# Medical physicists and health physicists: Radiation occupations

Did you know that physicists help save lives? Physicists aren't found only in lecture halls and laboratories. Some use their knowledge of physics principles to work in medicine and health.

Physics is the study of matter and energy and the ways in which the two interact. Some physicists use their expertise in physics to focus on radiation. These specialists, called medical physicists and health physicists, work to help people or protect the environment. Medical physicists work with physicians, assisting patients who need imaging technology and radiation treatment in hospitals and other medical facilities. Health physicists protect people or the environment from the potential hazards of radiation in a variety of settings.

Keep reading to learn more about these two types of physicists. The first section describes what medical physicists and health physicists do on the job. The second section provides information about employment and wages. And the third section covers skills, training, and certification. Sources for finding more information are at the end of the article.

# Physicists at work in medicine and health

Physicists devise theories and conduct research to further the knowledge of matter and energy. This knowledge may be used in practical applications, such as developing new technologies. Typically, physicists specialize in a particular subfield of physics, and some physicists combine physics with other disciplines in their work.

Medical physicists and health physicists are two such specialists who combine physics with other disciplines. Because of their training in physics and human biology, medical physicists and health physicists understand radiation and its effects on the human body. Additionally, health physicists have expertise in how radiation interacts with the environment. The ways in which both of these types of physicists apply their disciplines are described below.

## Medical physicists

Medical physicists combine an understanding of physics, specifically as it concerns radiation, with an understanding of human biology. They are involved in the diagnosis and treatment of patients, as well as in research and education.

Medical physicists are concerned with the safe and effective use of radiological procedures—the application of radiation to the human body. These procedures are used to prevent, diagnose, and treat disease. Examples include medical-imaging technologies, such as X rays, and radiation therapy, in which radiation is used to kill malignant cancer cells.

The application of radiation to the human body entails risk. For example, radiation that is used to kill cancer cells can damage healthy cells, too. Medical physicists, working with other healthcare professionals, ensure the safety and effectiveness of radiological

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procedures by verifying the appropriate type, dosage, and application of radiation to the body.

Physicists who help in medicine may be employed at a hospital or other healthcare facility or in a solo or group practice for practitioner-clients. Medical physicists employed by a healthcare facility perform different types of work depending on the facility's size and on the number of physicists on staff. A smaller facility may require physicists to work in a wider range of activities.

Medical physicists most commonly work in one of three areas: diagnostic radiology, radiotherapy, and nuclear medicine. Other medical physicists focus on research, teaching, or consulting.

***Diagnostic radiology.*** Medical physicists involved in patient diagnosis are concerned with technologies, such as magnetic resonance imaging (MRI), that produce images of the body's internal structure. These technologies allow physicians to see abnormalities and to monitor various processes, such as blood flow. The medical physicist's role is to ensure that such technologies are used both safely and effectively.

Medical physicists are often responsible for the equipment used in medical imaging. This might include testing, managing inventory, and supervising the maintenance, repair, and calibration of equipment. Additionally, medical physicists are responsible for ensuring that the technologists who operate medical imaging equipment follow proper safety precautions and procedures. And to ensure that medical images show clearly what is being evaluated, these workers also review the quality of the images.

Along with assisting in diagnosis, medical physicists involved in medical imaging may help physicians in the treatment of disease. For example, some medical physicists might use imaging technologies to guide neurosurgeons during brain surgery.

***Therapeutic radiology.*** Most medical physicists work in therapeutic radiology, also called radiation oncology. Therapeutic radiology is the process of treating cancer by projecting high-energy radiation at targeted cancer cells to shrink and eliminate tumors. In this area, medical physicists work as part of an oncology team that implements a treatment plan.

Medical physicists review plans developed by dosimetrists, workers who calculate the amount of radiation to be used in treatment. Physicists verify that the treatment plans are safe and effective, based on their knowledge of physics and human biology.

Like medical physicists involved in imaging, those involved in treatment oversee the safe application of radiation. Duties include confirming that machinery is calibrated

correctly and delivering the correct dosage of radiation. Additionally, medical physicists make sure that the patient is placed—and remains—in the proper position.

***Nuclear medicine.*** Nuclear medicine is used for both imaging and treatment after patients have received small amounts of radioactive materials—called radiopharmaceuticals—whether orally, intravenously, or by inhalation. In imaging, special cameras detect the radiopharmaceuticals and display information based on biological changes that occur when disease is present. In treatment, radiopharmaceuticals act specifically on the area being treated.

As part of a nuclear medical team that includes physicians and technicians, medical physicists evaluate the physical aspects of nuclear medical applications. Medical physicists use their knowledge of the possible effects of radiation on patients and medical personnel to develop accurate estimates for the lowest effective dosage. These physicists may also have expertise in interpreting images and in analyzing data produced during administration of nuclear medical procedures.

***Other areas.*** Medical physicists may also participate in medical research, teach or train medical professionals, or work as consultants.

As researchers, medical physicists concentrate in one of a variety of areas, including issues related to radioactivity, medical applications of computers, and developing imaging equipment and technologies. As educators, medical physicists instruct or train other medical physicists, medical students, and other healthcare workers who treat cancer. As consultants, medical physicists might participate in any of these activities or advise clients about issues related to medical physics.

## Health physicists

Health physicists help protect people and the environment by ensuring that hospitals, nuclear power plants, and other industries use radiation safely. They may also work as instructors or train others in radiation safety. Like medical physicists, health physicists understand radiation, how it can affect the human body and the environment, and what doses of radiation are dangerous.

What health physicists do is determined, in large part, by where they work.

***Hospitals.*** At hospitals and other medical facilities, health physicists help to protect workers, patients, and visitors by ensuring that facilities using radiation sources are doing so safely. These health physicists are responsible for evaluating radiation safety procedures, monitoring possible radiation exposure, and ensuring that the facility complies with government regulations on radiation safety.

***Nuclear power plants.*** A health physicist at a nuclear power reactor may regularly review data related to radiation levels. These health physicists also analyze laboratory results to make sure that the reactor is operating safely and complying with federal regulations.

Other responsibilities include choosing and maintaining equipment used to detect radiation and to protect workers and the environment from excessive amounts of radiation. These physicists may help to train workers or supervise technicians, chemists, or others working at the reactor. Additionally, these health physicists may also write emergency plans and respond to radiation accidents.

***Industry.*** Health physicists who do environmental work might help decontaminate areas affected by radioactivity. Their duties may include collecting environmental samples and analyzing the samples in a laboratory to detect radioactivity.

Health physicists also work for regulatory agencies that help to establish rules for the manufacture, use, and disposal of radioactive materials. In occupational safety, health physicists ensure that employers follow safety requirements. Researchers study how radiation affects matter to establish radiation-protection standards and to aid in designing radiation-detection equipment.

***Education.*** Some health physicists teach. Colleges and universities hire health physicists to instruct people or perform research or both. Health physicists may train other health physicists, medical personnel, nuclear plant workers, or others who need to understand the risks of radiation exposure—and how to prevent excessive amounts.

# Employment and wages

The U.S. Bureau of Labor Statistics (BLS) does not collect employment and wage data for medical physicists and health physicists specifically. However, BLS collects employment and wage data for physicists as a whole. According to that data, in May 2010, there were about 16,860 physicists employed nationwide—and they had a median annual wage of $106,370. That's considerably higher than the median annual wage of $33,840 that BLS data show for workers across all occupations in May 2010.

Data available from industry organizations provide employment and wage estimates for both occupations, but these data may not be precise. For example, the Health Physics Society estimates that there are more than 6,500 people working in health physics in the United States, a number that may include technicians and others in addition to health physicists.

# Skills, training, and certification

Both medical physicists and health physicists usually need at least a master's degree in a subject that demonstrates solid understanding of general physics. Generally, the more specialized their work, the more education they need. Jobs that are primarily technical usually have fewer training requirements.

In addition to knowing physics, medical physicists and health physicists must understand the effects of radiation on the human body. Knowledge of other disciplines is also required.

Other requirements for medical physicists and health physicists differ. For example, some states require licensing. And employers require all medical physicists and some health physicists to be certified.

## Medical physicists

Medical physicists need to know biology, physiology, chemistry, and electronics. And

because medical physicists work with physicians and other medical staff, they should have good interpersonal skills.

Minimum educational requirements for medical physicist jobs usually include either a master's degree or doctorate in physics, medical physics, or a related field. This is usually preceded by an undergraduate degree in physics, although some students' bachelor's degrees are in other natural sciences or engineering. After obtaining a graduate degree, medical physicists complete a residency traineeship or a postdoctoral program at a hospital for 2 years.

Some states require licensing of medical physicists, and all employers require certification. Certification requirements vary by specialty but usually involve some combination of education, experience, and testing. Specific requirements are available from professional medical physicist organizations.

### Health physicists

Health physicists must learn biology, chemistry, and electronics, along with mathematics and statistics, biochemistry, and genetics. Depending on where they work, health physicists may need knowledge in other areas, such as air and water sampling techniques or medical and industrial uses of radiation. Health physicists should also have strong analytical and communication skills.

Most health physicists have at least a master's degree, but not all jobs in professional health physics require one. Relevant studies may be in health physics or in another scientific or engineering field that offers opportunities for gaining practical experience in radiation safety.

Not all employers require health physicists to be certified. But some employers, such as nuclear utilities, may either prefer or require certification for hiring health physicists.

## For more information

The *Occupational Outlook Handbook* describes physicists in its profile "Physicists and Astronomers." The *Handbook* is available in libraries and career centers or online at **www.bls.gov/ooh**.

For information about medical physics and medical physicists, contact:

American Association of Physicists in Medicine
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**www.aapm.org**

For information about the medical physicist certification, contact the following organizations:

American Board of Medical Physics
P.O. Box 487
Barker, TX 77413
(281) 944-9482
*abmpexdir@comcast.net*
**www.abmpexam.com**

American Board of Radiology
5441 E. Williams Blvd.
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Tucson AZ 85711
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American Board of Science in Nuclear Medicine
3000 Spout Run Pkwy.
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And for information on the certification of health physicists, see the American Board of Health Physics website at **www.hps1.org/aahp/boardweb/abhphome.html**.