Medical Scientists

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Significant Points

- Epidemiologists typically require a master's degree in public health or, in some cases, a medical degree; other medical scientists need a Ph.D. degree in a biological science.
- Competition is expected for most positions.
- Most medical scientists work in research and development.

Nature of the Work

Medical scientists research human diseases in order to improve human health. Most medical scientists work in research and development. Some conduct basic research to advance knowledge of living organisms, including viruses, bacteria, and other infectious agents. Past research has resulted in the development of vaccines, medicines, and treatments for many diseases. Basic medical research continues to provide the building blocks necessary to develop solutions to human health problems. Medical scientists also engage in clinical investigation, technical writing, drug application review, patent examination, or related activities.

Medical scientists study biological systems to understand the causes of disease and other health problems and to develop treatments. They try to identify changes in a cell or chromosomes that signal the development of medical problems, such as different types of cancer. For example, a medical scientist 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. Those who are not physicians normally collaborate with a physician who deals directly with patients. Medical scientists examine the results of clinical trials and, if necessary, adjust the dosage levels to reduce negative side effects or to try to induce even better results. In addition to developing treatments for health problems, medical scientists attempt to discover ways to prevent health problems, such as affirming the link between smoking and lung cancer, or between alcoholism and liver disease.

Many medical scientists work independently in private industry, university, or government laboratories, often exploring new areas of research or expanding on specialized research that they started 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, such as the National Institutes of Health and the National Science Foundation, contribute to the support of scientists whose research proposals are determined to be financially feasible and have the potential to advance new ideas or processes.

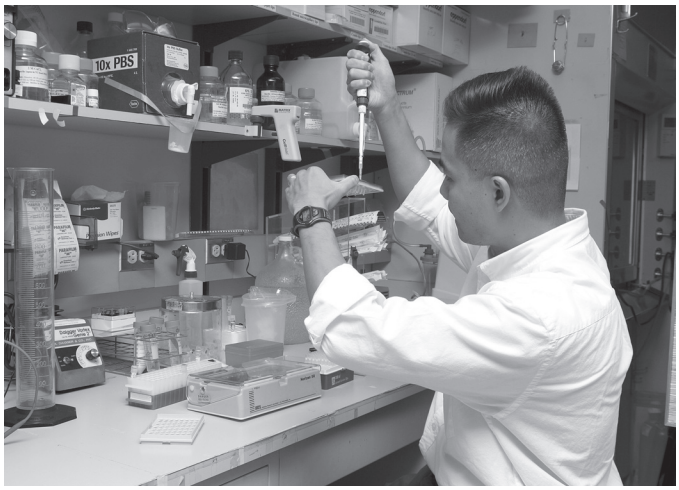
Medical scientists who work in applied research or product development use knowledge provided by basic research to develop new drugs and medical treatments. They usually have less autonomy than basic researchers to choose the emphasis of their research, relying instead on market-driven directions based on the firm's products and goals. Medical scientists doing applied research and product development in private industry may be required to express their research plans or results to nonscientists who are in a position to veto or approve their ideas, and they must understand the impact of their work on business. Scientists increasingly work as part of teams, interacting with engineers, scientists of other disciplines, business managers, and technicians.

Medical scientists who conduct research usually work in laboratories and use electron microscopes, computers, thermal cyclers, or a wide variety of other equipment. Some may work directly with individual patients or larger groups as they administer drugs and monitor and observe the patients during clinical trials. Medical scientists who are also physicians may administer gene therapy to human patients, draw blood, excise tissue, or perform other invasive procedures.

Some medical scientists work in managerial, consulting, or administrative positions, usually after spending some time doing research and learning about the firm, agency, or project. In the 1980s, swift advances in basic medical knowledge related to genetics and molecules spurred growth in the field of biotechnology. Medical scientists using this technology manipulate the genetic material of animals, attempting to make organisms more productive or resistant to disease. Research using biotechnology techniques, such as recombining DNA, has led to the discovery of important drugs, including human insulin and growth hormone. Many other substances not previously available in large quantities are now produced by biotechnological means; some may 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 and then determining their functionality. This work continues to lead to the discovery of the genes associated with specific diseases and inherited traits, such as certain types of cancer or obesity. 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 determinants of disease, disability, and other health outcomes and develops the means for prevention and control. Epidemiologists may study many different diseases such as tuberculosis, influenza, or cholera, often focusing on epidemics.

Epidemiologists can be separated into two groups, research and clinical. Research epidemiologists conduct basic and advanced research on infectious diseases that affect the entire body,



Most medical scientists conduct basic research to advance knowledge of living organisms.

such as AIDS or typhus—attempting to eradicate or control these diseases. Others may focus only on localized infections of the brain, lungs, or digestive tract, for example. Research epidemiologists work at colleges and universities, schools of public health, medical schools, and research and development services firms. For example, Government agencies such as the Department of Defense may contract with a research firm's epidemiologists to evaluate the incidence of malaria in certain parts of the world. While some perform consulting services, other research epidemiologists may work as college and university faculty.

Clinical epidemiologists work primarily in consulting roles at hospitals, informing the medical staff of infectious outbreaks and providing containment solutions. These clinical epidemiologists sometimes are referred to as infection control professionals. Consequently, many epidemiologists in this specific area often are physicians. Epidemiologists who are not physicians often collaborate with physicians to find ways to contain diseases and outbreaks. 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.

Working Conditions

Medical scientists typically work regular hours in offices or laboratories and usually are not exposed to unsafe or unhealthy conditions. Those who work with dangerous organisms or toxic substances in the laboratory must follow strict safety procedures to avoid contamination. Medical scientists also spend time working in clinics and hospitals administering drugs and treatments to patients in clinical trials. On occasion, epidemiologists may be required to work evenings and weekends to attend meetings and hearings for medical investigations.

Some medical scientists depend on grant money to support their research. They may be under pressure to meet deadlines and to conform to rigid grant-writing specifications when preparing proposals to seek new or extended funding.

Employment

Medical scientists, including epidemiologists, held about 62,000 jobs in 2002. Medical scientists accounted for 58,000 of the total; epidemiologists, 3,900. 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*.)

Almost 30 percent of medical scientists were employed in scientific research and development services firms, another 24 percent worked in Government, 14 percent in pharmaceutical and medicine manufacturing, 13 percent in private hospitals, and most of the remainder worked in private educational services and ambulatory health care services. About 1,000 were self-employed.

Among epidemiologists, nearly 45 percent were employed in Government, another 20 percent worked in management, scientific, and technical consulting services firms, 14 percent in private hospitals, and 12 percent in scientific research and development services firms.

Training, Other Qualifications, and Advancement

A Ph.D. degree in a biological science is the minimum education required for most prospective medical scientists, except epidemiologists, because the work of medical scientists is almost entirely research oriented. A Ph.D. degree qualifies one to do research on basic life processes or on particular medical problems or diseases, and to analyze and interpret the results of experiments on patients. Some medical scientists obtain a medical degree instead of a Ph.D., but may not be licensed physicians because they have not taken the State licensing examination or completed a residency program, typically because they prefer research to clinical practice. 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 physicians and surgeons elsewhere in the *Handbook*.) It is particularly helpful for medical scientists to earn both Ph.D. and medical degrees.

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, physics, and computer science, or courses in their field of interest. Once they have completed undergraduate studies, they can then select a specialty area for their advanced degree, such as cytology, genomics, or pathology. In addition to formal education, medical scientists usually spend several years 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.

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 they can provide instruction and advice to physicians and other healthcare professionals.

The minimum educational requirement for epidemiology is a master's degree from a school of public health. Some jobs require a Ph.D. or medical degree, depending on the work performed. Epidemiologists who work in hospitals and healthcare centers often must have a medical degree with specific training in infectious diseases. Currently, 134 infectious disease training programs exist in 42 States. Some employees in research epidemiology positions are required to be licensed physicians, as they are required to administer drugs in clinical trials.

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

Very 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, or pesticide use. The core work of environmental studies includes toxicology and molecular biology, and students may continue with advanced coursework in environmental or occupational epidemiology. Some epidemiologists are registered nurses and medical technologists seeking advancement.

Job Outlook

Employment of medical scientists is expected to grow faster than the average for all occupations through 2012. Despite projected rapid job growth for medical scientists, doctoral degree holders can expect to face considerable competition for basic research positions. The Federal Government funds much basic research and development, including many areas of medical research. Recent budget increases at the National Institutes of Health have led to large increases in Federal basic research and development expenditures, with the number of grants awarded to researchers growing in number and dollar amount. At the same time, the number of newly trained medical scientists has continued to increase at least as fast as employment opportunities, so both new and established scientists have experienced greater difficulty winning and renewing research grants. If the number of advanced degrees awarded continues to grow unabated, as expected, this competitive situation is likely to persist.

Medical scientists enjoyed rapid gains in employment between the mid-1980s and mid-1990s, in part reflecting increased staffing requirements in new biotechnology companies. Employment growth should slow somewhat as increases in the number of new biotechnology firms slow and existing firms merge or are absorbed into larger ones. 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, which is understanding how certain genes function within an entire organism, so that gene therapies can be developed to treat diseases. Even pharmaceutical and other firms not solely engaged in biotechnology are expected to increasingly use biotechnology techniques, thus creating employment for medical scientists.

Expected expansion in research related to health issues such as AIDS, cancer, and Alzheimer's disease also should result in employment growth. Although medical scientists greatly contributed to developing many vaccines and antibiotics, more medical research will be required to better understand these and other epidemics and to improve human health.

Opportunities in epidemiology also should be highly competitive, as the number of available positions remains limited. However, an increasing focus on monitoring patients at hospitals and healthcare centers to ensure positive patient outcomes will contribute to job growth. In addition, a heightened awareness of bioterrorism and infectious diseases such as West Nile Virus or SARS should also spur demand for these workers. As hospitals enhance their infection control programs, many will seek to boost the quality and quantity of their staff. Besides job openings due to employment growth, additional openings will result as workers leave the labor force or transfer to other occupations. Because employment of epidemiologists is somewhat tied to the healthcare industry, industry conditions will influence occupational demand.

Medical scientists and some 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 projects. However, a recession could influence the amount of money allocated to new research and development efforts, particularly in areas of risky or innovative medical research. A recession also could limit the possibility of extension or renewal of existing projects.

Earnings

Median annual earnings of medical scientists, except epidemiologists, were $56,980 in 2002. The middle 50 percent earned between $40,180 and $82,720. The lowest 10 percent earned less than $29,980, and the highest 10 percent earned more than $114,640. Median annual earnings in the industries employing the largest numbers of medical scientists in 2002 were:

Pharmaceutical and medicine manufacturing	$72,330
Scientific research and development services	61,470
General medical and surgical hospitals	50,660
Colleges, universities, and professional schools	35,520

Median annual earnings of epidemiologists were $53,840 in 2002. The middle 50 percent earned between $44,900 and $66,510. The lowest 10 percent earned less than $35,910, and the highest 10 percent earned more than $85,930.

Related Occupations

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

Sources of Additional Information

For a brochure entitled *Is a Career in the Pharmaceutical Sciences Right for Me?*, contact:

➤ American Association of Pharmaceutical Scientists (AAPS), 2107 Wilson Blvd., Suite #700, Arlington, VA 22201.

For a career brochure entitled *A Million and One,* contact:

➤ American Society for Microbiology, Education Department, 1752 N St. NW., Washington, D.C. 20036-2804. 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 (OPM) through a telephone-based system. Consult your telephone directory under U.S. Government for a local number or call (703) 724-1850; Federal Relay Service: (800) 877-8339. The first number is not tollfree, and charges may result. Information also is available from the OPM Internet site: **http://www.usajobs.opm.gov**.