Diagnostic Services

Medical Imaging

- Diagnostic Radiologic Technologist
- Radiation Therapist
- Nuclear Medicine Technologist
- Diagnostic Medical Sonographer

Laboratory Services

- Medical Technologist
- Medical Laboratory Technician
- Phlebotomist

Medical Imaging

Medical imaging professions include diagnostic radiologic technologist, radiation therapist, nuclear medical technologist, and diagnostic medical sonographer. They use noninvasive techniques to produce intended images for diagnosis and to treat disease.

Radiologic technologists, also referred to as radiographers, provide patient services using imaging equipment as directed by physicians qualified to order and/or perform radiologic procedures. Radiation therapists administer radiation treatments to patients using a planned design to treat cancers in the body that have been previously diagnosed. Nuclear medical technologists (NMTs) prepare stock solutions of radioactive materials and calculate doses to be administered for imaging.

Sonographers, also known as ultrasound technologists, direct nonionizing, high-frequency sound waves into areas of a patient's body; the equipment then collects reflected echoes to form an image. The image is viewed on a screen and may be recorded or photographed for interpretation and diagnosis by physicians.

Status

- Tennessee's radiography programs are adequate to meet current and projected needs, although hospital vacancies in excess of 4 percent are reported in the THA West and Middle districts.
- Numbers of graduates in Tennessee continue to increase, which may result in an oversupply in radiography and radiation therapy.
- The ARRT has formally approved the associate degree as the minimum education requirement for radiography, nuclear medicine, and radiation therapy beginning January 2015.
- Federal studies to determine the impact of educational standards on the quality of care in ultrasound are underway and may lead to increased federal regulations.
- Population ratios in Tennessee exceed the national ratio for all of the medical imaging fields.

Description

The medical imaging field encompasses a range of occupations that primarily use noninvasive techniques to produce internal images of the body and to treat diseases. Imaging professionals operate in a variety of settings including hospitals, freestanding clinics, and outpatient clinics, where they provide medical imaging and therapeutic services. These occupations emerged from x-ray technology and evolved from using radiation to create a simple internal body image to methods as varied as using radionuclides, sound waves, and magnetic fields to visualize internal organs, bones, and tissues.

Imaging professions reported in this study include diagnostic radiologic technology (radiography), including computed tomography (CT) and magnetic resonance imaging (MRI); radiation therapy; nuclear medicine technology; and diagnostic medical sonography. Radiographers are also trained to perform specific studies on breast tissue and vascular tissues and to detect osteoporosis.

For the purposes of this section, these occupations are grouped as follows: (A) diagnostic radiologic technology, including CT and MRI; (B) radiation therapy; (C) nuclear medicine technology; and (D) diagnostic medical sonography.

Diagnostic Radiologic Technologist (including CT and MRI)

Description

Radiologic technologists, also referred to as radiographers, provide patient services using imaging equipment as directed by physicians qualified to order and/or perform radiologic procedures. For radiographers, a gradual shift has taken place toward expanded job responsibilities and increased diagnostic latitude. Radiologic technologists who perform imaging examinations are responsible for accurately positioning patients and ensuring that a quality diagnostic image is produced. They work closely with radiologists, the physicians who interpret medical images, to either diagnose or rule out disease or injury. For the images to be interpreted correctly by the radiologist, the imaging examination must be performed properly by a radiologic technologist

Educational Preparation

Over time, radiography programs, which are two or four years in length, have moved from being hospital-based to predominantly college-based programs. Graduates from 721 approved programs sat for the American Registry of Radiologic Technologists (ARRT) examination in 2008. This represents a 24 percent growth rate in the number of programs in five years.

The Joint Review Committee on Education in Radiologic Technology (JRCERT) accredited 585 programs in 2003, and as of August 2009 the number has grown to 628 radiography programs. Graduates from regionally accredited programs also qualify to sit for the ARRT examination, bringing the total of approved programs to 721 nationally (www.arrt.org, accessed August 8, 2009).

In 2002, programs prepared 8,168 graduates who sat for the ARRT examination. In 2004, there were 11,860 graduates, which represents a significant growth in only two years. The number rose to 14,210 in 2008, indicating a slowing rate of growth in the number sitting for the primary radiography examination from 2004 to 2008.

The ARRT offers 12 postprimary certifications for those with advanced preparation and training: mammography, computed tomography, magnetic resonance imaging (both a primary and postprimary track), quality management, bone densitometry, cardiac-interventional radiography, vascular-interventional radiography, cardiovascular-interventional radiography (no longer available for new candidates), sonography (both a primary and postprimary track), vascular sonography, breast sonography, and radiologist assistant (postprimary certificate).

In 2003, four universities began radiologist assistant (RA) programs: now there are nine. The RA is an advanced clinical role for an ARRT-certified radiographer. The two newest programs were added in August 2009—Bloomsburg and Quinnipiac. These programs support the RA initiative by preparing individuals who are eligible for ARRT's registered radiologist assistant certification program. The RA extends the capacity of the radiologist by performing patient assessment, patient management, and fluoroscopy and by making initial observations of diagnostic images.

To be recognized by ARRT, RA programs must meet recognition criteria that include accreditation, clinical education, and preceptorship requirements.

National Supply and Demand

According to the BLS, in 2008 there were 214,200 radiologic technologists and technicians working in the U.S. with 251,700 projected for 2018. The ARRT reports that today there are more than 290,000 registrants.

The *Journal of the American Society of Radiologic Technologists* reported in April 1999 that the "current rate of growth in the number of new RTs was not sufficient to replace normal attrition from the profession, let alone the impending large-scale declines due to retirements. The ARRT 2002 annual report indicated an overall increase of 9.6 percent in first-time candidates, which was the second consecutive increase. An increased growth rate of almost 25 percent was noted in 2004. The sharp increase of graduates seen over several years appears to have leveled off: the 2008 figure indicates slower growth in the number sitting for the primary radiography examination than had been seen in the previous four years. This may be due, in part, to economic conditions.

TABLE 3.1
Certificate History – National

Year	Radiography
1994	10,628
1995	10,330
1996	9,427
1997	8,691
1998	8,146
1999	7,595
2000	7,149
2001	7,434
2002	8,168
2003	7,595
2004	11,860
2005	13,200
2006	14,061
2007	14,142
2008	14,210

Source: ARRT Annual Report, 1994–2009.

Even with these increases, the BLS expects that employment of radiologic technologists will increase by about 17.2 percent from 2008 to 2018, which is faster than average for all occupations. Although hospitals remain the principal employers—more than 60 percent—a number of new jobs will be found in physician's offices and diagnostic imaging centers. The American Society of Radiologic Technologists (ASRT) continues to track vacancy rates to assess staffing levels in medical imaging departments nationwide. Their 2006 data showed that vacancy rates for most specialty areas fell for the third year in a row, narrowing the gap between supply and demand.

In the last edition of this study, it was reported that the Department of Labor estimated that the annual graduation rate would not satisfy the need created by increased demand and attrition and that 50,000 more radiologic technologists would be needed within the next 10 years. This is contradicted by a 2008 ASRT study of the labor workforce, which estimates that between 2006 and 2016 a total of about 69,671 radiographers—almost 25 percent more than the BLS-estimated need—will have been added to (and remain in) the labor pool of radiographers. The study also noted that 7 percent of radiography program directors plan to increase their enrollments and 9 percent plan to decrease them. Schools and employers should use ASRT's data to set admissions and recruitment policies and to forecast workforce trends (www.asrt.org/Media/pdf/Research/EnrollmentSurvey08.pdf, accessed August 9, 2009).

State Supply and Demand

There are currently 7,184 registered technologists in good standing with the ARRT who reside in Tennessee, with 7,032 who identify radiography as their primary area of practice (www.arrt.org/registration/rtcensus.htm, accessed August 9, 2009). The Tennessee Department of Labor and Workforce Development reports 6,235 employed in Tennessee during 2008.

The Joint Annual Review reports vacancy rates for hospitals by county. They reported a 13 percent vacancy rate for hospitals in Tennessee in the last edition of this study. Their latest report indicates only a 3.32 percent vacancy rate. Considering there were only 259 new technologists prepared in Tennessee during 2004 and over 372 new

technologists in 2008, the present supply of new technologists may change the occupational outlook for Tennessee in this field.

TABLE 3.2
Tennessee Registered Radiographers, 1989–2009

Year	Radiography
1988	2,997
1989	3,255
1990	3,446
1991	3,557
1992	3,907
1999	4,891
2003	5,367
2008	7,184
2009	7,032

Source: American Registry of Radiologic Technology, 1988–2009 annual reports.

In Tennessee, there are 15 radiography programs. Nine of the 15 offer an A.A.S. degree, and four offer a B.S. degree. These programs are located at Chattanooga State Technical Community College, Columbia State Community College, Volunteer State Community College, Jackson State Community College, Southwest Tennessee Community College, Roane State Community College, Med Vance Institute in Nashville and Cookeville; certificate programs are at the University of Tennessee Medical Center at Knoxville, Metropolitan Nashville General Hospital, and Methodist Healthcare in Memphis; and baccalaureate programs are at the Baptist College of Health Sciences in Memphis, Austin Peay State University in Clarksville, East Tennessee State University of Elizabethton, and South College in Knoxville.

TABLE 3.3
Tennessee Radiography Programs and Graduates, 1989–2008

Year	Programs	Graduates
1989	11	120
1990	11	172
1991	13	179
1992	13	189
1999	12	160
2001	11	148*
2004	12	259**
2008	15	372**

Source: THEC graduation data, 2002.
**Graduation rates from THEC*
***New registrant data, ARRT annual reports*

The ARRT annual report indicated that 179 candidates in Tennessee sat for the ARRT exam in 1999, and 202 candidates each year sat for the ARRT exam in 2000, 2001, and 2002. This represented no growth in supply for that three-year period in Tennessee. However, within the past five years four new programs have opened, and the state and class size for most programs are at capacity with record applicant pools. Tennessee is producing a record number of graduates, resulting in a low vacancy rate in this field. According to the JAR, which records only vacancies in hospitals, there was only a 3.3 percent vacancy rate in Tennessee in 2007 and 2.8 in 2008, with regional shortages in the Middle and West THA districts (Appendix D).

Postprimary examinations offered through the American Registry of Radiologic Technology include computed tomography (CT), magnetic resonance imaging (MRI), cardiovascular-interventional technology, mammography, quality management, sonography, vascular cardiac-interventional technology, vascular-interventional technology, and bone densitometry. Formal training programs for these areas have been initiated in some institutions that also offer entry-level programs. Chattanooga State, Volunteer State, and most of the B.S. programs offer either online or traditional programs of varying length in several of the postprimary areas.

A limited practice x-ray technician is allowed to practice in Tennessee. These personnel are prepared through a 40-clock-hour course approved through the Tennessee Board of Medical Examiners, and completers take a state exam. The limited areas of practice presently include examinations of the chest and extremities.

Technicians and technologists must be licensed to work in most office settings. The Tennessee Occupational Information System reports continued growth, with a 2 percent growth rate expected until 2010 for technicians.

The advanced practice practitioner in Tennessee, the radiologist assistant, is regulated by the Board of Medical Examiners under Medical Doctor for Medical Operators. No programs are available in middle Tennessee

According to the state economic outlook, this field in Tennessee is a competitive market. Occupations in this field report more training completers than job openings expected annually.

Summary

Tennessee is educating an adequate number of radiographers as indicated by hospital vacancy rate data, population ratio data, and state supply and demand data. National shortages are not being recorded; there is an increase in the number of radiography applicants and graduates. A telephone survey of the programs in Tennessee indicates they are at capacity for the number of funded faculty positions.

Tennessee has converted two programs to baccalaureate-level, and two new baccalaureate-level programs in radiography have opened. Baccalaureate-level programs are sources of graduates who may be potential faculty members or managers in this discipline. Local demands may change within a short period of time and may not always reflect state workforce data.

Radiation Therapist

Status

- Tennessee is educating an adequate supply of radiation therapist to meet the demand.
- There are three radiation therapy programs in Tennessee.
- In 2008, 29 graduates sat for the ARRT registration examination.
- The Tennessee population ratio exceeds the population ratio for this discipline nationally.

Description

Radiation therapists administer radiation treatments to patients using a planned design to treat cancers in the body that have been previously diagnosed. The progressive improvement in the technology has led to a gradual increase in both the cognitive abilities and the general knowledge necessary to perform the tasks.

Educational Preparation

The increase in role requirements caused the professional organization ASRT to support a minimum requirement of a bachelor's degree for entry into the field. Although many programs now offer a B.S. degree, no mandate by the ARRT has been approved. ARRT registration following completion of an accredited bachelor's degree, associate's degree, or certificate in radiation therapy is required for practice.

National Supply and Demand

According to the BLS, employment is expected to increase much faster than the average, growing 27.1 percent from 2008 to 2018 (2.7 percent annually), and job prospects should be good, with 19,400 projected employment. As the population grows and an increasing share is in the older age group, the number of people needing treatment is expected to increase and to spur demand for radiation therapists.

According to an ASRT 2009 staffing study, it is estimated that 7.6 percent of all FTEs budgeted for radiation therapists are currently vacant and recruiting: 8.2 percent of dosimetrist positions,

12.1 percent of medical physicist positions, 9.2 percent of radiation oncologist positions, 7.1 percent of nursing positions, 6.1 percent of ancillary staff positions, and 10.2 percent of administrative staff FTEs in U.S. radiation therapy facilities are unfilled. Staffing shortages could affect patient care and increase the number of hours worked and the quality of patient care. Current BLS data suggests that there are around 15,300 working radiation therapists, most of whom are in hospitals (www.asrt.org/media/pdf/research/RTTStaffingReport2009.pdf, accessed August 9, 2009).

In 1985, there were 101 accredited radiation therapy programs nationally. In 1990, the number increased to 104 programs. In 1995, there were 120 accredited programs nationally, but the number dropped to 71 in 2002. As of 2009, there were 80 programs although more total graduates are recorded.

TABLE 3.4
Radiation Therapy – National

Year	Programs	Graduates
1985	101	—
1990	104	—
1991	111	659
1992	121	792
1994	—	1,045
1998	84	388
1999	—	389
2000	80	399
2001	79	579
2002	71	652
2008	80	1,008

Source: Health Professions Education Directory, 1991–2002, Annual Report to Radiologic Technologists, www.arrt.org, accessed August 7, 2009.

State Supply and Demand

In 2008, there were 408 estimated radiation therapists in Tennessee. The number needed was projected to be 480 in 2016. This represents a growth rate of 2.4 percent. By May of 2009, there were 400 registered radiation therapists which equals the projected growth rate, and represents more than the projected need (www.arrt.org/registration/rtcensus.htm).

In 2009, there were three accredited radiation therapy programs in Tennessee. There are two certificate programs, which last 12 months: Chattanooga State Technical Community College and Vanderbilt University Medical Center. Vanderbilt is also affiliated with Middle Tennessee State University to offer a B.S. degree. Vanderbilt recently restarted their program after a two-year inactive period. A program leading to a B.S. degree is also offered at Baptist College of Health Sciences in Memphis.

According to the *Health Professions Education Data Book* for 2007–2008, 36 students graduated from these programs in Tennessee and qualified to sit for the radiation therapy ARRT registration examination. In 2008, 29 graduates sat for the ARRT examination in Tennessee.

Summary

Tennessee has made progress toward educating an adequate supply of radiation therapists. One of the three programs in the state is sponsored by a medical center, and one is at a public community college that prefers certification in radiography for admission. Although this add-on approach provides career change opportunities for the radiographer, the national trend has been to provide training for radiation therapists at the bachelor's or associate's degree for entry-level, with bachelor's degree programs showing the most growth.

According to the state economic outlook, this field in Tennessee is a competitive market. Occupations in radiation therapy report more training completers than job openings expected annually. Local demands may change within a short period of time and may not always reflect state workforce data.

Nuclear Medicine Technologist

Status

- There is no overall shortage of Nuclear Medicine Technologists in Tennessee, although regional shortages may still be reported.
- In 2008 there were 23 new ARRT Nuclear Medicine candidates in Tennessee.
- There are five border states for Tennessee and they produce fewer graduates in this area and may be recruiting from Tennessee's graduation pool.
- The BLS projects that the outlook for this discipline is excellent and in demand through the year 2018.

Description

Nuclear medicine technology is the medical specialty that uses the nuclear properties of radioactive nuclides to make diagnostic evaluations of the anatomic or physiologic conditions of the body and to provide therapy with unsealed radioactive sources. These procedures typically involve preparing radioactive substances or isotopes, administering them to patients, operating equipment that takes images of radioactive substances within the body, and reading the results. Nuclear medical technologists (NMTs) prepare stock solutions of radioactive materials and calculate doses to be administered. They execute blood volume, red cell survival, and fat absorption studies following standard laboratory procedures. They operate cameras that detect or map the radioactive drug in a patient's body to create diagnostic images. The images are produced on computer screens for a physician to interpret. The skills of nuclear medicine technologists complement those of nuclear medicine physicians and other professionals in the field.

Nuclear medicine technology has been dramatically altered by computer enhancement. At the same time, government regulation has continued to grow, increasing the knowledge that the technologist must have of regulatory areas and radioactive materials management. The use of new technologies such as CT, MRI, and Positron Emission Tomography (PET) has reduced the number and types of studies performed by the nuclear medicine technologist. The expanded

approval of PET by the Centers for Medicare and Medicaid Services will increase the use of this imaging technology but may reduce other nuclear medicine imaging studies.

Professional Education

The professional portion of the program is one to four years long. Institutions offering accredited programs may provide an integrated educational sequence leading to a certificate, an associate's degree, or a baccalaureate degree over one to four years. Courses cover physical sciences, the biological effects of radiation exposure, radiation protection and procedures, the use of radiopharmaceuticals, imaging techniques, and computer application. Certification is voluntary. The two organizations that currently certify technologists in nuclear medicine are the Nuclear Medicine Technology Certification Board (NMTCB) and the American Registry of Radiologic Technology (ARRT). Many NMTs will have both certifications.

The NMTCB was formed for the purpose of creating and maintaining examinations for nuclear medicine technologists. Since 1978, the NMTCB has offered a high-quality certification exam for NMTs. More recently, it has provided specialty exams for NMTs who have a high level of knowledge in nuclear cardiology (the NCT exam) and NMTs, radiographers, and radiation therapists who have a high level of knowledge in positron emission tomography (the PET exam).

To sit for the certification examination, the NMTCB requires that one graduate from a program accredited by the Joint Review Committee on Educational Programs in Nuclear Medicine Technology (JRCNMT) or the six regional accrediting bodies. In 2006, there were about 100 accredited programs in the continental United States and Puerto Rico.

National Supply and Demand

The Department of Labor has indicated that the supply of nuclear medicine technologists has varied widely. The supply of technologists increased rapidly in the 1980s but declined in the middle and late 1990s. Technological innovations such as positron emission tomography (PET) and single photon emission tomography (SPECT) have expanded the diagnostic uses of nuclear medicine.

Another example of this expansion is the use of radiopharmaceuticals in combination with monoclonal antibodies to detect cancer at far earlier stages and without resorting to surgery. Another is the use of radionuclides to examine the heart's ability to pump blood. Wider use of nuclear medical imaging to observe metabolic and biochemical changes for neurology, cardiology, and oncology procedures will also spur some demand for these professionals, according to the BLS.

According to the BLS, employment for NMTs is expected to grow faster than the average for all occupations through the year 2018. Growth will arise from an increase in the number of middle-aged and older persons who are the primary users of diagnostic procedures including nuclear medicine tests.

In 2008, there were 21,800 nuclear medicine technologists in the United States. Two-thirds were employed in hospitals, and the rest worked in physician's offices and diagnostic imaging centers.

In 1985, there were 141 accredited nuclear medicine technology programs, but this number dropped to 107 in 1990. The number rose in 1995 to 120 programs but dropped in 2002 to 92 accredited programs. There are 100 accredited programs in 2009, according to the Joint Review Committee on Education Programs in Nuclear Medicine Technology.

TABLE 3.5

U.S. Nuclear Medicine Technologists

Year	ARRT	NMTCB
1988	9,491	—
1989	9,784	—
1990	10,815	—
1993	11,022	—
1999	11,109	—
2000	—	—
2003	10,634	21,989
2008	12,678	25,230

Source: ARRT annual report of registered technologists, April 1999, 2001, 2003, 2009.

State Supply and Demand

Certification is voluntary; however, as of 2009 a total of 699 nuclear medicine technologists in Tennessee held certificates in NMTCB. According to the ARRT, there were 279 NMTs certified by the ARRT as of May 2009 who identified nuclear medicine technology as their primary practice. Two agencies provide certification/registration, ARRT and NMTCB, and practitioners often hold both. Accurate data on the total number of practitioners is not available.

In 2008, the estimated employment for nuclear medicine technologists in Tennessee was 558, and the number was projected to be 589 in 2018, representing an annual growth rate of 2.7 percent with 31 annual job openings.

In 2009, there were 40 new registrants from six nuclear medicine technology programs in Tennessee; 23 registered through ARRT and 35 certified through NMTCB. Many of these may hold dual certificates. Three programs are hospital-based and offer certificates and/or bachelor's degrees. Methodist Hospital of Memphis awards a certificate, Vanderbilt University Medical Center awards a certificate but articulates with several universities which offer the bachelor's degree upon completion, and the University of Tennessee Medical Center at Knoxville awards certificate and bachelor's degrees. One nonhospital-based program at Chattanooga State Technical Community College prefers the applicant be a radiographer and offers a certificate program. Baptist Memorial College of Health Sciences in Memphis offers a baccalaureate degree, and South College in Knoxville offers a certificate or baccalaureate degree.

There is no overall shortage of nuclear medicine technologists in Tennessee although some regions report vacancies. The supply of these professionals is currently provided by six programs that graduate a number equal to the projected state demand. The five border states produce fewer graduates in these areas and migration of Tennessee's graduates to other states may be occurring.

TABLE 3.6
Tennessee New ARRT Candidates

Year	Nuclear Medicine Technologist	Radiologic Technologist (Radiographer)	Radiation Therapist
1993	23	189	32
1998	30	160	13
1999	8	171	7
2000	8	202	9
2001	11	202	25
2002	37*	202	39
2008	23	372	29

Source: Telephone survey, ARRT.
**ARRT and NMTCB (some may hold both certifications)*
ARRT accessed December 2009

Summary

According to the BLS, the employment outlook for nuclear medical technologists is expected to grow faster than the average for all occupations through the year 2018. An increase in the number of middle-aged and older persons who are the primary users of diagnostic procedures, coupled with an increase in technological innovations that have expanded the diagnostic uses of nuclear medicine contribute to the growth rate of this occupational cluster. The outlook for this field in Tennessee is considered excellent and in demand with employers. Local demands may change within a short period of time and may not always reflect state workforce data. Most nuclear medicine technologists are employed in hospitals, with some working in physicians' offices and diagnostic imaging centers.

Diagnostic Medical Sonographer

Status

- Diagnostic medical sonography in Tennessee is being supplied by graduates of five accredited programs.
- Population ratio, although a crude measure of need, indicates that the number of sonographers in Tennessee exceed the national ratio.
- Since licensure is not required in this field in Tennessee, an accurate recording of those in practice in Tennessee is difficult to determine.
- Anecdotal reports by hospital departments of human resources indicate shortages in less metropolitan areas.
- BLS data predicts that this field will continue to grow, although at a slightly less rate than in the past.

Description

Sonographers, also known as ultrasound technologists , provide imaging services using directing no ionizing high frequency sound waves into areas of the patients body. Sonographers have a high degree of autonomy in performing and evaluating the images, using critical thinking and eye hand coordination to produce and evaluate the images. The low cost, high accuracy, and improved computerized reconstruction of real time imaging, makes it a procedure of choice for many diagnostic studies.

Sonography can be used to examine many parts of the body, such as the abdomen, breasts, female reproductive system, prostate, heart and blood vessels, and more. Sonographers explain the procedure, record additional medical history, and then position the patient for testing. Viewing the screen as the scan takes place, sonographers look for subtle differences between healthy and pathological areas, decide which images to include, and judge whether the images are satisfactory for diagnostic purposes. Sonographers may specialize in abdomen, breast, neurosonology, obstetrics and gynecology; adult and pediatric echocardiography (RDCS); or noninvasive vascular technology (RVT). The relative low risk of the procedure makes it a choice for diagnosis during pregnancy. The low cost and high accuracy makes it a procedure of choice in many other areas.

The rapid growth of high-frequency ultrasound and real-time imaging for diagnostic purposes has demonstrated a need for quality education in this field. The initiation of prospective payment systems fostered the establishment of freestanding imaging centers and satellite diagnostic centers. An increasing number of private offices installing ultrasound scanners for their own use has increased the demand for highly trained sonographers.

The net effect of new providers and the expanded use of this modality has resulted in a marked increase in the number of patients being examined with ultrasound because of the reduced risks associated with the imaging modality.

Educational Preparation

Program length ranges from one to four years. In 2008, there were about 50,300 diagnostic medical sonographers. More than half worked in hospitals. Many sonographers, like radiologic technologists, have moved from hospitals to outpatient practices. Ultrasound has been used in medical diagnosis since 1970, and training initially consisted of one or two weeks of in-hospital instruction. Because licensure to practice is not required, sonographers often are still trained in short programs that are started and stopped based on local need, making determination of supply and demand difficult. There are four-year programs that result in certificate or baccalaureate degrees. One-year programs are for applicants who already possess qualifications in a clinically related allied health profession.

National Supply and Demand

In 2000, there were 38,594 diagnostic medical sonographers, and in 2008 there were 50,300 according to the BLS. Projected employment in 2018 is 59,500, a projected increase of 18.3 percent. More than half worked in hospitals. Many sonographers, like radiologic technologists, have moved from hospitals to outpatient practices.

There are 168 programs accredited by the Commission on Accreditation of Allied Health Education Programs (CAAHEP), reflecting an increase from 147 programs in 2006 (www.caahep.org/Find-An-Accredited-Program/, accessed August 10, 2009).

Sonographers can obtain national credentialing from the American Registry of Diagnostic Medical Sonographers (ARDMS), Cardiovascular Credentialing International (CCI), or the American Registry of Radiologic Technologists (ARRT). Although certification is not nationally required, the ARDMS recorded 18,264 registered sonographers in June 1993 and 38,594 in March 2000. This represents a significant increase in the use of the imaging modality and a trend toward more persons in the occupation seeking national certification.

From 1988 to 1998, the number of sonography programs nationally grew from 34 to 77, an increase of over 100 percent. Now, more than 168 programs are accredited

TABLE 3.7
U.S. Diagnostic Medical Sonography Programs, 1988–2009

Year	Total Programs	Total Enrollment	Graduates
1988	34	461	264
	38	567	316
	43	635	338
	47	887	443
	56	977	565
1998	77	1,366	730
	96	1,452	829
	147	—	—
2009	168	—	—

Source: AMA Allied Health Education Fact Sheet, 1990 and 1992; Allied Health Education Directory, 1993; and AMA Health Professions Education Directory, 1999–2000, 2003–2004, 2009.

State Supply and Demand

Many sonographers have been trained on the job and are not registered. 2009 data from ARDMS shows 1,263 in Tennessee holding certification. The 2008 estimated employment is around 1,292, and that number is expected to increase to 1,366 by 2010. This shows a 2.8 percent annual percent change, while the national growth rate is projected to be 1.8 percent. The Tennessee Department of Employment Security does not keep figures on supply and demand

in this category. Local demands may change within a short period of time and may not always reflect workforce data.

Tennessee has five accredited sonography programs: Chattanooga State Technical Community College offers a certificate based on a 12-month program. The program alternates between instruction in general sonography and echocardiography/vascular sonography. Baptist Memorial College of Health Sciences in Memphis offers a bachelor's degree preparing students for general sonography and vascular and echocardiography sonography. Methodist Le Bonheur Healthcare in Memphis offers a 15-month certificate for general sonography and echocardiography sonography. Vanderbilt University in Nashville offers an 18-month certificate in general sonography. Volunteer State Community College in Gallatin offers a 15-month certificate program in general sonography.

Summary

While statewide statistics help clarify the supply and demand situation, consideration must be given to the mobility of graduates, which contributes to regional shortages. Sonography is showing growth, and this growth is being met in Tennessee by five accredited programs and local training opportunities. Directors of human resources have reported shortages across the state. Since neither registration nor licensure is required, the supply/demand data is difficult to assess except through anecdotal reports of shortages from hospital human resource officers. Local demands may change within a short period of time and may not always reflect state workforce data.

Laboratory Services

Clinical laboratory services professions include **medical technologist**, **medical laboratory technician**, and **phlebotomist**. All perform a wide array of tests that are used to help physicians prevent, detect, diagnose, and treat diseases. Phlebotomists are limited-practice, certificate-prepared practitioners who draw blood for lab analysis and collect blood samples. Technologists are expected to recognize the interdependency of tests and have knowledge of physiological conditions affecting test results that allows them to confirm results and develop data useful to a physician in determining the presence, extent, and (as far as possible) the cause of disease. Generally, technicians perform routine tests under the supervision or direction of pathologists or other physicians, scientists, or experienced medical technologists.

Status

- New, more powerful diagnostic tests will encourage more testing and spur employment.
- The surge of retiring baby boomers from the ranks of laboratory personnel poses yet another staffing challenge for the clinical laboratory field. It is estimated that an average of 13 percent of current laboratory staff is likely to retire within the next five years.
- National shortages in laboratory personnel are becoming significant according to the results of a survey conducted by the American Society of Clinical Pathologists' Board of Registry.
- Tennessee's hospital vacancy rate for medical technologists and medical technicians is 3.8 percent statewide for 2008. Local vacancy rates vary and are reported by county (Appendix D).
- Nationally there has been a dramatic decline in medical technology programs. Tennessee State University has announced that they will close their program.

Description

Laboratory testing plays a crucial role in the detection, diagnosis, and treatment of disease by examining and analyzing body fluids and cells. Personnel look for bacteria, parasites, and other microorganisms; analyze the chemical components of fluids; match blood for transfusions; and test for drug levels in the blood that show how a patient is responding to treatment.

Laboratory technologists are also referred to as laboratory scientists or medical technologists (MTs). Laboratory technicians are also known as medical technicians or medical laboratory technicians (MLTs). All perform a wide array of tests that are used to help physicians prevent, detect, diagnose, and treat diseases. The generalized medical technologist is the most widely recognized practitioner in this field, but there are many specialties within the field: cytotechnologists (CTs) specialize in cytotechnology (the study of body cells), specialists in blood banking specialize in hematology (the study of blood), and histotechnicians/histotechnologists (HTs/HTLs) specialize in histology (the study of tissue specimens). Others include laboratory assistants (LAs) and pathologist assistants (PAs).

The laboratory services occupations surveyed for this report include medical technologist, medical laboratory technician, and phlebotomist.

Educational Preparation

Laboratory technologists (medical technologists) and laboratory technicians (medical laboratory technicians) are divided into two broad categories: (1) baccalaureate-prepared technologists and (2) technicians who are prepared with associate degrees or certificates. Technologists are expected to recognize the interdependency of tests and have knowledge of physiological conditions affecting test results that allows them to confirm results and develop data useful to a physician in determining the presence, extent, and (as far as possible) the cause of disease. Generally, technicians perform routine tests under the supervision or direction of pathologists or other physicians, scientists, or experienced medical technologists.

There are three models for training medical technologists: the university-based model, the hospital-based model, and university/

hospital partnerships. University-based programs educate baccalaureate-prepared technologists and develop relationships with area hospitals to provide appropriate clinical practicum opportunities. Hospital-based programs accept students with B.S. degrees and certain prerequisites into a one-year professional curriculum. Sponsored by hospitals or clinics that hold the program accreditation, partnership programs develop 3 plus 1 agreements with universities that provide three years of preprofessional academic preparation with the hospital or clinic that provides the fourth year of professional curriculum, and the degree is awarded by the university.

Medical laboratory technicians are prepared at the associate degree or certificate program level. Sponsored by community/technical colleges or hospitals, these graduates complete one- or two-year programs. These technicians perform less complex laboratory procedures than technologists do.

Phlebotomists are limited-practice, certificate-prepared practitioners who draw blood for lab analysis and collect blood samples. Programs for the education of phlebotomists may be started or discontinued based on local need. Little information is available on national supply and demand. The one phlebotomist program in Tennessee is at Southwest Tennessee Community College.

Other occupations in this category include cytotechnologist, blood bank technologist, and histologic technician/technologist. The numbers of positions needed in these categories are relatively small, and programs usually address a specific regional need. No programs in Tennessee are available for specialists in blood bank technology or for histologic technicians or technologists. There is a cytotechnologist program at the University of Tennessee Health Science Center in Memphis that lasts 12 months after three years of general studies and prerequisites and awards a B.S. degree.

National Supply and Demand

In 2008, there were an estimated 328,100 laboratory technologists and technicians employed in the United States, more than half of whom worked in hospitals.

Technological advances have two opposing effects on employment and will continue to have those effects through 2018

with a growth rate of 13.9 percent (1.4 percent annually) for both laboratory technologists and laboratory technicians according to the BLS. New, more powerful diagnostic tests will encourage more testing and spur employment. However, advances in genomics and laboratory automation are redefining the workforce skills necessary to meet the demand of tomorrow's laboratories.

The surge of retiring baby boomers from the ranks of laboratory personnel poses yet another staffing challenge for the clinical laboratory field. According to laboratory managers, it is estimated that an average of 13 percent of current laboratory staff is likely to retire within the next five years.

A biannual survey sponsored by the American Society of Clinical Pathologists (ASCP) showed that job vacancy rates are high in medical laboratories. The data presented in Table 3.8 includes hospital, blood bank, clinic, and independent clinical medical laboratories. ASCP has targeted recruitment of qualified students and retention of practicing professionals as ways to reduce shortages.

TABLE 3.8
National Vacancy Rates for Clinical Laboratory Positions, 1988–2009

	1988	1990	1994	1996	1998	2002	2009
Medical Technologists							
Staff	9.3	11.6	9.6	8.2	10.2	7.2	10.4
Supervisor	5.0	10.2	10.3	8.6	9.3	5.8	1.4
Manager	5.2	7.1	15.4	7.7	15.4	3.1	3.7
Medical Lab Technicians	6.5	11.1	14.8	12.5	12.3	8.3	6.4
Phlebotomists	8.2	12.2	14.8	12.5	12.3	9.0	5.9
Cytotechnologists	13.6	27.3	19.2	7.1	10.5	6.3	4.8
Histologic Technologists	—	14.3	17.4	5.3	10.3	10.9	8.0
Histologic Technicians	6.2	9.5	8.7	13.0	12.9	9.1	7.2

Source: American Society of Clinical Pathologists, 1999 and 2002, "Hospital Vacancy Rates"; LabMedicine, March 2009, www.ascp.org/pdf/Membership-Communications/Wage-and-Vacancy-Survey.aspx, accessed August 24, 2009.

The decline in the number of medical technology (MT) programs, as shown in Table 3.10, has been dramatic. In the seven-year period from 1984 to 1991, 205 programs closed, resulting in a decline from 615 programs to 410. From 1990 to 1992, ten programs closed. In 1998, there were 288 active programs; by 2003, the number of active programs had declined to 254. Today the decline continues. There were 223 CLS/MT programs in the U.S. in 2009.

Medical laboratory technician (MLT) programs increased by 21.3 percent in the 10-year period from 1981 to 1991. From 1991 to 1998, the number of programs fluctuated and in 1998 returned to approximately the same number that existed in the early 1990s. Some increase in the number of programs was seen from 2002 to 2003 but by 2009 the number of programs had declined to 203 programs.

TABLE 3.9

U.S. Trends in Clinical Laboratory Programs: Number of Programs

Year	CLS/Medical Technologist	CLT/Medical Lab Technician
1971	773	212
1976	696	191
1981	640	211
1986	516	261
1991	410	256
1992	404	255
1995	357	223
1998	288	249
2002	238	222
2003	254	226
2009	223	203

Source: SREB Dat-Ex, 1993; Health Professions Education Directory, 1999; Health Professions Education Data Book, 2003–2004, 2009, www.naacls.org/search/programs.asp, accessed August 24, 2009.

TABLE 3.10
U.S. Clinical Laboratory Graduates

Year	Medical Technologist	Medical Lab Technician
1989	3,148	2,292
1990	3,024	2,292
1991	2,932	2,437
1992	3,201	2,559
1998	2,667	2,412
2002	1,836	1,961
2007	2,706	2,416

Source: Allied Health Education Directory, 1993; Health Professions Education Directory, 1999; Health Professions Education Data Book, 2003–2004; NAACLS Survey Data, 2007

According to the March 2009 issue of *LabMedicine*, the ASCP Wage and Vacancy Survey of U.S. Medical Laboratories reported the overall vacancy rate for staff-level certified MTs was 10.4 percent, the highest across all the surveyed positions. The MLT staff-level position vacancy rate was 6.4 percent. In 2008 there were 4,233 medical technologists and 5,077 medical technicians employed in Tennessee according to "The Source."

State Supply and Demand

Using a projection matrix, the number of medical technologists projected to be needed in 2010 is 4,452 and in 2014 is 4,860. The estimated number of medical and clinical laboratory technicians needed in Tennessee for 2014 is 5,520 and in 2016 is 3,979 (www.state.tn.us/labor-wfd/outlooks/statewide.pdf).

Licensure information for each category is found in Table 3.11.

TABLE 3.11
Number of Licensed Medical and Clinical Laboratory Technologists and Medical and Clinical Laboratory Technicians

Year	Medical and Clinical Laboratory Technologists	Medical and Clinical Laboratory Technicians
1999	2,128	1,716
2000	2,737	1,980
2001	2,664	1,952
2002	2,562	1,942
2003	2,499	1,941
2004	2,471	1,957
2005	1,873	1,523
2009	4,233	3,781

Source: Tennessee Department of Labor and Workforce Development, "The Source," accessed December 16, 2009. "Licensed" refers to the number holding active licenses as of the date data was accessed for the years 1996–2008. 2009 data from the Tennessee Department of Health, Health Professional Licensing Reports, accessed December 16, 2009. "Licensed" for the year 2009 refers to the number holding active licenses as of the date data was accessed.

There are six programs for laboratory scientists/medical technologists (CLS/MT) in Tennessee. Vanderbilt University Medical Center offers a certificate, and the program lasts 12 months. Austin Peay State University and the University of Tennessee Medical Center at Knoxville offer certificates and B.S. degrees. These programs last 12 or 13 months. Lincoln Memorial University and Tennessee State University offer B.S. degrees, though the program at Tennessee State University is expected to close. University of Tennessee Health Science Center in Memphis offers a B.S. degree through a 21-month program and an M.S. degree through a 48-month program.

There are six programs for laboratory technicians/medical laboratory technicians (CLT/MLT, associate degree) in Tennessee. These programs are at MedVance Institute in Cookeville, Northeast State Technical Community College, Jackson State Community College, and Southwest Tennessee Community College. (Both Roane State Community College and Columbia State Community College discontinued their programs in 2000 due to budget cuts and enrollment issues.) These programs offer A.A.S. degrees and last between 18 and 24 months.

According to the *Health Professions Education Data Book*, 2007–2008, Tennessee graduated 62 medical technologists and 60 medical laboratory technicians in 2005–2006.

In 2001, hospital vacancy rates in Tennessee were 13 percent, according to a THA study. The 2007 JAR data identifies a vacancy rate of 7.92 percent for 2007 and 3.8 percent for 2008, which is less than the national average but still indicates the difficulty in recruitment for this category of hospital employment. The JAR data indicates a vacancy rate of 12.8 percent in the THA's South Middle district and some counties are reporting up to 50 percent vacancies.

For laboratory technologists, the outlook for this field in Tennessee is very good, and occupations in this field are expected to be in demand with employers with positive growth. There are more job openings expected annually than there were training completers in a recent year. For laboratory technicians, the outlook in Tennessee is excellent and in demand with employers, The growth rate is positive, and there are more job openings expected annually than there were training completers in a recent year. There is no demand data available for phlebotomists.

Summary

The licensure data indicates a continued increase in the number of technologists employed in Tennessee in both the MT and MLT categories. Austin Peay State University has increased its enrollment capacity due to outside funding and partnership with the Tennessee Hospital Association. Other creative partnerships with clinical agencies and academic institutions have been employed to reduce the vacancy rate for these categories. Local demands may change within a short period of time and may not always reflect state workforce data.