COMMENTARY

The Future of Nuclear Medicine Technology: Are We Ready for Advanced Practice?

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Objective: The purpose of this study was to identify the clinical skills, commonly performed by nuclear medicine technologists (NMTs), that are beyond the entry-level practice guidelines and to determine NMTs' interest in the development of an advanced practice career pathway for nuclear medicine technology.

Methods: The Society of Nuclear Medicine Technologist Section (SNMTS) conducted a survey of 1000 technologists certified by the Nuclear Medicine Technology Certification Board (NMTCB) to determine which advanced clinical skills were being performed by NMTs and the level of training required to perform these skills.

Results: Those who responded to the survey were older and tended to have more years of experience and a higher level of responsibility as compared to the average technologist. Sixty-two percent of the respondents thought the SNMTS should develop an advanced practice career pathway, and 85% thought that advanced practice education should be delivered in nontraditional formats such as nights, weekends, and by distance education.

Conclusion: NMTs reported a high level of interest in an advanced practice career pathway that could be completed while they remained employed.

Key Words: clinical skills; advanced practice; practice guidelines; scope of practice

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The 1990s represent one of the most dynamic decades for health professionals in the United States. Between 1966 and 1993, health care spending increased at an annual rate of 11.7%, and by 1996, health care costs composed almost 14% of the nation's expenditures (*1*). Third-party payers, employers, and consumers began to rethink how care should be delivered and paid for in the future. In the following decade, as pressure mounted to reduce expenditures, many hospitals closed and almost half of the inpatient hospital beds were lost. Concurrently, a massive expansion of primary care in ambulatory and community care settings occurred (*2*). As pressures mounted to reduce expenditures yet maintain high standards of care, health professionals had to reconsider the value that they themselves added to the delivery of health care.

Today health care professionals face many challenges in reimbursement, regulation, and the practice of their respective professions. As a result, they are confronted with having to learn new skills and new ways of practicing. In addition, the Pew Commission has recommended that the workplace of the future demand new professional skills and new configurations of staffing (*2*). Despite these changes in health care, the nation's educational programs continue to prepare students for yesterday's environment and have not yet assimilated new values, techniques, and skills into their curricula. The Pew Commission has called on these institutions to develop mechanisms that enlarge on practitioner's education to include a broader set of skills to meet the challenges in tomorrow's health care environment (*3*).

The nuclear medicine imaging profession has not been immune to these changes. According to a recent survey by the Society of Nuclear Medicine (SNM) (unpublished results, 1998) most nuclear medicine physicians and technologists spend significant parts of their day in areas other than nuclear medicine. Many physicians who read nuclear medicine films are radiologists with heavy demands on their time in other areas. The survey also showed that nearly 40% of the physicians and 35% of the technologists have worked in the field for more than 20 y. Approximately 65% of the physician respondents were over the age of 45 y and more than half of the technologists who responded were under the age of 45 y. The number of nuclear medicine residents is dwindling while increasingly more nuclear medicine procedures are performed by other medical specialists. The "graying" and eventual retirement of many in the existing physician population, the reduction in numbers of new nuclear medicine physicians, and the fact that many technologists have significant work experi-

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ence represent a unique opportunity for professional growth for technologists.

These changes in manpower and the delivery of health care have already produced new classifications of health care workers, that of physician extenders or nonphysicians performing tasks previously performed only by physicians. Physician extenders, such as nurse practitioners (NPs) and physician assistants (PAs), have been around for many years and were in an excellent position to provide cost-effective services. The Pew Commission has strongly endorsed the use of PAs and NPs in 2 reports (*2,3*). Research indicated that when the number of residency slots on various hospital services was reduced and physician extenders were used instead, the quality of care improved, probably as a result of using permanent, full-time employees (*4*). Cawley reported that by adjusting the mix of physicians, residents, and PAs, teaching hospitals could reduce overall salary costs and preserve adequate levels of medical care (*5*). These 2 professions of physician extenders or nonphysician practitioners may well provide models for the imaging professions, including nuclear medicine technology, in developing expanded scopes of practice.

The imaging professions in the United States and England have made significant progress in expanding their scopes of practice. Friedenberg (*6*) described a system that developed in the 1990s in England in which senior nuclear medicine technologists (NMTs) were trained to read and report results of specified nuclear medicine examinations. He also outlined the training provided to NMTs to undertake this new responsibility. The guidelines under which the technologists would operate were protocol specific, much in the way nurse practitioners operate.

In 1996 a consensus conference of U.S. educators in the fields of radiography, nuclear medicine technology, and sonography developed a monograph that outlined the skills that might be required of a master's degree in any of 7 educational tracks, including that of radiology practitioner (*7*). Among the skills identified were those of providing differential diagnoses, developing clinical pathways, evaluating images, screening, defining normal and abnormal studies, and using prescriptive powers.

Members of the sonography profession further developed their own guidelines for creating a ''middle care provider'' or ultrasound practitioner (*8*). In their study leading up to the final recommendations, they reported that many sonographers have provided a diagnosis and sometimes a final report on ultrasound findings, thus operating outside their current scope of practice. These sonographic practices may put the public at risk because of lack of standards in education and practice, and it was with that intent that a new profession, ultrasound practitioner, was developed. The practitioner would be capable of clinical assessment, patient counseling, patient referrals, and primary ultrasound image assessment. Sonography professionals anticipate that these practitioners would work with a health care team and in association with a primary care provider or specialty physician. As computer networking and telemedicine evolve, however, it is likely that some ultrasound practitioners will work at a site distant from the physician.

As part of its most recent strategic plan, the Society of Nuclear Medicine Technologist Section (SNMTS) was charged with evaluating the need and the desire for an advanced level of clinical practice for NMTs. As the profession of nuclear medicine has matured and changes in health care have occurred over the last quarter century, many NMTs have taken on roles in the clinical practice setting that are generally considered over and above the entry-level practice domain. For example, technologists are asked (under the supervision of a physician) to administer interventional drugs, stress and monitor cardiac patients, and/or obtain an informed consent for specified procedures. Most recently, technically complex SPECT and PET imaging in the new world of molecular biologic imaging have required the NMTs to acquire new skills.

Changes in the health care environment also have increased the demands on NMTs in the areas of decision making and advocacy for the field, an expanded role for which most NMTs often feel inadequately prepared. In surveys conducted before developing the SNMTS strategic plan, NMTs consistently voiced this concern (unpublished results, 1996).

For these reasons the SNMTS determined that it should investigate the need for an advanced level of clinical practice for NMTs. The primary purpose of this study was to identify the clinical tasks that NMTs are now performing and that may be considered beyond entry-level competencies (*9,10*). The second objective was to determine the interest in advanced practice on the part of the NMT community.

MATERIALS AND METHODS

Subject Selection

In 1999 participants were randomly selected from NMTs certified by the Nuclear Medicine Technology Certification Board (NMTCB) and listed as ''active'' in the field of nuclear medicine. The study sample consisted of 1000 NMTs who were sent a letter explaining the purpose of the study. Each NMT was invited to complete a survey online or by paper and pencil.

Survey

A survey was developed to ascertain whether NMTs presently perform advanced clinical tasks on a routine basis and whether NMTs feel there is a need for specialized training to perform these tasks. The online version of the survey was developed using WebCT (WebCT, Inc., Lynnfield, MA) software and results were collected by the University of Arkansas for Medical Sciences. A return postcard was provided in the letter for those who chose the paper-and-pencil version. On receipt of the postcard, the survey was mailed to the participant.

Information in 4 primary categories was requested on the survey: NMT demographics; place of employment; performance of specified clinical tasks; and interest in an advanced level of training to perform these tasks. Items relating to NMT demographics included current job title, age, number of years working in nuclear medicine, types of professional certifications, level of education, and type of training in nuclear medicine technology. Questions pertaining to place of employment included information about the facility; the number of nuclear medicine procedures per month; numbers and types of staffing, including medical staff, NMTs, and support staff; and the use of teleradiography to send or receive films. Several clinical tasks that may be deemed beyond the competency of most entry-level NMTs were listed and participants were asked if they performed any of those tasks and if they had received formal training to do so.

Opinions about the need for an advanced level of clinical training also were solicited and included questions about whether the tasks should be considered advanced level of practice, whether the professional society should develop an advanced level of practice, and how education for advanced practice should be conducted. Participants also were invited to express their opinions regarding the survey or the concept of advanced practice for NMTs.

Statistical Analysis

Results for each item on the survey were expressed as a percentage of those who responded to the particular item. Participants were allowed to select more than one response to some items, and not all items were answered by all participants.

RESULTS

Ninety-seven participants responded to the survey, for a 9.7% response rate. Of those, 60% completed the survey online and 37% preferred the paper-and-pencil version.

Technologist Demographics

Of those who responded to the survey, 30.8% were full-time staff technologists in a multitechnologist department and 33% were chief technologists. Slightly more than 10% were the only technologist in the department, 6.4% were per diem technologists, and the remainder was distributed among the categories of administrator, commercial vendor, educator, and other. The vast majority, 90%, has been working in the field of nuclear medicine for more than 10 y, and the majority had multiple certifications (Fig. 1). Most respondents (70.0%) received their education in nuclear medicine through formal training (Fig. 2), and 81.4% of the respondents had completed at least an associate's degree (Fig. 3). More than 82% of the respondents were over the age of 40 y (Fig. 4).

Place of Employment

Most of the respondents (75.3%) worked in a hospital setting, and 14.5% worked in an outpatient clinic or in a private office. Of those who worked in a hospital setting, the largest portion (32%) worked in settings with 100–299 beds (Fig. 5). Approximately 75% of the respondents worked in settings where the population base of the city was at least 70,000 (Fig. 6). Forty-five percent of the respondents indicated they performed less than 300 studies per month (Fig. 7).

Staffing ranged from 1 technologist per department to more than 8 technologists, with responses among the participants ranging from 13%–20%. Most of the respondents (44.7%) indicated that they had no other health care professionals staffing their departments other than physicians. Approximately

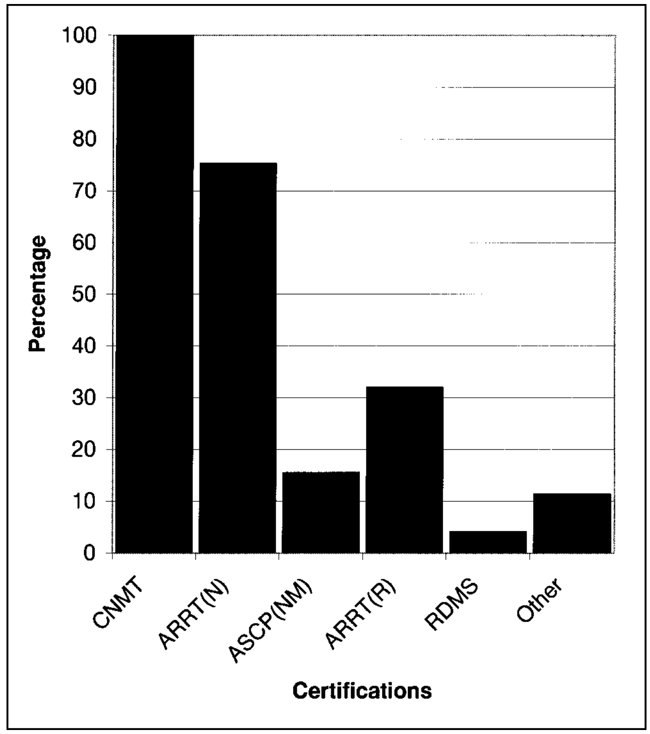

FIGURE 1. Nuclear medicine technologist certifications. CNMT: Certified Nuclear Medicine Technologist through the Nuclear Medicine Technology Certification Board. ARRT(N): American Registry of Radiologic Technologists, Nuclear Medicine. ASCP(NM): American Society of Clinical Pathologists, Nuclear Medicine. ARRT(R): American Registry of Radiologic Technologists, Radiography. RDMS: Registered Diagnostic Medical Sonography.

35.1% reported they had a registered nurse (RN), 18.6% had a physicist, 10.3% had a computer programmer, and 9.3% had a radiopharmacist on staff.

The number of gamma cameras per department varied considerably among the respondents, with 38.1% reported having only 1 or 2 cameras and 36% reported having 5 or more cameras. Approximately 39% of the respondents used PET radiopharmaceuticals with coincidence imaging or a dedicated PET camera (Fig. 8).

Nearly 50% of the respondents indicated that they worked in a department that was staffed full time by a nuclear medicine physician, and the same percentage reported they were staffed by a full-time radiologist. Only 13.4% reported having access to medical staff on a part-time basis only. When asked who approved the quality of nuclear medicine films before that, the patient was dismissed, 39.4% of the respondents indicated the physician made the final decision and 26.6% indicated that the decision was made by the technologist who completed the study. Fifty-one percent of the respondents used teleradiography to send or receive films for interpretation.

Clinical Tasks

Table 1 shows the types of clinical skills or tasks performed by the respondents. Some of the tasks may be considered entry-level skills while others are advanced skills. In some cases the tasks are clearly outside the accepted scope of practice of NMTs (*9*). Well over 50% of the respondents administered interven-

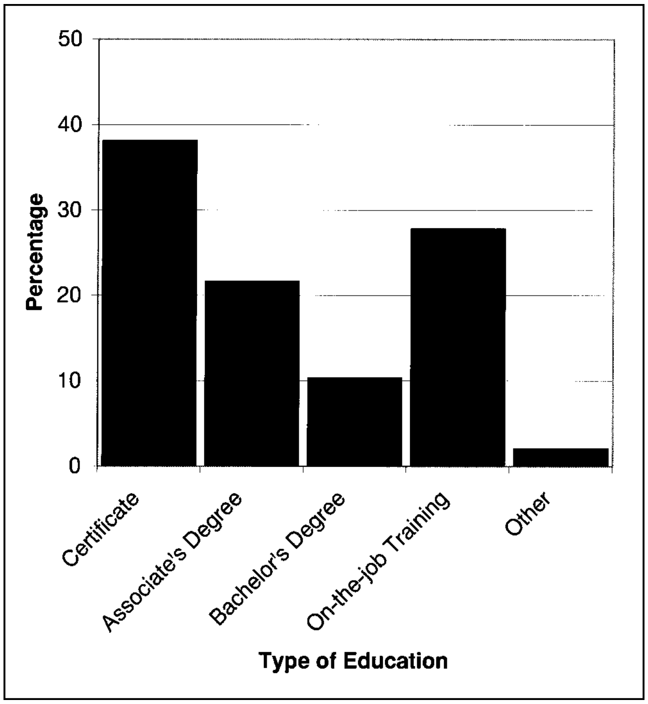

FIGURE 2. Type of education in nuclear medicine technology.

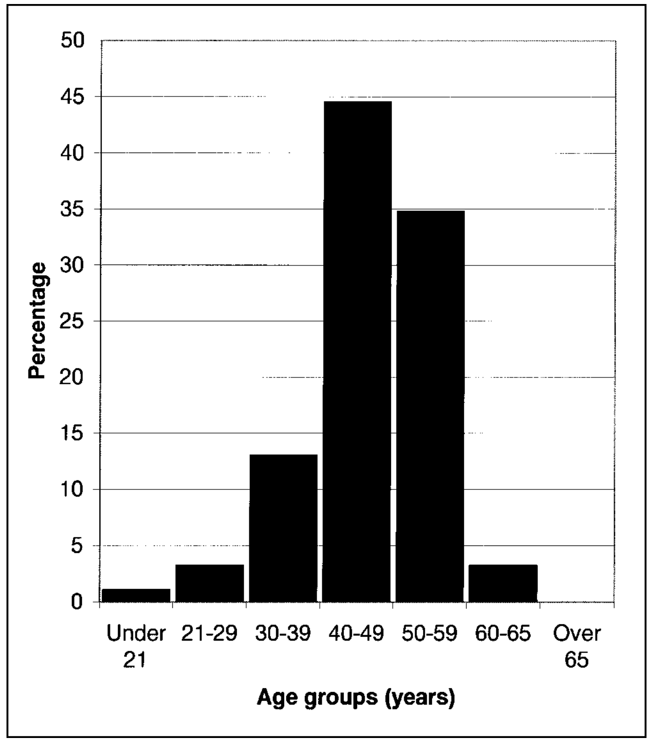

FIGURE 4. Age of technologists.

tional drugs at the direction of a supervising physician, with responses varying depending on the type of drug and the frequency with which the drug was used in general clinical practice. Over 60% of the technologists indicated they had been asked by a physician to provide an interpretation of the results of a nuclear medicine procedure.

When asked how they had been trained to perform any of the tasks on the skill list, most respondents indicated they had not received any formal training for these tasks. In most instances, technologists had received formal training for these skills less than 10% of the time.

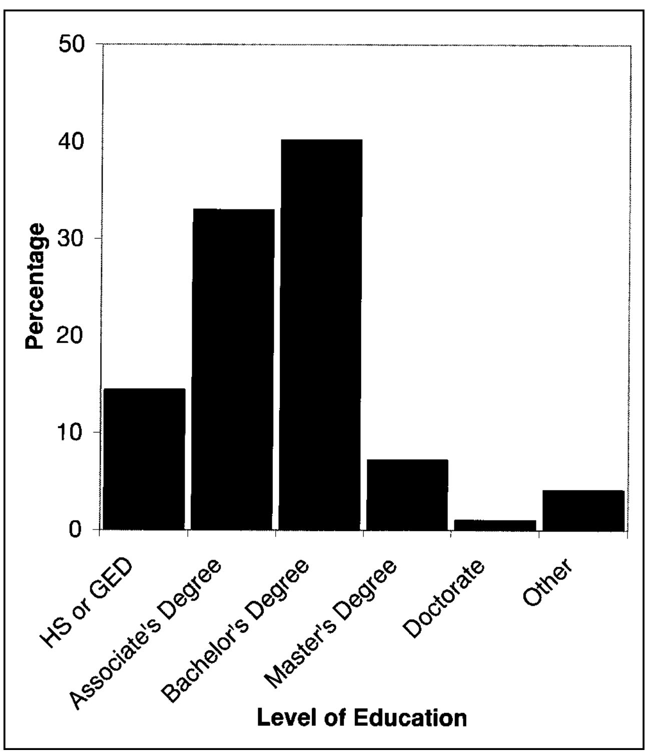

FIGURE 3. Highest level of education.

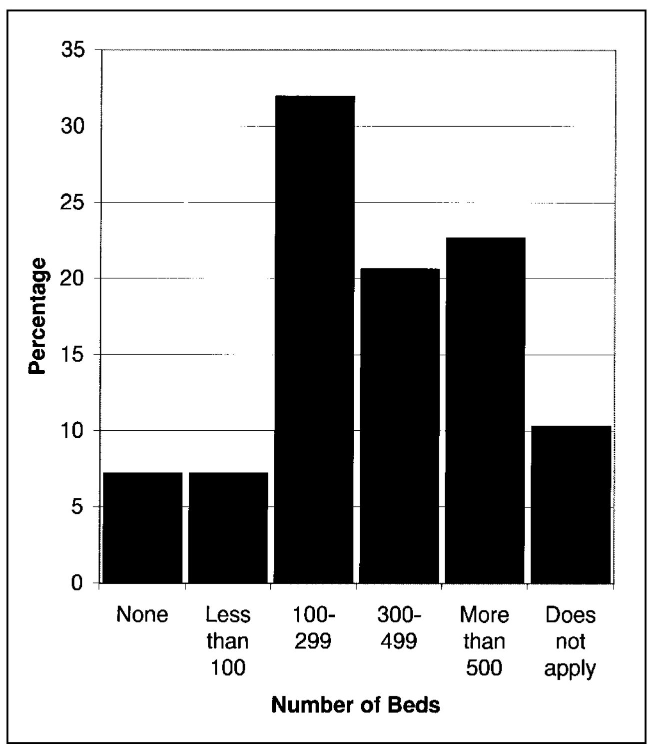

FIGURE 5. Number of beds in facilities.

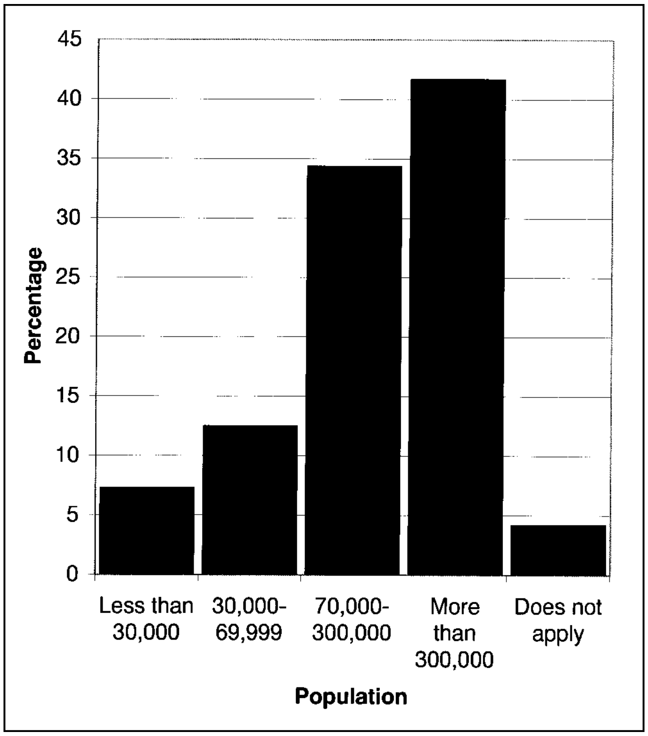

FIGURE 6. Population base.

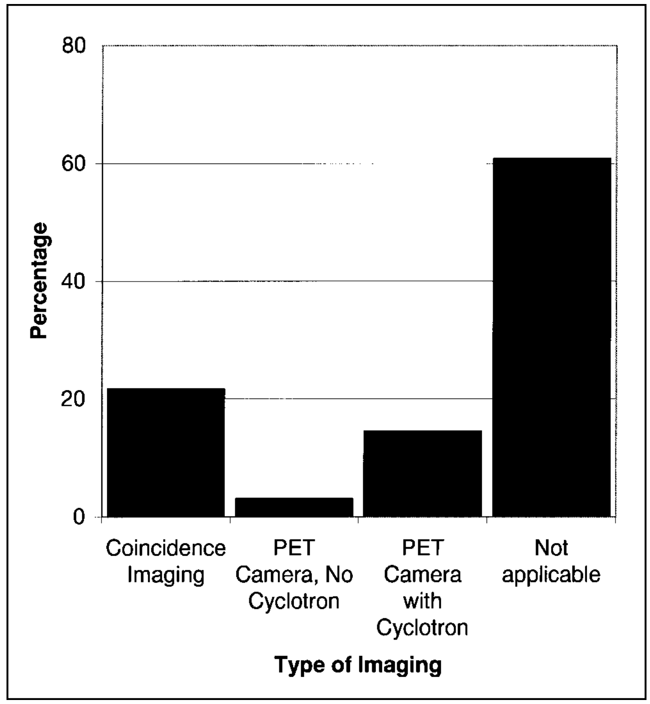

FIGURE 8. Use of PET radiopharmaceuticals.

Interest in Advanced Practice

The majority of respondents indicated that most of the tasks in Table 1 should be considered advanced skills beyond entry level and that additional formal training should be required. A few thought these skills should be taught to every entry-level technologist and 18.3% responded that technologists should not perform these tasks (Fig. 9).

When asked if the SNMTS should develop an advanced practice career pathway, 62% said yes, 13.9% said no, and 25.7% were unsure. Seventy-eight percent of the respondents indicated that an advanced practice technologist would be helpful in some workplaces, 7.6% said such technologists

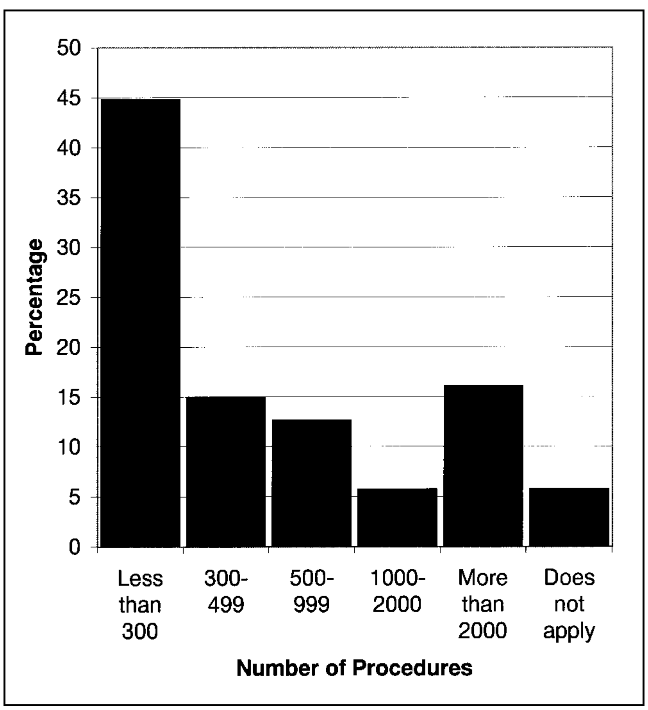

FIGURE 7. Number of procedures per month.

TABLE 1
Performance of Clinical Tasks and Level of Formal Training to Perform These Tasks

Clinical task	Has performed	Formally trained
Administered lasix	62.0%	9.6%
Administered ACE inhibitors	41.5%	6.4%
Administered dipyridamole or adenosine	59.6%	13.8%
Administered morphine	22.3%	3.2%
Administered cholecystikinin	69.1%	8.5%
Administered acetazolamide	15.9%	6.3%
Monitored glucose levels of patients undergoing PET studies	13.8%	3.2%
Performed cardiac stress testing	23.4%	2.1%
Obtained informed consent from patients	47.9%	10.6%
Provided limited patient physical exam such as for thyroid or breast imaging	26.6%	9.6%
Performed ECGs on patients	43.6%	21.3%
Interpreted ECGs on patients	13.8%	8.5%
Monitored patients under conscious sedation	23.4%	4.3%
Performed urinary catheterization on patients	11.7%	9.6%
Received request from a physician to provide an interpretation of a nuclear medicine procedure	63.8%	7.4%

would not be helpful, and 13.0% were unsure. When asked if the individual respondent was personally interested in an advanced practice credential, 59.1% responded yes, 20.4% responded no, and 20.4% were unsure.

Responses varied considerably regarding the level of education at which a curriculum in advanced practice should be taught. Over 50% of the respondents thought the curriculum should be a bachelor's degree or bachelor's degree plus certificate. Approximately 40% thought the curriculum should be less than a bachelor's degree, and 7.5% thought it should be taught at the master's level or higher. When asked how the educational curriculum should be delivered, respondents were asked to rank 3 choices: traditional classes on a full-time basis during the day; classes at nights and weekends with part-time options; and distance education with online Internet courses and compressed video. The most popular choice was night and weekend classes on a part-time basis (46.2%) closely followed by distance education options (40.4%). Only 13.5% of the respondents favored the traditional class format offered on a full-time basis. When asked whether NMTs with an advanced practice credential also should hold a credential in another health care profession or imaging specialty, such as radiologic technology, 81.7% indicated that was not necessary. Fifteen percent stated that it would helpful, and only 1% said that additional certifications should be mandatory.

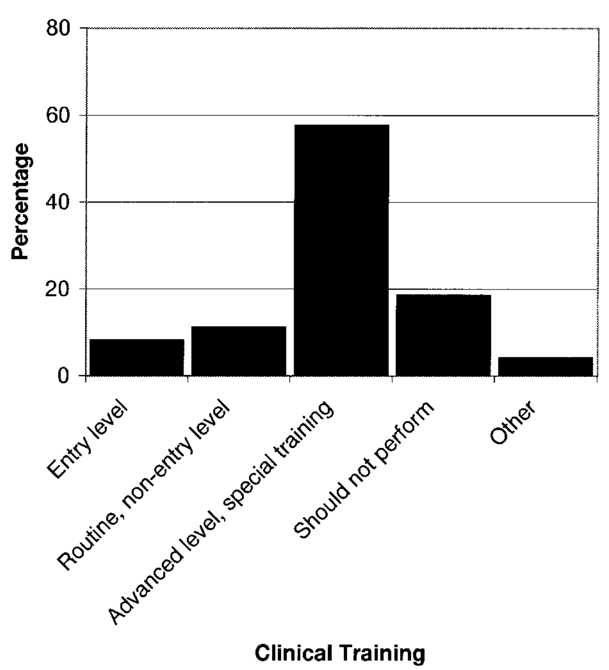

FIGURE 9. Desired level of clinical training and opinion regarding clinical tasks in Table 1. Entry level: clinical tasks should be routine for all nuclear medicine technologists and should be part of the training program for students. Routine, nonentry level: clinical tasks should be routine for all experienced technologists but not necessarily at the entry level. Advanced level, special training: clinical tasks should be considered advanced procedures and nuclear medicine technologists should receive specialized training. Should not perform: nuclear medicine technologists should not perform these tasks.

DISCUSSION

Seventy-eight percent of the respondents felt that an advanced practice NMT would be helpful in some clinical settings, and over half indicated they were currently performing tasks that were beyond the entry-level skill level for NMTs.

Technologist demographics indicated that those who responded to this survey were older and tended to have more years of experience and a higher level of responsibility compared with the average NMT. A 1998 survey by the SNM (unpublished results, 1998) indicated that more than half the NMTs were less than 45 y old, echoing a similar study in 1996 (*11*), whereas 82% of the respondents in this survey were older than 40 y.

Although 90% of the respondents in this study had been working more than 10 y, 2 earlier studies (*11*,*12*) showed that only 63%–70% of the technologists had been working the same amount of time. Crosthwaite et al. (*12*) reported that only 15% of the technologists held the job title of chief technologist, whereas 33% of the respondents in this survey held that job title. Crosthwaite's study included a much larger sample size and was probably more indicative of the NMT population as a whole.

Most of the respondents worked in a hospital setting of at least 100 beds and in urban settings with a population base of at least 70,000, data that are comparable with Neagley's manpower studies of 1996 and 1998 (*11*,*13*). A large number of respondents reported having full-time physician coverage in the department but almost half the respondents used teleradiography to send or receive images, which may indicate that some were working without a nuclear medicine physician within the department. Less than 40% of the time a physician made the final decision about image quality, which again may imply that NMTs were working without on-site physician supervision or had some responsibilities delegated to them.

Respondents in this survey had performed clinical tasks that were beyond the accepted entry-level skills guidelines for NMTs (*9*). Several technologists had performed limited physical exams, conducted cardiac stress testing, and obtained informed consents from patients. Conversely, very few had received formal training and education to conduct these activities, which placed the nuclear medicine physician and the hospital at an increased risk in case of an adverse event. The most significant clinical task performed by NMTs was providing an interpretation of an image. Surprisingly, 7% indicated they had been trained to do so.

Some of the skills identified in Table 1 are clearly defined in the performance and responsibility guidelines (*9*). For example, it is permissible to administer interventional pharmaceuticals at the direction of a physician. Over 50% of the technologists have administered various types of pharmaceuticals, which correlates well with Neagley's 1998 study (*13*). Survey respondents reported, however, that very few of them had received formal training to do so. This is a risk management issue, and in some states, technologists are not legally allowed to administer these drugs.

According to this study, technologists were interested in an advanced practice career pathway but were not sure at what educational level the training and education should be offered. Over 85% of the respondents stated that such training should be offered in a nontraditional format, which implied that very few of them were prepared to quit their jobs to return to school on a full-time basis.

The greatest limitation to this study was the low response rate to the survey. The response rate could have been low for several reasons. No follow-up was conducted for either the computerized version or paper-and-pencil version of the survey. The fact that the survey was computerized may have resulted in the low rate of return, although more replied in this manner than by paper and pencil. It is also possible that the most effective means of obtaining technologists' opinions was not used. According to the national work force dataset for allied health professions, as compiled by the Association of Allied Health Professions (ASAHP) and the Bureau of Health Professions (ASAHP, 2000), the option most preferred by technologists in responding to a survey was a telephone interview with a live interviewer (*14*). The likelihood of responding to a mail survey received a relatively high negative response. Although more expensive and time consuming, telephone surveys may be a more reliable option in the future.

CONCLUSION

NMTs have expressed a high level of interest in an advanced practice career pathway according to this study. They also indicated they were currently performing many tasks outside accepted entry-level practice guidelines and were doing so without the benefit of formalized training. Such activity puts the technologist, the physician, the institution, and, most important, the patient, at risk for an adverse event.

These survey results provide a baseline for further exploration of an advanced practice career pathway. Imaging professionals in the United States and England began the process, but such interest must go beyond the technical professions. Future studies should focus on all stakeholders, to include physicians, employers, administrators, third-party payers, and regulatory agencies. The profession itself will need to determine how an advanced practice curriculum is to be developed and delivered to the prospective student, how educational programs will be accredited, and how the advanced practice technologist would be credentialed.

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