THEMED PATHWAYS AND SPECIALISMS IN HEALTHCARE SCIENCE

Description of healthcare science themed pathways

The healthcare science workforce consists of many specialisms. All involve the application of science, technology, engineering or mathematics to health. Traditionally, specialisms have been divided into three broad areas: life sciences, physical science and engineering and physiological measurement. But rapid advances in science and technology and changes in patient needs are beginning to blur the lines between these divisions, and specialisms are grouping in themed pathways:

- Infection sciences
- Blood sciences
- Cellular sciences
- Blood and cellular sciences – genetics
- Neurosensory sciences
- Cardiovascular, Respiratory and Sleep Sciences
- Clinical Engineering
- Medical Physics

LIFE SCIENCES

Specialisms involving infection sciences, blood sciences, or cellular sciences themes.

These healthcare scientists may work in pathology and genetics clinical laboratories where they analyse blood, tissues, cells and other body fluids, describing abnormalities and interpreting what this means for people who are ill. They may work in services where they provide a vital service in producing and quality assuring blood and blood products for use in transfusions or in services where they provide a specialist public health function, for example in monitoring infectious disease outbreaks or identifying responsible strains.

Infection Sciences

Microbiologists identify the microscopic organisms that cause infection, including bacteria, viruses, fungi and parasites and the best drug to treat the patient. Many are specialists in one type of organism, such as fungi (mycology). These scientists work in agencies such as the Health Protection Agency in the surveillance and control of infectious disease as well as in hospital and public health settings.

Viruses cause a wide range of disease including cervical cancer (HPV), measles and AIDS. Healthcare scientists in this field can have a number of roles including research, surveillance and the development of vaccines.

Blood Sciences

Phlebotomists take blood for analysis and have specialist skills that enable them to take blood from the frail, from children or very tiny babies.

Clinical biochemists help diagnose and manage disease through the analysis of blood or other body fluids. They advise hospital doctors and GPs on which tests are needed, how to use the results and the options for treatment.

Paediatric metabolic biochemists are specialists who are involved in the screening, diagnosis, treatment and monitoring of babies and children born with metabolic diseases.
Haematologists play a major role in monitoring patients with blood and bone marrow disorders, such as leukaemia, anaemia and sickle cell disease as well as clotting disorders such as haemophilia

Transfusion Scientists work in hospital blood banks or transfusion services ensuring blood from donors is matched to those requiring blood after accidents, surgery or during treatment. May also collect, process and issue blood components. Investigate problems encountered with blood and tissue matching.

Clinical immunologists investigate abnormalities of the immune system associated with autoimmune disease, allergies, leukaemia and HIV AIDS. They monitor immune response to vaccination, treatments and transplantation.

A clinical scientist in haemostasis and thrombosis aims to identify specific abnormalities in the blood which may upset the delicate balance between factors, which promote blood coagulation (clotting), and those which act as anti-coagulants.

**Cellular Sciences**

Histopathologists prepare and examine samples of tissue for examination and diagnosis using specialised staining techniques (also used by cytologists)

Electron microscopy is a specialised field of histopathology which uses ultra high-powered instruments to visualise tiny structure within cells and viruses and help support or make a clinical diagnosis.

Cytopathologists examine a wide range of samples of cells under the microscope including cervical smears to look for cervical abnormality

Anatomical pathologists work to understand and identify the cause of death and assist doctors with post mortems. They may provide support to bereaved relatives.

Embryologists work in infertility clinics and are vital to the success of IVF. They help collect eggs and assess the quality of the fertilised embryo. Andrologists specialise in the analysis of sperm.

In the specialisms of histocompatibility and immunogenetics, healthcare scientists undertake tissue matching for organ and bone marrow transplants.

Toxicologists identify, measure and study the effects of harmful chemicals, biological agents and drug overdoses. They plan and carry out investigations to determine the impact of toxic materials and advise how to treat those affected.

**Blood and Cellular Sciences – Genetics**

Molecular geneticists examine DNA to look for genetic errors that may be responsible for inherited disease or cancer. They are heavily involved in prenatal diagnosis and testing for carrier status. They can make predictions as to the likelihood of the next generation inheriting a particular gene.

Cytogeneticists look at chromosomes taken from a patients cells under the microscope to see if there are abnormalities. They may also diagnose some forms of leukaemia.

**PHYSIOLOGICAL SCIENCES**
Specialisms involving neurosensory sciences or cardiovascular, respiratory and sleep sciences themes.

Healthcare scientists applying physiological sciences work in services which assess the functioning of major organ systems such as the heart, brain and lungs and the impact that disease or treatment may have on them. They may also work in services that have a specialist restorative or rehabilitative focus for example, in taking over the work of the heart and lungs in open cardiac surgery, or in helping people who have respiratory failure, sleep disorders, hearing loss, or who have heart problems requiring pacemakers. Increasingly they may work in the community.

Neurosensory Sciences

Audiologists measure and evaluate hearing and balance, fit and adjust aids and offer techniques to help improve quality of life. An important function is involvement in the Newborn Hearing Screening Programme which screens 650,000 babies each year for hearing loss. This service is unique to Britain.

Neurophysiology involves the investigation of the function of the nervous system as well as the diagnosis and monitoring of neurological disorders such as epilepsy and Parkinsons Disease and conditions affecting nerve function, such as Carpal tunnel syndrome.

Autonomic neurovascular function is a specialist division of neurophysiology, these scientists investigate patients with impaired nerve function arising from viral illness or conditions like diabetes. Monitoring the extent of dysfunction is important in treatment.

Ophthalmic and vision scientists study disorders of vision, disease of the eye and the visual pathway, using measurements of the field of vision and of tiny electrical signals in the eye, eye pressures and eye images. These measurements provide important information for diagnosis and management.

Cardiovascular, Respiratory and Sleep Sciences

Cardiac physiologists work with patients with known or suspected heart disease, using a wide variety of methods and equipment to assess and often treat the mechanical and electrical function of the heart. The skill of scientists in this area can be lifesaving.


Respiratory physiologists work with patients who have lung and airway problems or other difficulties with blood oxygenation. Their tests use a variety of technologies and skills. These are often difficult for frail patients with breathing problems, so a caring, encouraging approach is essential.

Sleep physiologists are healthcare scientists who work in highly specialised sleep laboratories where sleep disorders such as narcolepsy and sleep apnoea are diagnosed and treatment of these problems monitored. Some sleep physiologists work exclusively with children.

In the field of GI physiology, the activity of the digestive system is measured and assessed. Gastrophysiologists help diagnose abnormal function and disease and offer therapeutic techniques which help patients with swallowing and other functions.
Urodynamics and urological measurements involve the study and assessment of urinary problems. Healthcare scientists use special equipment to measure and record pressures, urine flows and muscle activity to help plan and monitor treatments.

Clinical perfusionists are part of the open heart surgery team, managing heart lung machines and other vital equipment during operations. Their skills are also used in intensive care units. Critical care technologists look after the complex equipment used for life support, diagnosis and monitoring, both in operating theatres and intensive care units.

**MEDICAL PHYSICS AND CLINICAL ENGINEERING**

**Specialisms involving clinical engineering and medical physics themes**
Those that apply physics and bioengineering may work in medical physics where they ensure that x-rays and other imaging services such as MRI and ultrasound are safe to use on people, and in monitoring levels of radiation to make sure they are kept within the correct limits. They also provide specialist treatment planning and protective moulds for radiotherapy. Others bring their knowledge of materials science, computing and engineering techniques to provide innovative individual patient solutions for those with disabilities or loss of function caused by invasive and degenerative disease, burns and strokes as well as in developing novel and innovative ways of measuring and monitoring disease.

**Clinical Engineering**

Rehabilitation engineers are healthcare scientists who work as part of the rehabilitation team to assess the individual needs of disabled people. They provide standard and custom-made assistive technology to help with communication and daily living, including special seating, wheelchairs, artificial limbs, electronic communicators and robotic aids.

Biomechanical engineers are scientists who may be involved in designing artificial body parts such as hip and knee joints, and in measuring walking characteristics to improve the function of artificial limbs and surgical corrections of deformities. Modern techniques such as keyhole and robotic surgery have been achieved with the support of biomechanical engineering.

Medical engineering and design scientists have a sound knowledge of engineering and apply this to the design and development of solutions for specific problems or completely new pieces of equipment.

In medical electronics and instrumentation, using state-of-the-art electronic and computing techniques, healthcare scientists and engineers design, develop, build and adapt specialised medical equipment. Examples include new life support and monitoring systems in intensive care, special baby care units, and improved surgical and anaesthetic techniques.

Healthcare scientists and engineers working in the field of device risk management and governance, ensure medical equipment is installed, used and maintained correctly and safely.

In the field of clinical measurement, leading-edge electronic and other techniques are pushing forward medical practice. Healthcare scientists work with clinicians in some of the most highly specialised branches of medicine, for example heart surgery, to develop innovative techniques for diagnosing and treating disease.

In maxillofacial prosthetics and reconstruction, these scientists specialise in the reconstruction of jaws, faces and skulls of patients needing corrective treatment as a result of malformation, cancer or trauma.
In the field of renal science and technology, healthcare scientists are responsible for ensuring renal dialysis equipment is maintained, and that it works safely and efficiently. They work in hospitals and patients’ homes, and train staff and patients in equipment use.

Medical illustrators and clinical photographers provide photography, video, illustration and graphic design services to support patient care, teaching and research. Images are used to assist in patient diagnosis and treatment, as well as the design and production of patient information and other medical publications.

**Medical Physics**

Radiation safety practitioners play an essential role in the safe use, for diagnosis and therapy, of many different types of radiation, such as X-rays, radioisotopes, lasers and ultraviolet radiation. They measure and calculate doses received by patients and staff, survey the working environment, and monitor equipment performance to ensure compliance with stringent regulations.

Radiotherapy physics is the treatment of cancer with ionising radiation such as X-rays. Healthcare scientists maintain the precision and accuracy of treatments by using advanced computer calculations of patient treatments and ensuring equipment is calibrated precisely and used safely. They also develop new techniques to improve the effectiveness of treatments.

Diagnostic imaging is one of the most rapidly expanding areas of the NHS. Healthcare scientists monitor the performance of imaging equipment and give advice on the specification and acceptance of new equipment. They help develop and assess new techniques to ensure the best results are obtained with minimum exposure to radiation.

Nuclear medicine is the use of radioactive substances for diagnosis and therapy. Healthcare scientists are engaged in administering radionuclide pharmaceuticals to patients and then taking images and measurements. They ensure safety and are involved in interpreting results and developing new procedures.

Radiopharmacy is the manufacture and supply of radioactive medicinal products for use in nuclear medicine to support diagnosis and treatment.

The use of Magnetic Resonance Imaging (MRI) is increasing rapidly and it is now being combined with other imaging methods. Healthcare scientists are involved in the use and development of new equipment and in the interpretation of images.

Non ionising forms of radiation, such as heat and light, are used in a wide range of medical applications including lasers, photodynamic therapy and UV light treatments. Healthcare scientist help develop and monitor their use.

Ultrasound is used to produce images that are vital for the diagnosis and management of a range of medical conditions as well as use during pregnancy. Healthcare scientists in this area assess how well the equipment is working and use their expertise to advise on the purchase of new apparatus.