programs provide opportunities to increase educational efficiencies, share resources and faculty, open programs to non-traditional students, and increase workforce penetration in areas where there are no educational programs. On-line education programs in NMT are not currently widely available, which creates an important opportunity for a number of programs to fill the void.

A narrative question on the survey described in this report addressed on-line content in programs. All these comments are listed at the end of this report and reveal that, while a few programs have embraced the option of on-line education with success, many programs have very little or no distance education available. In fact, many respondents seemed not to appreciate the opportunity that on-line education offers.

On-line education is also a strategy to address the need for faculty resources. On-line programs promote sharing of resources among programs by permitting experts in a particular area to design courses that can be widely disseminated. In addition, although faculty is still required to review coursework and address student issues, it increases the capacity of faculty by permitting them to oversee more students, more efficiently.

On-line education also addresses the needs of many second-career and part-time students who seek alternative methods of education to accommodate work and family schedules. Although on-line education for health professionals presents special challenges, there are many examples of successful programs that create a network of clinical affiliates in a variety of geographic areas to teach and mentor students in clinical rotations.

- **Develop course content that anticipates new nuclear medicine technologies.** The possible advent of fusion MRI technology is just one example of an opportunity for existing NMT education programs—and even SNM—to take the lead in training NMTs and other imaging professionals in the latest technologies. A quick environmental scan suggests that fusion technology is neither a blip on the screen nor a unique event. There are concerted efforts afoot to blend MRI and mammography with nuclear medicine technology. The anticipated move from diagnostic to therapeutic technology will also affect NMT work in the near future.

These and other expected innovations will require adaptation in both the core NMT curriculum and continuing education programs. It will become increasingly difficult for educational programs to prepare technologists adequately when new technologies are introduced for use with short time lines between introduction and full implementation. For this reason, it is important for education programs to be in a proactive position, constantly scanning new developments and potential technologies to understand the knowledge, skills, and competencies that will be required by NMTs and other imaging professionals.

Currently, many technologists rely on technology or pharmaceutical vendors for their education about innovations. Although this may be appropriate if the training is operational in nature, the NMT profession must also be certain that the scientific foundations of

NMTs are adequate to learn and master these new applications. Ideally, teams of educators, scientists, physicians, technologists, and others can be established to help keep education programs abreast of important technological and clinical breakthroughs.

- **Develop strategies to ensure an adequate supply of NMT program faculty.** NMT education programs must address a number of faculty-related issues. It is essential to identify and recruit competent faculty who can be relied on over time to teach didactic courses and clinical rotations. This means that the NMT profession must address a number of inter-related issues, including:

- Creating interdisciplinary faculty teams to teach required didactic content;
- Creating a mix of financial and non-financial incentives to attract NMT faculty;
- Increasing class sizes to make education programs more efficient;
- Substituting on-line for face-to-face classes to use existing faculty more effectively; and
- Finding people at the cutting edge of new technologies.

Strategies in these different areas might be developed and refined in a number of bellwether educational programs, and then disseminated to other programs through professional meetings and publications. This dissemination strategy suggests an important coordination role that might be played by SNM in helping to promote timely changes in educational programs.

- **Stabilize production of new NMTs to avoid boom-bust cycles in the NMT job market.** Currently, education programs in NMT, like those in a number of health professions, appear to be operating in a cyclical pattern of over- and under-production driven by a perceived need to respond quickly to small nuances in the job market for NMTs. These cycles create hardships for all concerned as enrollments rise and fall in response to demand for new professionals.

Ideally, these cyclical swings could be eliminated—or at least smoothed out—by developing accurate estimates of the underlying demand for new NMTs. Education programs could then collectively set target enrollment and graduation levels to achieve a balance between supply and demand. Over time, this would help to reduce dramatic swings in NMT production, creating a more stable environment in which education programs can operate. This is not to suggest that estimating the baseline demand for NMTs would be a simple task, but devoting some resources to this strategic task could have significant payoffs for all stakeholders in the nuclear medicine industry.