MEDICAL PHYSICISTS AND BIOMEDICAL ENGINEERS: Unsung Innovators of the NHS

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The NHS has always been a world leader in healthcare innovation: constantly developing or improving technologies, treatments and ways of working. Doctors are usually perceived to be the prime source of this innovation. Indeed, the Medical Innovation Bill put before Parliament in 2014 focuses solely on the role of the doctor. Meanwhile, the contribution of NHS physicists and engineers continues to be substantial. With this article, we celebrate the vital role they play in keeping the NHS creative, productive and forward-looking.

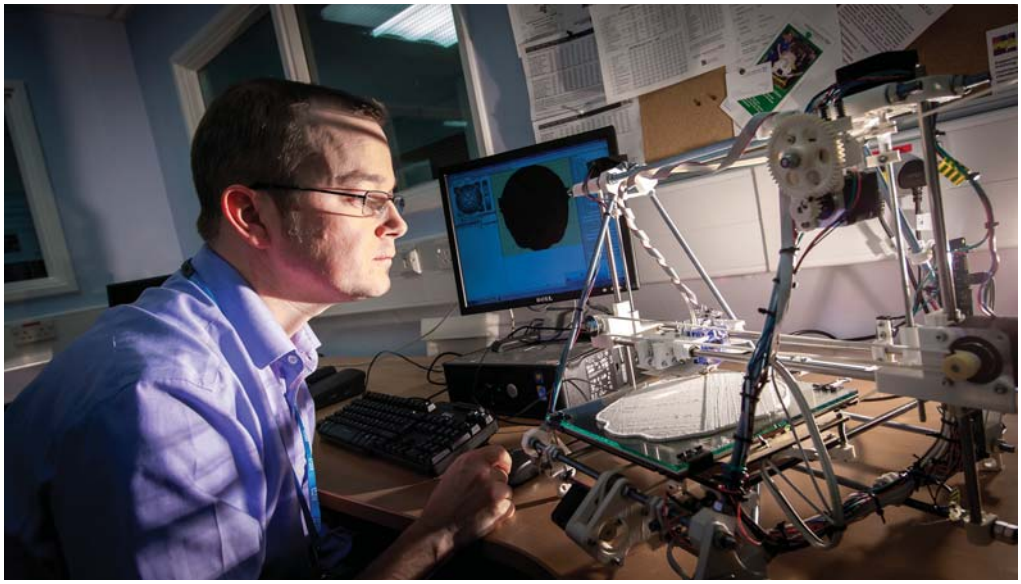
The NHS depends on innovation to improve productivity, keep down costs and deliver better outcomes for patients. Knowledge and technology developed within the NHS is exported, helping the UK's economic growth. It is important to understand how this innovation comes about, in order to nurture and promote it.

The Institute of Physics and Engineering in Medicine (IPEM) represents about 4,000 people working in medical physics and biomedical engineering. Most of our members work in the NHS although we also have members in academia and industry.

... world's first fully articulated bionic hand ...

Physicists and engineers have important roles within the NHS. Our members help to ensure that patients are correctly diagnosed and safely treated for illnesses such as cancer and stroke. They maintain and manage medical equipment and help ensure the safety of both patients and staff. However, they are also trained scientists, creative thinkers and a driving force behind NHS innovation. Medical physics and biomedical engineering have long been major research strengths for the UK and many of the healthcare technologies now being used in the NHS and worldwide have their origin in discoveries by IPEM members.

Clinical imaging has changed the face of medicine and revolutionised diagnosis and treatment. British physicists and engineers have been responsible for, or made major contributions to, the most widely used medical imaging techniques: Computerised Tomography (CT), Magnetic Resonance Imaging (MRI), Positron Emission Tomography (PET), Single Photon Emission Computed Tomography (SPECT)



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and medical ultrasound. The CT and MRI pioneers Godfrey Hounsfield and Peter Mansfield received Nobel prizes for their work, while ultrasound pioneer (and former IPEM President) Peter Wells was recently awarded a Royal Medal by the Queen.

Intensity Modulated Radiotherapy (IMRT) is an advanced form of cancer treatment, which precisely targets radiation at the tumour, while minimising the amount going to surrounding healthy tissues. Medical physicist and IPEM Fellow, Professor Steve Webb, was one of the key researchers behind its invention. The use of IMRT is now rapidly expanding across the NHS, with the help of the Government's Radiotherapy Innovation Fund. Medical physicists have been vital to implementing this new technology safely and are now developing new and improved treatments, made possible by IMRT.

Biomedical and clinical engineering is one of the fastest advancing areas of healthcare science, covering areas such as medical implants, joint replacements, robotic surgery, rehabilitation devices and tele care. The world's first fully articulated bionic hand was invented by NHS clinical engineer and IPEM Fellow, David Gow, who was recently appointed CBE for his work. His revolutionary, modular design for the i-Limb has been successfully commercialised, enabling thousands of users worldwide to perform delicate, individual finger movements and complicated grips not possible with previous prostheses.

... non-invasive optical techniques ...

Medical innovation is not all about ground-breaking developments and Nobel prizes. NHS physicists and engineers are constantly finding creative solutions and new approaches to deal with everyday challenges to effective patient care. Since 2012, IPEM's Research and Innovation awards have been providing small grants for such front-line work and especially for early-stage, speculative or niche research projects that would struggle to find funding elsewhere. Four of our projects are outlined in the box below. They provide a snapshot of the wide range of research and development undertaken by our members and the considerable improvements it can bring to patient outcomes, cost effectiveness and quality assurance.

Physicists and engineers represent a rich scientific resource embedded within the health service. In these increasingly demanding times, the pioneering advances they deliver, working with doctors and other healthcare staff, are vital to help the NHS keep its world-leading position.

FOUR RESEARCH PROJECTS ASSISTED WITH IPEM FUNDING.

1. Quick and accurate mapping of skin cancer lesions

Megan Duffy is one of a team of scientists at St Thomas's Hospital, London developing a new technique that could enable skin cancer tumours to be mapped accurately, quickly and cheaply for the first time. They are using advanced non-invasive optical techniques to detect cancer-affected areas under the skin and accurately map them before surgery. The system will help surgeons remove all the cancerous tissue from a patient whilst minimising skin damage and disfigurement. The new technique will be a huge improvement over existing practice, which requires taking repeated cuts of tissue from the patient's skin for microscopic examination. It is expected to cut operating times dramatically.

2. Better brain scans with the help of 3D printers

A wide range of illnesses and conditions are detected or assessed with the help of medical scanning. Medical physicists use test objects called phantoms to check that the scanners are operating correctly. This is important, in order to ensure that any potential abnormalities detected are real and not due to variations in scanner performance. Dr Robin Holmes of University Hospitals Bristol Foundation Trust has been developing the use of 3D printers to produce low cost, anatomically correct brain phantoms for testing Positron Emission Tomography (PET) and other scanners. With better phantoms, scan reporting for conditions such as neurodegeneration will become more objective and accurate, reducing uncertainty and enabling earlier diagnoses.

3. Safer seatbelts for passengers with spinal deformity

There are currently no car passenger restraints on the market designed specifically for those with severe or complex spinal deformities. Paul Harrington of the Oxford University Hospitals NHS trust has been developing car restraints for better protection of wheelchair users. He has designed and tested a wheelchair-integrated system which incorporates both a lap belt and an upper torso restraint. Recent crash tests have found that his new system provided better protection and met international safety standards regarding the level of restraint provided. Paul is now developing a commercial product with a manufacturer.

4. Wider access to self-administered pain relief

When patients are allowed to administer their own pain relief, it has been found to reduce the requirement for costly nursing and to be more effective at relieving pain. However, an estimated 20% of patients who would benefit from Patient Controlled Analgesia (PCA) are physically unable to operate the handsets. Dr Thomas Stone and Sonya Sireau of Addenbrookes Hospital, Cambridge, working with Ian Hosking of the Cambridge University Engineering Design Centre are developing several different PCA handsets for disabled patients. They believe that, with the right devices, almost every patient should be able to access PCA. Their first prototypes are now being tested with patients.