Medical Scientists

(O*NET 19-1041.00, 19-1042.00)

Significant Points

- Most medical scientists need a Ph.D. in a biological science; some hold a medical degree.
- Epidemiologists typically need a master's degree in public health or, in some cases, a Ph.D. or medical degree.
- Competition is expected for most positions; however, those with both a Ph.D. and M.D. are likely to have very good opportunities.

Nature of the Work

Medical scientists research human diseases to improve human health. Most medical scientists conduct biomedical research and development to advance knowledge of life processes and living organisms, including viruses, bacteria, and other infectious agents. Past research has resulted in advances in diagnosis, treatment, and prevention of many diseases. Basic medical research continues to build the foundation for new vaccines, drugs, and treatment procedures. Medical scientists engage in laboratory research, clinical investigation, technical writing, drug application review, and related activities.

Medical scientists study biological systems to understand the causes of disease and other health problems. They develop treatments and design research tools and techniques that have medical applications. Some try to identify changes in cells or in chromosomes that signal the development of medical problems. For example, medical scientists involved in cancer research may formulate a combination of drugs that will lessen the effects of the disease. Medical scientists who are also physicians can administer these drugs to patients in clinical trials, monitor their reactions, and observe the results. They may draw blood, excise tissue, or perform other invasive procedures. Those who are not physicians normally collaborate with physicians who deal directly with patients. Medical scientists examine the results of clinical trials and adjust the dosage levels to reduce negative side effects or to induce better results. In addition to developing treatments for medical conditions, medical scientists attempt to discover ways to prevent health problems. For example, they may study the link between smoking and lung cancer or between alcoholism and liver disease.

Medical scientists who work in applied research or product development use knowledge discovered through basic research to develop new drugs and medical treatments. They usually have less autonomy than basic medical researchers do to choose the emphasis of their research. They spend more time working on marketable treatments to meet the business goals of their employers. Medical scientists doing applied research and product development in private industry may also be required to explain their research plans or results to nonscientists who are in a position to reject or approve their ideas. These scientists must consider the business effects of their work. Scientists increasingly work as part of teams, interacting with engineers, scientists of other disciplines, business managers, and technicians.

Swift advances in basic medical knowledge related to genetics and organic molecules have spurred growth in the field of biotechnology. Discovery of important drugs, including human insulin and growth hormone, is the result of research using biotechnology techniques, such as recombining DNA. Many other substances not previously available in large quantities are now produced by biotechnological means; some may one day be useful in treating diseases such as Parkinson's or Alzheimer's. Today, many medical scientists are involved in the science of genetic engineering—isolating, identifying, and sequencing human genes to determine their functions. This work continues to lead to the discovery of genes associated with specific diseases and inherited health risks, such as sickle cell anemia. These advances in biotechnology have opened up research opportunities in almost all areas of medical science.

Some medical scientists specialize in epidemiology. This branch of medical science investigates and describes the causes and spread of disease and develops the means for prevention or control. Epidemiologists may study many different illnesses, often focusing on major infectious diseases such as influenza or cholera. Epidemiologists can be separated into two groups—research and clinical.

Research epidemiologists conduct research in an effort to eradicate or control infectious diseases. Many work on illnesses that affect the entire body, such as AIDS or typhus, while others focus on localized infections such as those of the brain, lungs, or digestive tract. Research epidemiologists work at colleges and universities, schools of public health, medical schools, and independent research firms. For example, Federal Government agencies, such as the U.S. Department of Defense, may contract with a research firm to evaluate the incidence of malaria in certain parts of the world. Other research epidemiologists may work as college and university faculty and are counted as postsecondary teachers.

Clinical epidemiologists work primarily in consulting roles at hospitals, informing the medical staff of infectious outbreaks and providing containment solutions. These epidemiologists sometimes are referred to as infection control professionals, and some of them are also physicians. Clinical epidemiologists who are not also physicians often collaborate with physicians to find ways to contain outbreaks of diseases. In addition to traditional duties of studying and controlling diseases, clinical epidemiologists also may be required to develop standards and guidelines for the treatment and control of communicable diseases. Some clinical epidemiologists may work in outpatient settings.

Work environment. Many medical scientists work independently in private industry, university, or government laboratories, exploring new areas of research or expanding on specialized research that they began in graduate school. Medical scientists working in colleges and universities, hospitals, and nonprofit medical research organizations typically submit grant proposals to obtain funding for their projects. Colleges and universities, private industry, and Federal Government agencies—particularly the National Institutes of Health and the National Science Foundation—provide the primary support for researchers whose proposals are determined to be financially feasible and to have the potential to advance new ideas or processes. Medical scientists who rely on grant money may be under pressure to meet deadlines and to conform to rigid grant-

Opportunities will be best for medical scientists with both a Ph.D. and M.D.

writing specifications when preparing proposals to seek new or extended funding.

Medical scientists who conduct research usually work in laboratories and use a wide variety of equipment. Some may work directly with individual patients or larger groups as they administer drugs and monitor patients during clinical trials. Often, these medical scientists also spend time working in clinics and hospitals.

Medical scientists usually are not exposed to unsafe or unhealthy conditions; however, those scientists who work with dangerous organisms or toxic substances must follow strict safety procedures to avoid contamination.

Medical scientists typically work regular hours in offices or laboratories, but longer hours are not uncommon. Researchers may be required to work odd hours in laboratories or other locations, depending on the nature of their research. On occasion, epidemiologists may be required to travel to meetings and hearings for medical investigations.

Training, Other Qualifications, and Advancement

A Ph.D. in a biological science is the minimum education required for most prospective medical scientists, except epidemiologists. However, some medical scientists pursue medical degrees to perform clinical work. Epidemiologists typically need at least a master's degree in public health, but some work requires a Ph.D. or medical degree. A period of postdoctoral work in the laboratory of a senior researcher is becoming increasingly common for medical scientists.

Education and training. A Ph.D. typically qualifies people to research basic life processes or particular medical problems and to analyze the results of experiments. Some medical scientists obtain a medical degree instead of a Ph.D., but some do not become licensed physicians because they prefer research to clinical practice. It is particularly helpful for medical scientists to earn both a Ph.D. and a medical degree.

Students planning careers as medical scientists should have a bachelor's degree in a biological science. In addition to required courses in chemistry and biology, undergraduates should study allied disciplines, such as mathematics, engineering, physics, and computer science, or courses in their field of interest. Once they have completed undergraduate studies, they can then select a specialty for their advanced degree, such as cytology, bioinformatics, genomics, or pathology.

The minimum educational requirement for epidemiologists is a master's degree from a school of public health. Some jobs may require a Ph.D. or medical degree, depending on the work performed. Epidemiologists who work in hospitals and health care centers often must have a medical degree with specific training in infectious diseases. Some employees in research epidemiology positions are required to be licensed physicians because they must administer drugs in clinical trials.

Few students select epidemiology for undergraduate study. Undergraduates, nonetheless, should study biological sciences and should have a solid background in chemistry, mathematics, and computer science. Once a student is prepared for graduate studies, he or she can choose a specialty within epidemiology. For example, those interested in studying environmental epidemiology should focus on environmental coursework, such as water pollution, air pollution, pesticide use, toxicology, and molecular biology. Other specialties include occupational epidemiology, infection processes, infection control precautions, surveillance methodology, and outbreak investigation. Some epidemiologists begin their careers in other health care occupations, such as registered nurse or medical technologist.

In addition to formal education, medical scientists usually spend some time in a postdoctoral position before they apply for permanent jobs. Postdoctoral work provides valuable laboratory experience, including experience in specific processes and techniques such as gene splicing, which is transferable to other research projects. In some institutions, the postdoctoral position can lead to a permanent job.

Licensure. Medical scientists who administer drug or gene therapy to human patients, or who otherwise interact medically with patients—drawing blood, excising tissue, or performing other invasive procedures—must be licensed physicians. To be licensed, physicians must graduate from an accredited medical school, pass a licensing examination, and complete 1 to 7 years of graduate medical education. (See the statement on physicians and surgeons elsewhere in the *Handbook*.)

Epidemiologists who perform laboratory tests often require the knowledge and expertise of a licensed physician to administer drugs to patients in clinical trials. Epidemiologists who are not physicians frequently work closely with one.

Other qualifications. Medical scientists should be able to work independently or as part of a team and be able to communicate clearly and concisely, both orally and in writing. Those in private industry, especially those who aspire to consulting and administrative positions, should possess strong communication skills so that they can provide instruction and advice to physicians and other health care professionals.

Certification and advancement. The Association for Professionals in Infection Control and Epidemiology offers continuing education courses and certification programs in infection

prevention and control and applied epidemiology. To become certified as an infection control professional, applicants must pass an examination. Certification can be an advantage for those seeking advancement in this rapidly evolving field.

Advancement among medical scientists usually takes the form of greater independence in their work, larger budgets, or tenure in university positions. Others choose to move into managerial positions and become natural science managers (see engineering and natural science managers elsewhere in the *Handbook*). Those who pursue management careers spend more time preparing budgets and schedules.

Employment

Medical scientists held about 92,000 jobs in 2006. Epidemiologists accounted for only 5 percent of that total. In addition, many medical scientists held faculty positions in colleges and universities, but they are classified as college or university faculty. (See teachers—postsecondary, elsewhere in the *Handbook*.)

About 34 percent of medical scientists, except epidemiologists, were employed in colleges and universities. About 28 percent were employed in scientific research and development services firms; 12 percent were employed in pharmaceutical and medicine manufacturing; 9 percent were employed in hospitals; and most of the remainder were employed in private educational services and ambulatory health care services.

Among epidemiologists, 57 percent were employed in government; 12 percent were employed in hospitals; 11 percent were employed in colleges and universities; and 9 percent were employed in scientific research and development services.

Job Outlook

Medical scientists can expect to face competition for most jobs, in part because of the attractiveness of the career. However, those with both a Ph.D. and M.D. are likely to experience very good opportunities.

Employment change. Employment of medical scientists is expected to increase 20 percent over the 2006-16 decade, faster than the average for all occupations. The Federal Government funds much basic research and development, including many areas of medical research. Although previous budget increases at the National Institutes of Health have led to large increases in the number of grants awarded to researchers, the increase in expenditures has slowed significantly, causing expected future employment growth to be more modest than in the past despite the faster than average projected growth.

Medical scientists enjoyed rapid gains in employment since the 1980s—reflecting, in part, the growth of biotechnology companies. Job growth should be dampened somewhat as fewer new biotechnology firms are founded and as existing firms merge or are absorbed by larger biotechnology or pharmaceutical firms. Some companies may conduct a portion of their research and development in other lower-wage countries, further limiting employment growth. However, much of the basic medical research done in recent years has resulted in new knowledge, including the isolation and identification of new genes. Medical scientists will be needed to take this knowledge to the next stage—understanding how certain genes function within an entire organism—so that medical treatments can be developed for various diseases. Even pharmaceutical and other firms not solely engaged in biotechnology have largely adopted biotechnology techniques, thus creating employment for medical scientists.

Employment growth should also occur as a result of the expected expansion in research related to illnesses such as AIDS, cancer, and avian influenza, along with growing treatment problems such as antibiotic resistance. Moreover, environmental conditions such as overcrowding and the increasing frequency of international travel will tend to spread existing diseases and give rise to new ones. Medical scientists will continue to be needed because they greatly contribute to the development of treatments and medicines that improve human health.

An increasing focus on monitoring patients at hospitals and health care centers to ensure positive patient outcomes will contribute to job growth for epidemiologists. In addition, a heightened awareness of bioterrorism and rare, but infectious diseases such as West Nile Virus or severe acute respiratory syndrome (SARS) should spur demand for these workers. As hospitals enhance their infection control programs, many will seek to boost the quality and quantity of their staff.

Job prospects. Besides job openings due to employment growth, openings will arise as workers leave the labor force or transfer to other occupations. However, doctoral degree holders can expect to face considerable competition for basic research positions and for research grants. If the number of advanced degrees awarded continues to grow, applicants are likely to face even more competition.

Although medical scientists can expect competition for jobs, those with both doctoral and medical degrees are likely to experience very good opportunities. As funding for research becomes more difficult to obtain, those with both a biological and professional medical background will have a distinct advantage. Opportunities in epidemiology also should be highly competitive, as the number of available positions will continue to be limited.

Medical scientists and epidemiologists are less likely to lose their jobs during recessions than are those in many other occupations because they are employed on long-term research

Projections data from the National Employment Matrix

Occupational Title	SOC Code	Employment, 2006	Projected employment, 2016	Change, 2006-2016	
				Number	Percent
Medical scientists	19-1040	92,000	110,000	18,000	20
Epidemiologists	19-1041	4,500	5,100	600	14
Medical scientists, except epidemiologists	19-1042	87,000	105,000	18,000	20

NOTE: Data in this table are rounded. See the discussion of the employment projections table in the *Handbook* introductory chapter on *Occupational Information Included in the Handbook*.

projects. However, a recession could influence the amount of money allocated to new research and development, particularly in areas of risky or innovative medical research. A recession also could limit extensions or renewals of existing projects.

Earnings

Median annual earnings of wage and salary medical scientists, except epidemiologists, were $61,680 in May 2006. The middle 50 percent of these workers earned between $44,830 and $88,130. The lowest 10 percent earned less than $35,490, and the highest 10 percent earned more than $117,520. Median annual earnings in the industries employing the largest numbers of medical scientists were:

Pharmaceutical and medicine manufacturing	$82,640
Research and development in the physical, engineering, and life sciences	71,490
Offices of physicians	70,000
General medical and surgical hospitals	64,700
Colleges, universities, and professional schools	44,600

Median annual earnings of wage and salary epidemiologists were $56,670 in May 2006. The middle 50 percent earned between $45,220 and $71,080. The lowest 10 percent earned less than $36,920, and the highest 10 percent earned more than $87,300.

Related Occupations

Many other occupations deal with living organisms and require a level of training similar to that of medical scientists. These occupations include biological scientists, agricultural and food scientists, pharmacists, engineering and natural sciences managers, and health occupations such as physicians and surgeons, dentists, and veterinarians.

Sources of Additional Information

For information on pharmaceutical scientists, contact:

➤ American Association of Pharmaceutical Scientists (AAPS), 2107 Wilson Blvd., Suite 700, Arlington, VA 22201. Internet: **http://www.aapspharmaceutica.org**

For information on careers in microbiology, contact:

➤ American Society for Microbiology, Career Information—Education Department, 1752 N St.NW., Washington, DC 20036. Internet: **http://www.asm.org**

For information on infectious diseases training programs, contact:

➤ Infectious Diseases Society of America, Guide to Training Programs, 66 Canal Center Plaza, Suite 600, Alexandria, VA 22314. Internet: **http://www.idsociety.org**

Information on obtaining a medical scientist position with the Federal Government is available from the Office of Personnel Management through USAJOBS, the Federal Government's official employment information system. This resource for locating and applying for job opportunities can be accessed through the Internet at **http://www.usajobs.opm.gov** or through an interactive voice response telephone system at (703) 724-1850 or TDD (978) 461-8404. These numbers are not toll free, and charges may result. For advice on how to find and apply for Federal jobs, see the Occupational Outlook Quarterly article "How to get a job in the Federal Government," online at: **http://www.bls.gov/opub/ooq/2004/summer/art01.pdf**.