

# Update from the NIHR Clinical Research Facility at The Royal Marsden and the ICR

*A centre of cancer imaging expertise*



## Highlight on MRI

Magnetic resonance imaging (MRI) is a type of scan that combined with advanced computer software can produce detailed 3 dimensional images of the inside of your body.

In clinical MRI scans, it is the protons within the hydrogen atoms of water molecules that are being measured. MRI machines produce a strong magnetic field that forces these protons in the body to align with the magnetic field. Radiofrequency is then pulsed into the patient; the protons are temporarily stimulated and spin against the magnetic field. When the radiofrequency is turned off, the MRI sensors are able to detect the energy released from the protons, using devices called coils which are placed against the patient, close to the area being investigated. The time it takes for the protons to re-align with the magnetic field, as well as the amount of energy released changes depending on the chemical nature of the proton environment allowing us to tell the difference between types of tissue and create an image for diagnosis.

Diffusion weighted imaging (DWI) is a form of MRI based on measuring the random motion of water

molecules within a tissue. When cells within a tissue are denser than normal, the water molecules surrounding them are not able to move freely. This type of imaging has proven useful in detecting and monitoring cancer, as the cells within a tumour grow quickly and are more tightly packed than those in normal tissue

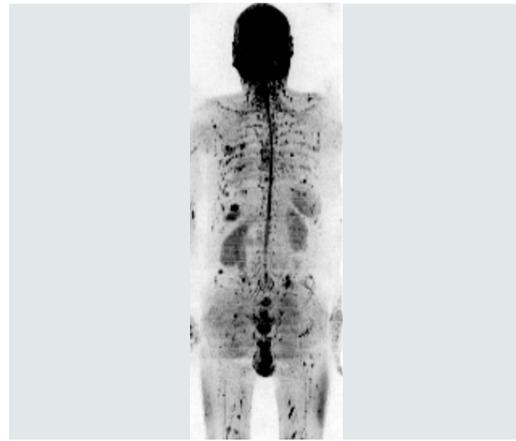
In some situations it may be necessary to administer a contrast agent, via a vein in the arm, to produce a brighter signal. Contrast agent is sometimes administered using a pump injector and images are taken simultaneously to observe how quickly the contrast flows into and out of the tissues. This can then be plotted onto a graph and analysed, providing the radiologist with information about the blood flow to a particular area. The administration of intravenous contrast is carefully considered by the radiologist and only given where the patient does not have certain risk factors, such as poor renal function and where it will add information.

Radiomics is a recent development where computers can be used to extract information invisible to the human eye from an image. As a specialist cancer imaging Clinical Research Facility, we support research into the development and evaluation of new MRI techniques as well as new application of techniques we are already using.

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## Regulation within MRI

MRI does not use ionizing radiation but does use a strong magnetic field which extends further than the machine. It exerts very powerful forces on magnetic materials, such as objects made of iron and steel, with forces strong enough to pull a wheelchair across a room. All MRI units in the UK operate strict safety policy, set out by the Medicines and Healthcare Products Regulatory Agency (MHRA). These guidelines apply to anyone entering the unit and all entrants to the department are stringently checked. Medical implants must be confirmed as MRI safe and no ferrous metal can be taken in.



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## MRI research studies

### Image-guided Theranostics in Multiple Myeloma (iTMM)

Theranostics is a personalised approach to cancer treatment where accurate diagnostic tests are used to guide choice of therapy. Our Clinical Research Facility is supporting the iTMM study, where myeloma patients have whole body MRI (WB-MRI) and PET/CT imaging to assess their myeloma and then follow up WB-MRI is used to assess response and whether there are any tiny sites of disease left behind after treatment. Assessment of myeloma is difficult as it is a cancer that can happen anywhere within the bone marrow, requiring imaging of the whole skeleton. WB-MRI not only provides this visualisation, but can detect disease before it can be seen by X-ray or CT. Detection of residual disease can provide an indication of prognosis and an opportunity for further treatment.

### Machine Learning In Myeloma Response (MALIMAR)

Whole body diffusion weighted imaging (WB-DWI) provides accurate and vital information of the amount of disease as well as the response to treatment in many cancer types. However, each examination is made up of more than 1,000 images which need to be interpreted by a radiologist. The time taken to read a WB-DWI is much longer than a standard MRI scan which can be a barrier to NHS hospitals offering this imaging service. Research staff at The Royal Marsden and Imperial College have worked together to develop a highly specialised computer system that is able to perform an initial and very rapid interpretation of these examinations for the radiologist to then review. The computer system must be 'trained' and part of this is being able to recognise healthy tissue as well as cancerous tissue. This study recruited healthy volunteers to undergo WB-DWI in order to provide the computer system with the data required to teach it what healthy tissue looks like.

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### IMAGIng MRD in Myeloma (MUK9 IMAGIMM)

In this study, whole body DW-MRI is used for disease distribution assessment and imaging minimal residual disease (MRD) in combination with the standard bone marrow assessment in patients with high risk myeloma. It aims to demonstrate that imaging MRD post therapy is associated with outcome and so can provide a more sensitive measure of response assessment that can inform patient treatment options. Although it has now become national guideline that WB-MRI should be offered to myeloma patients, many centres are not yet experienced in this technique. We have therefore been running national training courses in both acquiring and interpreting the images for this specialist examination to share our specialist knowledge with the aim of improving outcomes for patients.



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### Patient and Public Involvement (PPI)

We work closely with patient representatives to ensure patient-focussed outcomes and improved patient experience. For WB-MRI, patients need to lie still in the scanner for up to an hour with coils that cover most of the body. This can add to feelings of claustrophobia. A patient representative has worked with us to develop information that is reflective of the real patient experience of having a WB-MRI scan. This has helped radiological staff to better understand patient anxiety in whole body imaging and has helped patient understanding of the scanning procedure, improving tolerance and study compliance.

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**If you would like more information about the Imaging Clinical Research Facility or are interested in working with us, please email [imagingCRF@rmh.nhs.uk](mailto:imagingCRF@rmh.nhs.uk) or call 020 8915 6624.**