Education and Employment of New England Nuclear Medicine Technologists

Kathleen H. Murphy

Nuclear Medicine Technology Program, Yale-New Haven Hospital, New Haven, Connecticut

Objective: The purpose of this study was to determine the recommendations of chief nuclear medicine technologists regarding the educational levels required for employment, as well as the need for multiskilled and multicredentialed technologists.

Methods: A cross-sectional survey was performed using a sampling frame derived from the *1993 Directory of the American Hospital Association*. A questionnaire was sent to the chief nuclear medicine technologist in every New England hospital with more than 50 beds listed in this directory.

Results: The majority of chief technologists prefer to hire staff technologists possessing associates (30.4%) or bachelors (38.2%) degrees, in addition to multiskills (75.2%) and/or multicredentials (82.4%).

Conclusion: Chief technologists in New England recommend that prospective technologists graduate from an associates or bachelors degree program and possess additional skills and/or credentials. Nuclear medicine educators should provide their students with the knowledge and skills needed to meet these recommendations.

Key Words: technologist education; employment; multiskilled; multicredentialed

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The job market for nuclear medicine technologists in New England has become saturated (*1*). This is due to an excessive number of students graduating from nuclear medicine technology programs in New England and a decreased number of openings for staff technologists in this region (*1*). The decreased number of openings is the result of economic restraints on health care institutions. Patient-focused care models, downsizing and hiring freezes have all contributed to the scarcity of openings for new graduates.

Educators in this field need to prepare their students to compete in this very difficult job market. The scope of practice for nuclear medicine technologists has changed significantly over the past few years due to health care reform, managed care, capitation and patient-focused care models (*2–5*). The data derived from this cross-sectional survey will enable nuclear medicine educators in New England to counsel their students appropriately and to propose timely curriculum changes if necessary. The results of this project will be of interest to prospective students of nuclear medicine technology who need to know what prospective employers expect of them. As a consequence, this will assist prospective students in the selection of a nuclear medicine technology program that will provide them with the education and training to obtain employment after graduation.

MATERIALS AND METHODS

An observational study using a cross-sectional survey was the research design employed for this project (*6–11*). The data collected contain information regarding the size of institutions surveyed, hiring trends, and the education and skills needed to obtain employment as a nuclear medicine technologist in New England. The data collected are from chief nuclear medicine technologists throughout New England. The sampling frame was gathered by choosing every hospital in New England with more than 50 beds, as listed in the *1993 Directory of the American Hospital Association* (*12*). This resulted in a sample of 194 chief nuclear medicine technologists.

A questionnaire (Table 1) was developed and mailed to the entire sample with a cover letter, explaining the purpose of the study, and a self-addressed stamped envelope, to encourage participation in the study (*1,3–6,8*).

The data collected included the size of the institutions (number of beds), the number of full-time equivalents (FTEs) employed in the nuclear medicine department, the number of FTEs hired during the last year and the predicted number of FTEs to be hired in the upcoming year. The survey also elicited data on how an applicant's certification, registration, education and skills affected the chief technologists' hiring decisions.

The questionnaire asked the respondent to choose between two job applicants: one possessing the American Registry of Radiologic Technologists' Nuclear Medicine designation

For correspondence and reprints contact: Kathleen H. Murphy, BS, CNMT, RTN, Yale-New Haven Hospital, Nuclear Medicine Technology Program, 20 York Street, SP2, New Haven, CT 06504.

TABLE 1
Survey Questionnaire and Responses

Question	Responses
1. What is the size of your institution?	100
2. How many full-time equivalents (FTEs) does your department employ?	101
3. How many FTEs have you hired during the last year?	102
4. How many FTEs do you anticipate hiring in the upcoming year?	101
5. If you had to choose between two prospective employees, a RT(N) and a CNMT, which candidate would you hire?	
RT(N)	25
CNMT	65
Either	12
6. If you had five prospective employees applying for a staff technologist position and each candidate possessed a different level of education, which of the following candidates would you hire? Please check one.	
On-the-job training	6
Hospital-based program certificate	25
Associates degree	31
Bachelors degree	39
Masters degree	1
7. If you had five prospective employees applying for a supervisory/management position, each with a different level of education, which of the following candidates would you hire? Please check one.	
On-the-job training	1
Hospital-based program certificate	5
Associates degree	11
Bachelors degree	60
Masters degree	25
8. If you had to choose between two prospective employees, one multiskilled and the other multicompetent/multicredentialed, which candidate would you hire? Please check one.	
Multiskilled	44
Multicompetent/multicredentialed	58
9. If you had five multiskilled candidates applying for a staff technologist position, which one would you hire? Please check one.	
ECG placement and monitoring skills	20
Direct patient care skills (assessment, vitals, etc.)	34
Computer programming skills	30
Clerical skills (scheduling, transcription, billing, etc.)	5
Phlebotomy skills	12
10. If you had five multicompetent/multicredentialed candidates applying for a staff technologist position, which one would you hire? Please check one.	
Radiography	68
CT	9
MRI	7
Diagnostic medical sonography	14
Mammography	2
11. Which candidates would you hire for the following two positions?	
Staff technologist position (please check one)	
Advanced education (BS or higher)	25
Multiskilled	76
Supervisory/management position (please check one)	
Advanced education (BS or higher)	84
Multiskilled	18
12. Which candidates would you hire for the following two positions?	
Staff technologist position (please check one)	
Advanced education (BS or higher)	18
Multicompetent/multicredentialed	84
Supervisory/management position (please check one)	
Advanced education (BS or higher)	78
Multicompetent/multicredentialed	24

(ARRT, RTN) and another with the Nuclear Medicine Technology Certification Board designation (NMTCB-CNMT). This question addressed whether a preference exists between these two designations.

The respondent then considered five prospective employees, each possessing a different level of education: on-the-job training, hospital-based program certificate, associates degree, bachelors degree and masters degree. The level of education

did not necessarily correspond with the type of nuclear medicine program that the applicant attended. For example, an applicant may have possessed an AS in nuclear medicine technology and a BS in health administration. The chief technologist was asked to choose one of these five candidates for a staff technologist position, and then for a supervisory or management position.

The next question asked for a choice between a multiskilled applicant and a multicompetent/multicredentialed applicant. For this study multiskilled technologists are defined as possessing additional skills (e.g., ECG, phlebotomy), but are not certified or licensed to perform these skills. Multicompetent/multicredentialed technologists possess certifications, licenses or registrations in other modalities (e.g., radiography, CT, MRI, ultrasound).

The next item instructed the chief technologist to choose between five multiskilled candidates, each with one of the following skills: ECG placement and monitoring; direct patient care (patient assessment, vital signs, etc.); computer programming (the ability to write original programs or to alter current programs); clerical (scheduling, transcription, billing, etc.); or phlebotomy skills.

The chief technologist then chose between five multicompetent/multicredentialed prospective employees, each with one of the following credentials in addition to the nuclear medicine registration or certification: radiography; CT; MRI; diagnostic medical sonography; or mammography.

Item 11 on the questionnaire asked for a choice between a technologist with an advanced degree (BS or higher) or a multiskilled technologist for the positions of staff technologist and supervisor/manager. On the last question, the respondent chose between a technologist with an advanced education or a multicompetent/multicredentialed technologist for the positions of staff technologist and supervisor/manager.

An alpha level of 0.05 was used for all statistical analyses (*6,8*). A z-test for comparing proportions was used to analyze the levels of education preferred by chief technologists in New England for both staff and supervisory technologists (*8*). To determine if there was a relationship between hospital size (number of beds) and the level of education preferred by chief technologists in New England, an analysis of variance (ANOVA) was used (*13*). The analysis of the level of education preferred for a staff technologist and its relationship to the number of beds required the removal of an outlier. The respondent removed from the analysis was employed in a 200-bed hospital and preferred a masters degree for a staff technologist position. The analysis of the number of beds and the preferred level of education for a supervisory position also required the removal of an outlier. The respondent removed was employed in a 719-bed hospital and preferred a hospital-based program certificate for a supervisory/management position. Both of these analyses were run with and without the inclusion of the outliers (*13*).

The chief technologists' recommendations for staff and supervisory/management positions (multiskilled and multicompetent/multicredentialed versus advanced education) were analyzed by the z-test for comparing two proportions (*13*).

TABLE 2
Preferred Nuclear Medicine Credentials

Credential	N	Percent
CNMT	65	63.7
RT(N)	25	24.5
Either	12	11.8

Descriptive statistics and z-tests, for comparing proportions, were used to analyze the remaining items of the questionnaire (number of FTEs employed by nuclear medicine departments, number of FTEs hired during the last year, etc.) (*6,8*).

RESULTS

One hundred and twelve questionnaires were returned from the 194 sent out, resulting in a response rate of 57.7% (*1,3*). Of the 112 questionnaires returned, 102 (91.1% of returned) were used for this study. One questionnaire was returned because the hospital closed, seven hospitals did not have a nuclear medicine department and two questionnaires were improperly completed.

The mean number of beds for this sample was 244.06 with a standard deviation of 163.57. The standard deviation is large because of the wide range of hospitals studied. The smallest hospital contained 52 beds, and the largest housed 815 beds. The mean number of FTEs currently employed was 3.52 with a standard deviation of 2.51. The mean number of FTEs hired last year was 0.20 with a standard deviation of 0.54. The mean number of FTEs the chief technologists anticipated hiring in the upcoming year was 0.11 with a standard deviation of 0.35.

There was a statistically significant difference ($z = 5.64$, $p = 0.0001$) between the nuclear medicine credentials (CNMT or RTN) preferred by the respondents (Table 2). There was no significant difference between the preference of an associates over a bachelors degree for a staff technologist position. However, the preference of a bachelors degree was significantly greater than all other levels of education (hospital-based program certificate: $z = 2.11$, $p = 0.0174$; on-the-job training: $z = 2.61$, $p = 0.0045$; masters degree: $z = 2.95$, $p = 0.0016$) (Table 3).

There was a statistically significant difference between preferences for the bachelors versus the masters degree ($z = 4.97$, $p = 0.0001$) as the level of education for a supervisory/management position. Preference for the bachelors degree was also

TABLE 3
Preferred Level of Education for Technologists

	Staff technologist		Supervisory/ management	
Level of education	N	Percent	N	Percent
Bachelors degree	39	38.2	60	58.8
Associates degree	31	30.4	25	24.5
Hospital-based certificate	25	24.5	11	10.8
On-the-job training	6	5.9	5	4.9
Masters degree	1	1.0	1	1.0

TABLE 4
Preferred Multiskills for Staff Technologists

Skill	N	Percent
Direct patient care	34	33.7
Computer programming	30	29.7
ECG placement and monitoring	20	19.8
Phlebotomy	12	11.9
Clerical	5	5.0

significantly greater than for all other levels of education (associates degree: $z = 7.16$, $p = 0.0001$; hospital-based program certificate: $z = 8.29$, $p = 0.0001$; on-the-job training: $z = 9.03$, $p = 0.0001$) (Table 3).

The choice of multiskilled versus multicompetent/multicredentialed resulted in no significant difference in preference. Fifty-eight (56.9%) of the respondents preferred multiskills and 44 (43.1%) preferred multicompetencies/multicredentials.

There was no statistically significant difference in preference between direct patient care and computer programming skills for applicants for staff technologist positions. However, direct patient care skills were preferred statistically more than all other skills (ECG placement and monitoring: $z = 2.24$, $p = 0.0125$; phlebotomy: $z = 3.71$, $p = 0.0002$; clerical: $z = 5.19$, $z = 0.0001$) (Tables 4 and 5). Radiography was preferred statistically more than all other multicompetencies/multicredentials (ultrasonography: $z = 7.84$, $p = 0.0001$; computed tomography: $z = 8.66$, $p = 0.0001$; magnetic resonance imaging: $z = 8.99$, $p = 0.0001$; mammography: $z = 9.88$, $p = 0.0001$) (Tables 6 and 7).

Seventy-six (75.2%) of the respondents preferred multiskills while 25 (24.8%) preferred an advanced education for employment as a staff technologist, a statistically significant finding ($z = 5.86$, $p = 0.0001$). Eighty-four (82.4%) respondents preferred advanced education while 18 (17.6%) preferred multiskills for a supervisory/management position. This was also statistically significant ($z = 8.53$, $p = 0.0001$).

TABLE 5
Hospital Size and Preferred Multiskills

	Small (<200 beds)		Medium (200–400 beds)		Large (>400 beds)	
Multiskills	N	Percent	N	Percent	N	Percent
EKG	9	19.6	8	19.5	2	16.7
Patient care	18	39.1	12	29.3	2	16.7
Computer programming	13	28.3	13	31.7	5	41.7
Clerical	2	4.3	3	7.3	0	0
Phlebotomy	4	8.7	5	12.2	3	25.0

TABLE 6
Preferred Multicompetencies/Multicredentials for Staff Technologists

Multicompetency/multicredential	N	Percent
Radiography	68	68
Ultrasonography	14	14
Computed tomography	9	9
Magnetic resonance imaging	7	7
Mammography	2	2

TABLE 7
Hospital Size and Preferred Multicompetencies/ Multicredentials

	Small (<200 beds)		Medium (200–400 beds)		Large (>400 beds)	
Multicompetency/ multicredential	N	Percent	N	Percent	N	Percent
Radiography	30	65.2	31	75.6	6	54.5
CT	3	6.5	5	12.2	1	9.1
MRI	2	4.3	3	7.3	2	18.2
Ultrasonography	10	21.7	2	4.9	2	18.2
Mammography	1	2.2	0	0	0	0

Eighty-four (82.4%) chief technologists preferred multicompetencies/multicredentials and 18 (17.6%) preferred advanced levels of education for staff technologist positions. This was a statistically significant difference ($z = 8.53$, $p = 0.0001$). Seventy-eight (76.5%) preferred advanced levels of education and 24 (23.5%) preferred multicompetencies/multicredentials for supervisory/management positions. This was also a statistically significant finding ($z = 6.31$, $p = 0.0001$).

There were statistically significant differences (F-ratio = 3.67, $p = 0.0080$) between the number of beds and the levels of education preferred for staff technologists. After removing an

TABLE 8
Hospital Size and Preferred Level of Education for Staff Technologists*

Level of education	Number of beds
On-the-job training	149.5 ± 63.4
Hospital-based certificate	153.3 ± 32.4
Associates degree	272.8 ± 27.9
Bachelors degree	290.5 ± 24.9

*with an outlier removed from the analysis

TABLE 9
Hospital Size and Preferred Level of Education for Staff Technologists

	Small (<200 beds)		Medium (200–400 beds)		Large (>400 beds)	
Level of education	N	Percent	N	Percent	N	Percent
On-the-job training	5	10.9	1	2.4	0	0
Hospital-based certificate	15	32.6	6	14.6	2	15.4
Associates degree	12	26.1	14	34.1	5	38.5
Bachelors degree	14	30.4	19	46.3	6	46.2
Masters degree	0	0	1	2.4	0	0

outlier, these differences remained statistically significant (F-ratio = 4.87, p = 0.0034) (Tables 8 and 9).

There were no statistically significant differences between the number of beds and the levels of education preferred for supervisory/management technologists. After removing an outlier, these differences remained statistically insignificant (Tables 10 and 11).

DISCUSSION

Achieving an advanced level of education is a means of acquiring professional status by radiologic science professionals. The different sections of the radiologic sciences are currently discussing how this will affect the field. The radiation therapy section of the American Society of Radiologic Technologists (ASRT) took a definitive step in the direction of advanced degrees in June 1993. The ASRT House of Delegates adopted Resolution 93-3.05 which states that all students entering radiation therapy programs in the year 2000 and beyond must complete a bachelors degree as an entry-level requirement for the field of radiation therapy. However, no studies have been published that describe how educators and employers are reacting to the requirement of a bachelors degree at the entry level (*14,15*).

Radiographers are also looking towards the future regarding advanced educational requirements and the need to acquire more skills. In a survey conducted by Steven B. Dowd, radiography educators felt that customer satisfaction and technical and computer skills would have a significant affect on the future of radiographers. However, they ranked multicompetency lower than expected. Dowd proposed that a follow-up survey be conducted to sample radiographers in supervisory positions. This author hypothesizes that a second survey would provide educators with updated curriculum input to meet employers' needs (*6*).

Associates and bachelors degrees are important for radiographers who want to advance in their profession. Increasingly, training programs in hospital-based certificate programs and associates degree programs articulate with four-year degree granting institutions. This allows graduates to pursue advanced levels of education (*16*).

A meeting of educators representing a wide group of allied health disciplines, including radiologic science, met in Washington, DC in April 1995 to discuss a core curriculum applicable to all allied health disciplines. The core curriculum idea is the product of current trends in health care towards cross-training and multiskilling. Leonard Finocchio, the associate director of the Pew Health Professions Commission at the University of California, San Francisco Center for Health Professions, is a strong advocate of the core curriculum. He states, "If you ask human resource administrators in hospitals [what they want], their main interest is in the education outcome product. They want a student who is flexible, who can adapt quickly, who is multiskilled, who can change jobs quickly or add on other skills quickly, who has some management experience, who is quick on their feet and adaptable to career changes in the event of downsizing or retraining; people who are personable and who can assume responsibility of multitasks (*17*)."

Don A. Pack predicts that patient-focused care models will require radiographers to perform more direct patient care procedures. He believes that all allied health practitioners will be multiskilled and cross-trained in ECG, phlebotomy, specimen collection and other basic skills. Many other researchers in the health sciences believe that becoming multiskilled is an intelligent career move for allied health professionals (*18*).

The Society of Nuclear Medicine, Technologist Section National Council conducted a survey in May 1994 on the effects of health care reform on nuclear medicine technologists. This survey reported that many hospitals were downsizing and, as a result, eliminating nuclear medicine technologist positions. Cross-training into other related modalities (CT, MRI, radiography, echocardiography, etc.) was being implemented or discussed. Nuclear medicine technologists were requested to perform a variety of skills including: ECG, phlebotomy, central line access, drug administration, ACLS/CPR certification, bladder catheter placement, oxygen therapy and others (*4,5*).

The results of the Society of Nuclear Medicine Technologist Section Manpower Survey, reported in December of 1992, showed that a significant number of nuclear medicine technologists were already multicredentialed. This survey also revealed that many part-time nuclear medicine technologists were spending less than 80% of their time in nuclear medicine. The remainder of their time was spent in other modalities, such as ultrasound, radiography and radiation therapy (*19*).

In 1994 the NMTCB conducted a Practice Trends Analysis Survey. The survey had a high response rate of 72.4%; 869

TABLE 10
Hospital Size and Preferred Level of Education for Supervisory/Management Technologists*

Level of education	Number of beds
On-the-job training	150.0 ± 157.4
Hospital-based certificate	221.8 ± 78.7
Associates degree	213.4 ± 47.5
Bachelors degree	225.9 ± 20.5
Masters degree	290.7 ± 32.1

*with an outlier removed from the analysis

TABLE 11
Hospital Size and Preferred Level of Education for Supervisory/Management Technologists

	Small (<200 beds)		Medium (200–400 beds)		Large (>400 beds)	
Level of education	N	Percent	N	Percent	N	Percent
On-the-job training	1	2.2	0	0	0	0
Hospital-based certificate	2	4.3	2	4.8	1	7.7
Associates degree	7	15.2	3	7.1	1	7.7
Bachelors degree	29	63.0	25	59.5	6	46.2
Masters degree	7	15.2	12	28.6	5	38.5

nuclear medicine technologists participated. Their demographic data showed that 31% were also registered radiographers, 30% possessed an associates degree and 46% had a bachelors degree. The survey revealed that 39% performed modalities other than nuclear medicine, such as sonography, CT and MRI. The respondents also identified the multiple skills they were performing: 12% placed ECG leads; 30% assisted the physician in monitoring stress tests; 33% took vital signs; 35% administered nonradioactive drugs; 16% operated treadmills; and 23% operated ECG machines (*3*).

This study showed that chief technologists in New England preferred an associates or bachelors degree education for staff technologists seeking employment. They also preferred a bachelors degree for nuclear medicine technologists applying for supervisory/management positions. These findings are in agreement with many expert opinions (*6,7,14–16*). However, chief technologists in New England would hire a technologist with multiskills and/or multicompetencies/multicredentials over an advanced level of education for a staff technologist position. They also preferred an advanced level of education as opposed to multiskills and/or multicompetencies/multicredentials for supervisory/management positions. These findings also support the opinions of many experts in the field of nuclear medicine technology and allied health (*4–6,17,18,20*).

There is a relationship between the level of education preferred for staff technologists and the size of the hospital (number of beds) in which the respondent was employed. As the size of the hospital increases, the level of education preferred by chief technologists increases. However, this survey indicates that a masters degree is not necessary to obtain employment as a staff technologist. A relationship does not exist between the size of the hospital and the level of education required for supervisory/management positions.

The findings from this study support the incorporation of additional patient care skills and computer programming training into the curricula for nuclear medicine technology programs in New England. Prospective nuclear medicine technology students should consider entering programs which award the associates or bachelors degrees. This study also suggests that radiologic technologists credentialed in nuclear medicine and radiography are needed in New England. Nuclear medicine technology educators in non-degree programs can work on establishing articulation agreements with colleges and/or universities (*16*) so their graduates will be able to transfer their credits with ease.

The sampling frame included hospitals without nuclear medicine departments and hospitals which had closed since 1993, and this may have affected the response rate of the survey. Due to the forced choice method, it may be difficult for chief technologists to state hiring preferences based on only one aspect of a prospective employee's qualifications. A future study might give the respondent the ability to choose more than one multiskill or multicredential to assess whether more than one choice is preferred. Bias may have been introduced into the study based on the level of education of the respondent. For example, a chief technologist with an RT(N) who holds a hospital-based program certificate might answer questions differently than a chief technologist with a CNMT and a bachelors degree. Although useful for our purposes, this study reflects only New England. The conclusions drawn from this study may not necessarily be applicable to the other regions of the U.S. Outpatient facilities were excluded since they were not included in the *1993 American Hospital Association Directory*. A chief technologist in an outpatient facility may have different hiring preferences. Further studies are necessary to address these questions.

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