Why are there *Physicists* in the NHS?

NHS Greater Glasgow and Clyde

NHS Education for Scotland

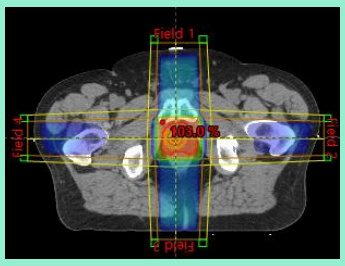
Physicists in the NHS generally work behind the scenes. They work with doctors, technologists and radiographers to provide safe, state of the art, and accurate diagnosis and treatment for a wide variety of conditions.

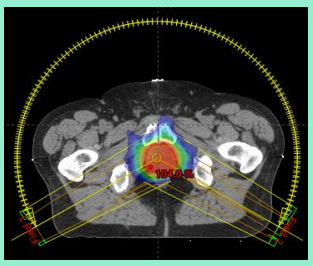
This poster explains the main departments you will find physicists in and what they do in each of them.

Radiotherapy

Radiotherapy uses high energy radiation to damage cancer cells in the body.

- ❑ Radiotherapy physicists provide scientific and technical support to radiographers, technologists, and doctors.
- ❑ They perform quality assurance of equipment to ensure the treatment machines deliver the right dose for safe and accurate treatment.
- ❑ Radiotherapy physicists plan complex radiotherapy treatments, making sure the tumour receives the intended radiation dose while minimising dose to the surrounding normal tissues.
- ❑ They participate in research to develop new techniques and improve patient outcomes.





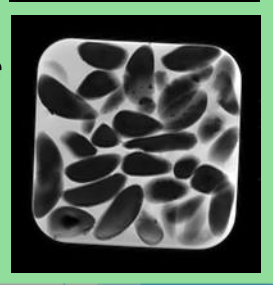
Research on new treatment planning techniques:
New techniques in treatment planning are continually being developed. These allow a reduction in the radiation dose to nearby organs and normal tissue, reducing negative effects of the treatment. Physicists must evaluate the benefits and risks of any new technique before it is used on patients.

MRI

MRI uses very strong magnets and radio waves to see inside the body. MRI images are used to diagnose and monitor conditions, as well as to plan treatments.

- ❑ Placing metal within a strong magnetic field can be dangerous! MRI physicists review pacemakers, metal implants, and any other sources of metal inside or on a patient to ensure they are safe to go in the MRI scanner.
- ❑ MRI physicists are involved in image optimisation, to ensure image quality is good enough to detect abnormalities and allow a diagnosis to be made.
- ❑ They advise on the purchasing and use of new equipment and research and perform advanced techniques, such as functional MRI.

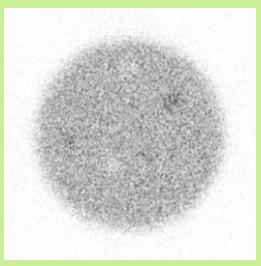
MRI Sequences:
The appearance of different tissues in an MRI image is dependent on the pulse sequence (the pattern of radiofrequency pulses and magnetic field variations). The images to the right are of Brazil nuts in a tub of water, to represent fat and water in the body. The bottom image added 'fat saturation', which alters the pulse sequence to null the signal from fat, making the Brazil nuts appear dark. Clinically, this can be used to improve the detection of abnormalities that would otherwise be obscured by the signal from fat

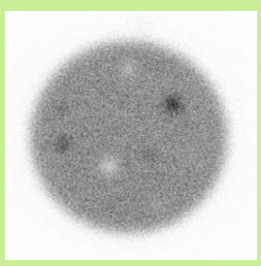


Nuclear Medicine

Nuclear medicine departments administer radioactive pharmaceuticals (tracers) to patients for diagnosis and treatment.

- ❑ Physicists in nuclear medicine oversee the safe storage and disposal of radioactive waste.
- ❑ They perform reconstruction and analysis of images, and report findings alongside a radiologist, providing scientific input.
- ❑ Nuclear medicine physicists research and introduce new diagnostic tests and techniques, including new tracers.
- ❑ They optimise techniques and imaging to get suitable image quality while keeping patient radiation doses as low as possible.





Optimisation in nuclear medicine:
Nuclear medicine imaging identifies areas of increased uptake ('hot') or decreased uptake ('cold') of the tracer. The images above show a test object with several 'hot' and 'cold' circles of varying sizes. Identification of these circles is improved in the image on the right by increasing the number of counts (the amount of radiation detected). However, this is achieved by using a higher radiation dose or longer scan time. The latter increases the risk of patient movement which results in blurring. Therefore, physicists conduct research to determine optimal protocols.

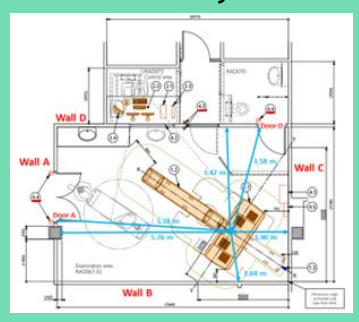
Health Physics

Health Physics covers radiation protection and diagnostic radiology (x-ray, CT, fluoroscopy, and mammography).

- ❑ Physicists in radiation protection provide radiation safety advice to staff and the public.
- ❑ They ensure the health board is compliant with the laws relevant to the use and disposal of radiation.
- ❑ Physicists calculate the shielding required to ensure anyone outside the room does not receive a significant accidental radiation exposure.
- ❑ In diagnostic radiology, physicists perform dose audits to assess the average radiation doses received by patients and identify places requiring optimisation.
- ❑ They also perform dose calculations in the event of a radiation incident.

Radiation shielding:
Shielding, commonly lead, is essential to reduce the radiation dose to members of the public and staff outside of the radiology room. Physicists perform calculations to determine the thickness of lead required in the walls, ceiling, floor, doors, and windows to ensure the legal public dose limit of 1 mSv per calendar year is not exceeded.

Once installed, physicists carry out measurements of radiation through the shielding, to identify any problems before the room is used clinically.



Bethany Aylward, 2024