

animals. However, the level of training required for these occupations is substantially less than that needed by veterinarians.

### Sources of Additional Information

For additional information on careers in veterinary medicine and a list of U.S. schools and colleges of veterinary medicine and accreditation policies, send a letter-size, self-addressed, stamped envelope to:

► American Veterinary Medical Association, 1931 N. Meacham Rd., Suite 100, Schaumburg, IL 60173-4360. Internet: <http://www.avma.org>

For information on veterinary education, write to:

► Association of American Veterinary Medical Colleges, 1101 Vermont Ave. NW., Suite 710, Washington, DC 20005. Internet:

<http://www.aavmc.org>

For information on scholarships, grants, and loans, contact the financial aid officer at the veterinary schools to which you wish to apply.

## Health Technologists and Technicians

### Cardiovascular Technologists and Technicians

(O\*NET 29-2031.00)

#### Significant Points

- Employment will grow faster than the average, but the number of job openings created will be low, because the occupation is small.
- Job prospects will be good due to an aging population and increased need for vascular technology and sonography as an alternative for more costly and invasive heart surgery.
- About 7 out of 10 jobs are in hospitals, in both inpatient and outpatient settings.

#### Nature of the Work

Cardiovascular technologists and technicians assist physicians in diagnosing and treating cardiac (heart) and peripheral vascular (blood vessel) ailments. Cardiovascular technologists may specialize in three areas of practice: Invasive cardiology, echocardiography, and vascular technology. Cardiovascular technicians who specialize in electrocardiograms (EKGs), stress testing, and Holter monitors are known as *cardiographic* or *EKG technicians*.

Cardiovascular technologists specializing in invasive procedures are called *cardiology technologists*. They assist physicians with cardiac catheterization procedures in which a small tube, or catheter, is wound through a patient's blood vessel from a spot on the patient's leg into the heart. The procedure can determine if a blockage exists in the blood vessels that supply the heart muscle and help diagnose other problems. Part of the procedure may involve balloon angioplasty, which can be used to treat blockages of blood vessels or heart valves, without the need for heart surgery. Cardiology technologists assist physicians as they insert a catheter with a balloon on the end to the point of the obstruction.

Technologists prepare patients for cardiac catheterization and balloon angioplasty by first positioning them on an examining table and then shaving, cleaning, and administering anesthesia to the top of the patient's leg near the groin. During the procedures, they monitor patients' blood pressure and heart rate using EKG equipment and notify the physician if something appears wrong. Technologists also may prepare and monitor patients during open-heart surgery and the implantation of pacemakers.

Cardiovascular technologists who specialize in echocardiography or vascular technology often run noninvasive tests using ultrasound instrumentation, such as doppler ultrasound. Tests are called

"noninvasive" if they do not require the insertion of probes or other instruments into the patient's body. The ultrasound instrumentation transmits high frequency sound waves into areas of the patient's body and then processes reflected echoes of the sound waves to form an image. Technologists view the ultrasound image on a screen that may be recorded on videotape or photographed for interpretation and diagnosis by a physician. While performing the scan, technologists check the image on the screen for subtle differences between healthy and diseased areas, decide which images to include, and judge if the images are satisfactory for diagnostic purposes. They also explain the procedure to patients, record additional medical history, select appropriate equipment settings, and change the patient's position as necessary. (See the statement on diagnostic medical sonographers elsewhere in the *Handbook* to learn more about other sonographers.)

Those who assist physicians in the diagnosis of disorders affecting circulation are known as *vascular technologists* or *vascular sonographers*. They perform a medical history and evaluate pulses by listening to the sounds of the arteries for abnormalities. Then they perform a noninvasive procedure using ultrasound instrumentation to record vascular information, such as vascular blood flow, blood pressure, limb volume changes, oxygen saturation, cerebral circulation, peripheral circulation, and abdominal circulation. Many of these tests are performed during or immediately after surgery.

Technologists who use ultrasound to examine the heart chambers, valves, and vessels are referred to as *cardiac sonographers*, or *echocardiographers*. They use ultrasound instrumentation to create images called echocardiograms. This may be done while the patient is either resting or physically active. Technologists may administer medication to a physically active patient to assess their heart function. Cardiac sonographers may also assist physicians who perform transesophageal echocardiography, which involves placing a tube in the patient's esophagus to obtain ultrasound images.

Cardiovascular technicians who obtain EKGs are known as *electrocardiograph* (or *EKG*) *technicians*. To take a basic EKG, which traces electrical impulses transmitted by the heart, technicians attach electrodes to the patient's chest, arms, and legs, and then manipulate switches on an EKG machine to obtain a reading. A printout is made for interpretation by the physician. This test is done before most kinds of surgery and as part of a routine physical examination, especially for persons who have reached middle age or have a history of cardiovascular problems.

EKG technicians with advanced training perform Holter monitor and stress testing. For Holter monitoring, technicians place electrodes on the patient's chest and attach a portable EKG monitor to the patient's belt. Following 24 or more hours of normal activity for the patient, the technician removes a tape from the monitor and places it in a scanner. After checking the quality of the recorded impulses on an electronic screen, the technician usually prints the

information from the tape so that a physician can interpret it later. Physicians use the output from the scanner to diagnose heart ailments, such as heart rhythm abnormalities or problems with pacemakers.

For a treadmill stress test, EKG technicians document the patient's medical history, explain the procedure, connect the patient to an EKG monitor, and obtain a baseline reading and resting blood pressure. Next, they monitor the heart's performance while the patient is walking on a treadmill, gradually increasing the treadmill's speed to observe the effect of increased exertion. Like vascular technologists and cardiac sonographers, cardiographic technicians who perform EKG, Holter monitor, and stress tests are known as "noninvasive" technicians.

Some cardiovascular technologists and technicians schedule appointments, type doctor interpretations, maintain patient files, and care for equipment.

### Working Conditions

Technologists and technicians generally work a 5-day, 40-hour week that may include weekends. Those in catheterization labs tend to work longer hours and may work evenings. They also may be on call during the night and on weekends.

Cardiovascular technologists and technicians spend a lot of time walking and standing. Those who work in catheterization labs may face stressful working conditions, because they are in close contact with patients with serious heart ailments. Some patients,



About 7 out of 10 cardiovascular technologists and technicians work in hospitals.

for example, may encounter complications from time to time that have life or death implications.

### Employment

Cardiovascular technologists and technicians held about 39,000 jobs in 2000. Most worked in hospital cardiology departments, whereas some worked in offices of cardiologists or other physicians, cardiac rehabilitation centers, or ambulatory surgery centers.

### Training, Other Qualifications, and Advancement

Although a few cardiovascular technologists, vascular technologists, and cardiac sonographers are currently trained on the job, most receive training in 2- to 4-year programs. Cardiovascular technologists, vascular technologists, and cardiac sonographers normally complete a 2-year junior or community college program. One year is dedicated to core courses followed by a year of specialized instruction in either invasive, noninvasive cardiovascular, or noninvasive vascular technology. Those who are qualified in a related allied health profession only need to complete the year of specialized instruction.

Graduates from the 23 programs accredited by the Joint Review Committee on Education in Cardiovascular Technology are eligible to obtain professional certification through Cardiovascular Credentialing International in cardiac catheterization, echocardiography, vascular ultrasound, and cardiographic techniques. Cardiac sonographers and vascular technologists may also obtain certification with the American Registry of Diagnostic Medical Sonographers.

For basic EKGs, Holter monitoring, and stress testing, 1-year certificate programs exist; but most EKG technicians are still trained on the job by an EKG supervisor or a cardiologist. On-the-job training usually lasts about 8 to 16 weeks. Most employers prefer to train people already in the health care field—nursing aides, for example. Some EKG technicians are students enrolled in 2-year programs to become technologists, working part-time to gain experience and make contact with employers.

Cardiovascular technologists and technicians must be reliable, have mechanical aptitude, and be able to follow detailed instructions. A pleasant, relaxed manner for putting patients at ease is an asset.

### Job Outlook

Employment of cardiovascular technologists and technicians is expected to grow faster than the average for all occupations through the year 2010. Growth will occur as the population ages, because older people have a higher incidence of heart problems. Employment of *vascular technologists* and *echocardiographers* will grow as advances in vascular technology and sonography reduce the need for more costly and invasive procedures. Employment of *EKG technicians* is expected to decline, as hospitals train nursing aides and others to perform basic EKG procedures. Individuals trained in Holter monitoring and stress testing are expected to have more favorable job prospects than those who can only perform a basic EKG.

Some job openings for cardiovascular technologists and technicians will arise from replacement needs, as individuals transfer to other jobs or leave the labor force. Relatively few job openings, due to both growth and replacement needs are expected, however, because the occupation is small.

### Earnings

Median annual earnings of cardiovascular technologists and technicians were \$33,350 in 2000. The middle 50 percent earned between \$24,590 and \$43,450. The lowest 10 percent earned less than \$19,540, and the highest 10 percent earned more than \$52,930.

Median annual earnings of cardiovascular technologists and technicians in 2000 were \$33,100 in offices and clinics of medical doctors and \$32,860 in hospitals.

### Related Occupations

Cardiovascular technologists and technicians operate sophisticated equipment that helps physicians and other health practitioners diagnose and treat patients. So do diagnostic medical sonographers, nuclear medicine technologists, radiation therapists, radiologic technologists and technicians, and respiratory therapists.

### Sources of Additional Information

For general information about a career in cardiovascular technology, contact:

➤ Alliance of Cardiovascular Professionals, 4456 Corporation Ln., Suite 165, Virginia Beach, VA 23462. Internet:

<http://www.acp-online.org/index.html>

For a list of accredited programs in cardiovascular technology, contact:

➤ Joint Review Committee on Education in Cardiovascular Technology, 3525 Ellicott Mills Dr., Suite N, Ellicott City, MD 21043-4547. Internet:

<http://www.sicp.com/jrc-cvt>

For information on vascular technology, contact:

➤ The Society of Vascular Technology, 4601 Presidents Dr., Suite 260, Lanham, MD 20706-4365. Internet: <http://www.svtnet.org>

For information on echocardiography, contact:

➤ American Society of Echocardiography, 4101 Lake Boone Trail, Suite 201, Raleigh, NC 27607. Internet: <http://www.asecho.org>

For information regarding registration and certification, contact:

➤ Cardiovascular Credentialing International, 4456 Corporation Ln., Suite 110, Virginia Beach, VA 23462. Internet: <http://www.cci-online.org>

➤ American Registry of Diagnostic Medical Sonographers, 600 Jefferson Plaza, Suite 360, Rockville, MD 20852-1150. Internet: <http://www.ardms.org>

## Clinical Laboratory Technologists and Technicians

(O\*NET 29-2011.00, 29-2012.00)

### Significant Points

- Clinical laboratory technologists usually have a bachelor's degree with a major in medical technology or in one of the life sciences; clinical laboratory technicians need either an associate's degree or a certificate.
- Employment is expected to grow as fast as average as the volume of laboratory tests increases with population growth and the development of new types of tests.

### Nature of the Work

Clinical laboratory testing plays a crucial role in the detection, diagnosis, and treatment of disease. Clinical laboratory technologists, also referred to as *clinical laboratory scientists* or *medical technologists*, and clinical laboratory technicians, also known as *medical technicians* or *medical laboratory technicians*, perform most of these tests.

Clinical laboratory personnel examine and analyze body fluids, tissues, and cells. They look for bacteria, parasites, and other microorganisms; analyze the chemical content of fluids; match blood for transfusions; and test for drug levels in the blood to show how a patient is responding to treatment. These technologists also prepare

specimens for examination, count cells, and look for abnormal cells. They use automated equipment and instruments capable of performing a number of tests simultaneously, as well as microscopes, cell counters, and other sophisticated laboratory equipment. Then, they analyze the results and relay them to physicians. With increasing automation and the use of computer technology, the work of technologists and technicians has become less hands-on and more analytical.

The complexity of tests performed, the level of judgment needed, and the amount of responsibility workers assume depend largely on the amount of education and experience they have.

*Medical and clinical laboratory technologists* generally have a bachelor's degree in medical technology or in one of the life sciences, or they have a combination of formal training and work experience. They perform complex chemical, biological, hematological, immunologic, microscopic, and bacteriological tests. Technologists microscopically examine blood, tissue, and other body substances. They make cultures of body fluid and tissue samples, to determine the presence of bacteria, fungi, parasites, or other microorganisms. They analyze samples for chemical content or reaction and determine blood glucose and cholesterol levels. They also type and cross match blood samples for transfusions.

Medical and clinical laboratory technologists evaluate test results, develop and modify procedures, and establish and monitor programs, to ensure the accuracy of tests. Some medical and clinical laboratory technologists supervise medical and clinical laboratory technicians.



Laboratory technologists and technicians examine and analyze body fluids, tissues, and cells.