

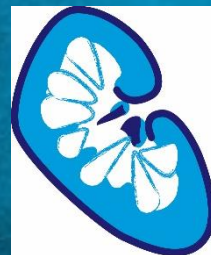


**University of
Nottingham**

UK | CHINA | MALAYSIA

Update from the United Kingdom Renal Imaging Network (UKRIN)

Sue Francis
Sir Peter Mansfield Imaging Centre
University of Nottingham



**UK Renal
Imaging Network**

Transforming kidney health
through technology

UK Renal Imaging Network (UKRIN) brings together major UK renal MRI research centres through membership of a national group of MR physicists, radiologists, and clinicians dedicated to developing imaging methods to study the kidney.

Research networks

The UK Kidney Research Consortium (UKKRC) is jointly hosted and supported by the Renal Association, Kidney Research UK and the British Renal Society.

| | | | |
|---|---|--|---|
| <p>UK Renal Imaging Network Transforming kidney health through technology.</p> <p>Find out more</p> | <p>Clinical study groups Giving focus to the 12 renal medicine sub-specialities.</p> <p>Find out more</p> | <p>UK Renal Trials Network Facilitating the design and delivery of nephrology clinical trials.</p> <p>Find out more</p> | <p>Kidney Patient Involvement Network Improving quality public involvement and engagement in research</p> <p>Find out more</p> |
| <p>UK Renal Regenerative Medicine Network Leading the UK in renal stem cell research and regenerative medicine.</p> <p>Find out more</p> | <p>UK Renal Fibrosis Network Working together to investigate fibrosis in kidneys.</p> <p>Find out more</p> | | |

Clinical Study Groups

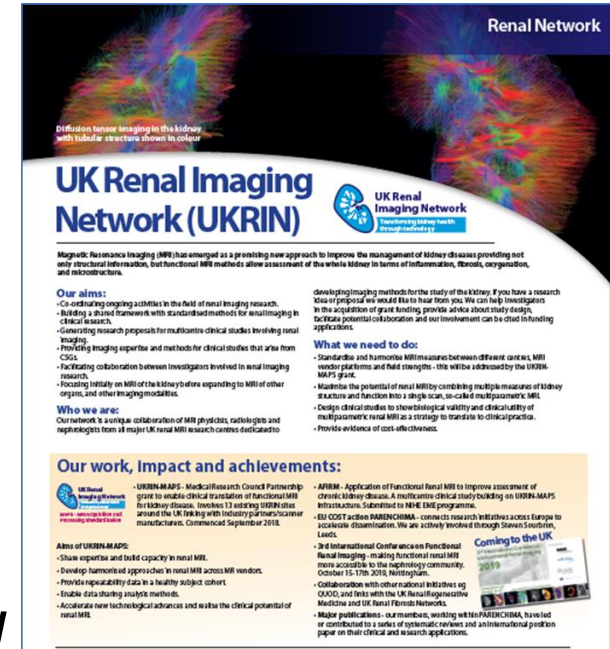
The UK Kidney Research Consortium (UKKRC) established a platform for Clinical Study Groups (CSGs) for 12 renal medicine specialities. Each group has a remit for generating a portfolio of clinical studies that can and should be undertaken in the UK where there is a clear need for more evidence.

| | | | |
|--|---|---|--|
| <p>Acute Kidney Injury</p> <p>Find out more</p> | <p>Anaemia</p> <p>Find out more</p> | <p>Autosomal Dominant Polycystic Kidney Disease</p> <p>Find out more</p> | <p>Cardio-Renal</p> <p>Find out more</p> |
| <p>Chronic Kidney Disease, Progression, Biomarkers</p> <p>Find out more</p> | <p>Exercise and Lifestyle</p> <p>Find out more</p> | <p>Glomerulonephritis, Vasculitis, Lupus</p> <p>Find out more</p> | <p>Haemodialysis</p> <p>Find out more</p> |
| <p>CKD Mineral and Bone Disorder</p> <p>Find out more</p> | <p>Paediatric Nephrology</p> <p>Find out more</p> | <p>Peritoneal Dialysis</p> <p>Find out more</p> | <p>Transplantation</p> <p>Find out more</p> |

UK Renal Imaging Network (UKRIN) brings together major UK renal MRI research centres through membership of a national group of MR physicists, radiologists, and clinicians dedicated to developing imaging methods to study the kidney.

Primary Aims:

- *Co-ordinate activities in renal imaging research*
- *Build a framework of standardised methods for renal imaging.*
- *Generate research proposals for multicentre clinical studies involving renal imaging*
- *Provide imaging expertise for clinical studies that arise from Clinical Study Groups*
- *Facilitate collaboration between investigators involved in renal imaging research*
- *Be inclusive of all imaging modalities*



Renal Network

Diffusion tensor imaging in the kidney with tubular structure shown in colour

UK Renal Imaging Network (UKRIN)

Magnetic Resonance Imaging (MRI) has emerged as a promising new approach to improve the management of kidney diseases providing not only structural information, but functional MRI methods allow assessment of the whole kidney in terms of information, fibrosis, oxygenation, and microstructure.

Our aims:

- Co-ordinating ongoing activities in the field of renal imaging research.
- Building a shared framework with standardised methods for renal imaging in clinical research.
- Generating research proposals for multicentre clinical studies involving renal imaging.
- Providing imaging expertise and methods for clinical studies that arise from CSIGs.
- Facilitating collaboration between investigators involved in renal imaging research.
- Focusing initially on MRI of the kidney before expanding to MRI of other organs, and other imaging modalities.

Who we are:
Our network is a unique collaboration of MRI physicists, radiologists and nephrologists from 24 major UK renal MRI research centres dedicated to

developing imaging methods for the study of the kidney. If you have a research idea or proposal we would like to hear from you. We can help investigators in the acquisition of grant funding, provide advice about study design, increase potential collaboration and our involvement can be cited in funding applications.

What we need to do:

- Standardise and harmonise MRI measures between different centres, MRI vendor platforms and field strengths - this will be addressed by the UKRIN-MAPS grant.
- Maximize the potential of renal MRI by combining multiple measures of kidney structure and function into a single scan, so-called multiparametric MRI.
- Develop clinical studies to show biological validity and clinical utility of multiparametric renal MRI as a strategy to translate to clinical practice.
- Provide evidence of cost effectiveness.

Our work, impact and achievements:

- **UKRIN-MAPS:** Medical Research Council Partnership grant to enable clinical translation of functional MRI for kidney disease. Involved 13 leading UKRIN centres around the UK linking with industry partners/scientist manufacturers. Commenced September 2018.
- **AFIRM:** Application of Functional Renal MRI to Improve assessment of chronic kidney disease. A multicentre clinical study building on UKRIN-MAPS infrastructure. Submitted to NIHR IAG programme.
- **EU COST action IMRENCHINA:** Connects research initiatives across Europe to accelerate dissemination. We are actively involved through Steven Southern, Leeds.
- **3rd International Conference on Functional Renal Imaging - making functional renal MRI more accessible to the nephrology community.** October 15-17th 2019, Nottingham.
- **Collaboration with other national initiatives** eg QUICO, and links with the UK Renal Regenerative Medicine and UK Renal Fibrosis Networks.
- **Major publications:** our members, working with IMRENCHINA, have led or contributed to a series of systematic reviews and an international position paper on their clinical and research applications.

Coming to the UK



Establishing the UKRIN and outputs

1st Meeting: LONDON February 2016
funded by **ISMRM** | **British & Irish**



CHAPTER
Isky Gordon

UKRIN established June 2016



2nd Meeting: NOTTINGHAM, June 2016

3rd Meeting: LEEDS, November 2016

4th Meeting: NEWCASTLE, February 2017

5th Meeting: KRUK, April 2017

6th Meeting: KRUK, July 2017

7th Meeting: GLASGOW, January 2018

8th Meeting: MANCHESTER, June 2018

9th Meeting: CAMBRIDGE, March 2019

10th Meeting: NOTTINGHAM, 3rd Renal Meeting

11th Meeting: SHEFFIELD, 21st January 2020

- Website: <https://kidneyresearchuk.org/research/research-networks/uk-renal-imaging-network/>
- 150 on mailing list – **Sign up!**

September 2017

MRC Partnership grant submission



MAPS - MRI Acquisition and Processing Standardisation

September 2018 commenced

UK Renal Imaging Network (UKRIN): Enabling clinical translation of functional MRI for kidney disease, MRC Partnership, Sept 2018 – Sept 2021.

£795,786

Normative healthy volunteer study



November 2018

NIHR EME submission to 'Functional Imaging' call

Application of functional MRI to improve assessment of chronic kidney disease (AFiRM study)

NIHR EME grant, Sept 2020 – Sept 2026. £1,975,786

CKD Study



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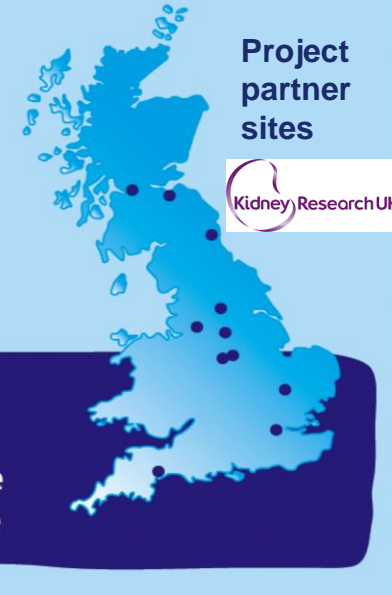
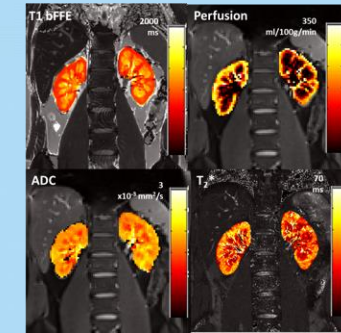
**MAPS - MRI Acquisition and
Processing Standardisation**

UKRIN-MAPS

(see Poster 09)

AIMS:

- To develop **harmonized approaches in multiparametric renal MRI** across 1.5 and 3 T and MR vendors.
- To implement a "travelling kidney" study for within- and between-site reproducibility of phantom and *in-vivo* data.
- To set up a Data Analysis Centre (DAC) using the template of the Dementias Platform UK (DPUK) of open source XNAT informatics.
- To form a normative data set. 50 subjects at 1.5 and 3 T to establish reproducibility and biological variance



Use our QR code to find out more

<https://www.nottingham.ac.uk/research/groups/spmic/research/uk-renal-imaging-network/ukrin-maps.aspx>

Twitter handle: @UKRIN_MAPS



WP1: Governance, Network Activities and Patient Engagement



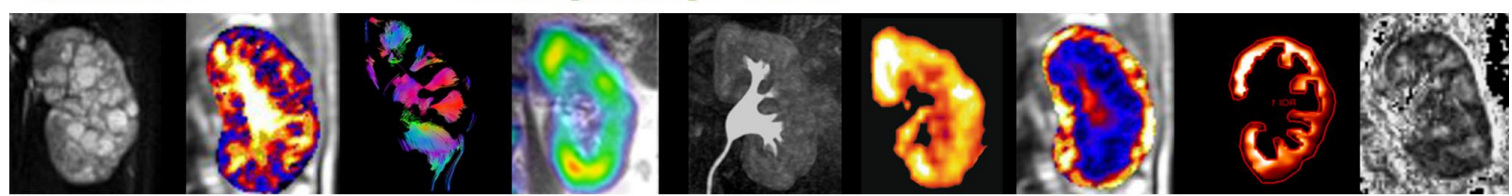
Nottingham, UK
October 15-17th

www.nottingham.ac.uk/go/3rdrenalMRI

Co-organised by



Funded by the Horizon 2020 Framework Programme of the European Union



Patient Engagement

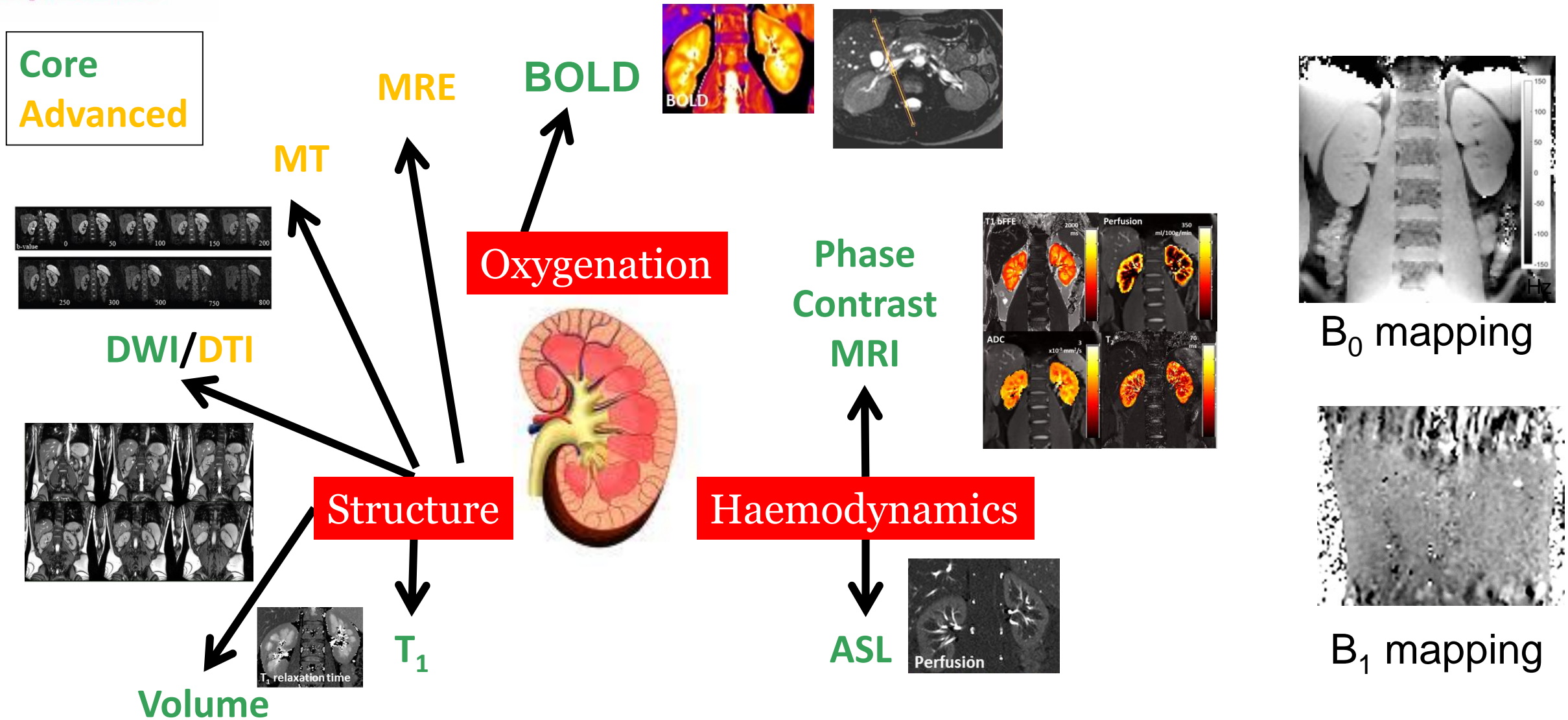
- Patient Engagement Team ensuring patient input into future trial trial. Development of patient MRI information including leaflets, patient videos illustrating case studies of the MRI scan experience.



WP2: Protocol Optimisation and Harmonisation

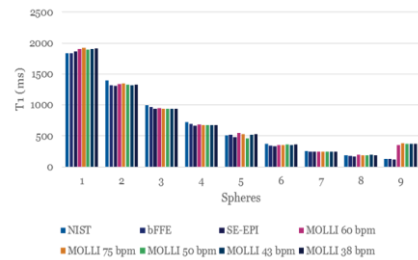
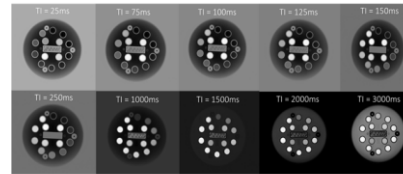
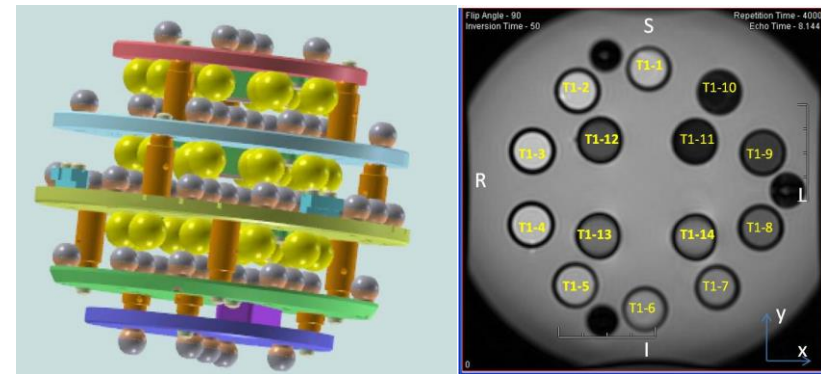
MAPS - MRI Acquisition and Processing Standardisation

Core
Advanced



Lead vendor sites- Nottingham: Philips, Cambridge = GE, UCL = Siemens

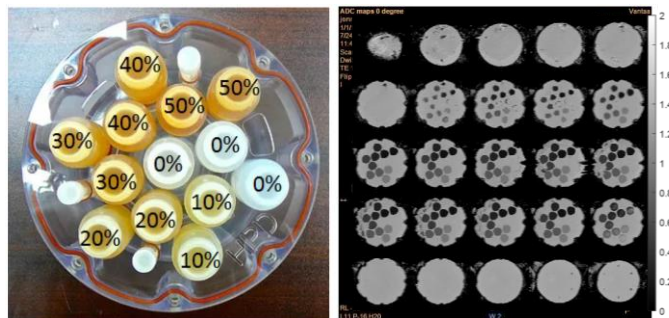
T₁ and T₂ mapping



*Specifications/images are provided as a guide only and are subject to change

<https://collaborate.nist.gov/mriphantoms/bin/view/MriPhantoms/MRISystemPhantom>

DWI



Qalibre MD Diffusion Standard Model 128 phantom

Quality control (QC) procedures.

- Phantom-based and *in-vivo* metrics-informed QC protocols. Standardised QC phantoms and flow phantoms.
- Standard operating procedures (SOPs) for QC. XNAT-based pipelines for evaluating in-vivo image quality.
- Subject-specific QC data metrics, and SOPs.

WP 2: Protocol Optimisation and Harmonisation

Conduct a “travelling kidney” across MR vendors.

- Standardised MR measures and physiological criteria– age, sex, BMI, blood pressure, time of day of scan, hydration status, etc.
 - Nine healthy subjects imaged twice on each vendor to assess test-retest and between-site variability.
 - Five subjects scanned 5 times at their home site at 1.5T and 3T.
- ***Mini-travelling kidney study underway comprising: B0 and B1 mapping, T₁ mapping, DWI and BOLD mapping, and pilot ASL measures.***

Collect normative data set.

- Data collected across UKRIN sites for both 3 T and 1.5 T.
 - 6 x (2 sites) x (3 vendors) = 36 subjects for each field strength.
- 50 subjects’ at both 1.5 T and 3T to establish reproducibility and biological variance for future clinical multi-centre trials.



To develop a **Data Analysis Centre (DAC)** for centralised image processing.

Software for processing multi-parametric renal MRI

- Create a repository of training data, and library of renal MRI image processing and analysis algorithms.
- Harmonise image processing algorithms into a modular architecture.
- Create a user interface for image visualisation, segmentation and processing.

Central Quality Control

- Develop SOP's, training protocols and qualification procedures.
- Implement automated phantom QC measurements and patient QC metrics in XNAT.
- Develop SOP's, training protocols and qualification procedures for observers performing/interpreting the QC measurements.

Online, user-friendly data sharing platform

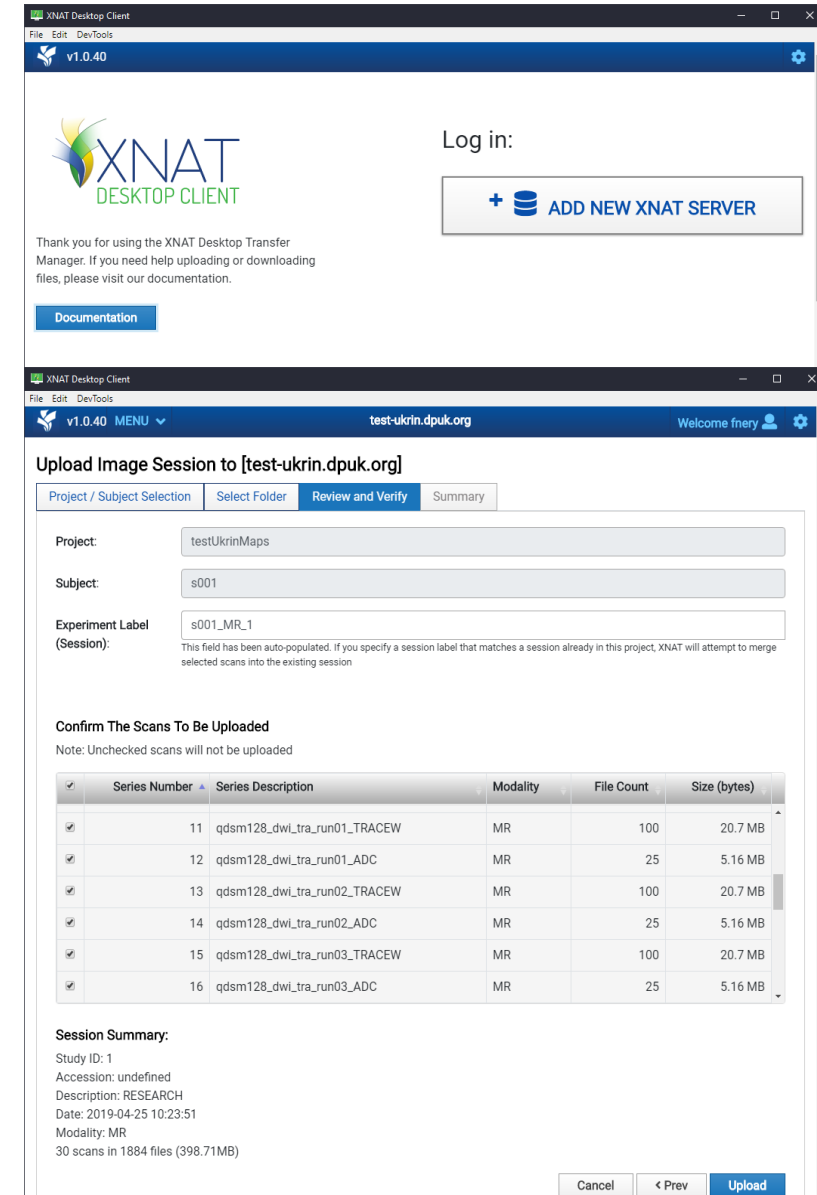
- XNAT-based informatics platform, enabling data to be uploaded easily via a web-based interface. XNAT system allows customised definition of data types and meta-data fields.

Data sharing

- Sharing of each harmonised protocol.
- Upload scans to the central system for sharing or identify the data's existence via the cross-site "aggregator"

Standardised data analysis pipelines

- Analysis pipelines optimised for renal MRI data shared via the DPUK informatics platform XNAT servers, enabling a flexible and uniform interface to a broad range of software.



The screenshot displays the XNAT Desktop Client interface, version 1.0.40. The top window shows the login screen with the XNAT logo and a 'Log in:' section containing an 'ADD NEW XNAT SERVER' button. Below this is a 'Documentation' link.

The second window shows the 'Upload Image Session' workflow for the server 'test-ukrin.dpuk.org'. The user is logged in as 'frery'. The workflow includes steps for 'Project / Subject Selection', 'Select Folder', 'Review and Verify', and 'Summary'. The 'Review and Verify' step is currently active, showing the following details:

- Project:** testUkrinMaps
- Subject:** s001
- Experiment Label (Session):** s001_MR_1

A note indicates: "This field has been auto-populated. If you specify a session label that matches a session already in this project, XNAT will attempt to merge selected scans into the existing session."

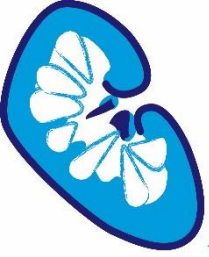
The 'Confirm The Scans To Be Uploaded' section includes a table of scans to be uploaded:

| Series Number | Series Description | Modality | File Count | Size (bytes) |
|---------------|------------------------------|----------|------------|--------------|
| 11 | qdsm128_dwi_tra_run01_TRACEW | MR | 100 | 20.7 MB |
| 12 | qdsm128_dwi_tra_run01_ADC | MR | 25 | 5.16 MB |
| 13 | qdsm128_dwi_tra_run02_TRACEW | MR | 100 | 20.7 MB |
| 14 | qdsm128_dwi_tra_run02_ADC | MR | 25 | 5.16 MB |
| 15 | qdsm128_dwi_tra_run03_TRACEW | MR | 100 | 20.7 MB |
| 16 | qdsm128_dwi_tra_run03_ADC | MR | 25 | 5.16 MB |

The 'Session Summary' section provides the following information:

- Study ID: 1
- Accession: undefined
- Description: RESEARCH
- Date: 2019-04-25 10:23:51
- Modality: MR
- 30 scans in 1884 files (398.71MB)

At the bottom of the interface, there are 'Cancel', '< Prev', and 'Upload' buttons.



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Future Directions

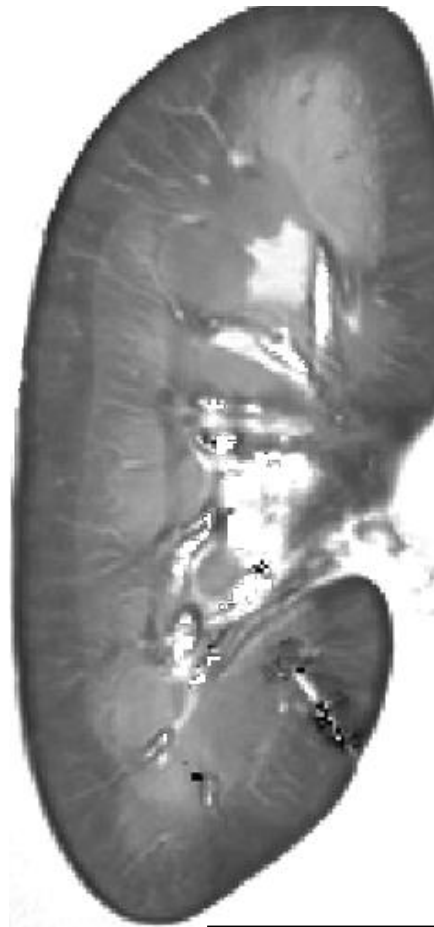
Inflammation /Fibrosis

T1 mapping

T2 mapping

DWI/DTI

Whole organ imaging

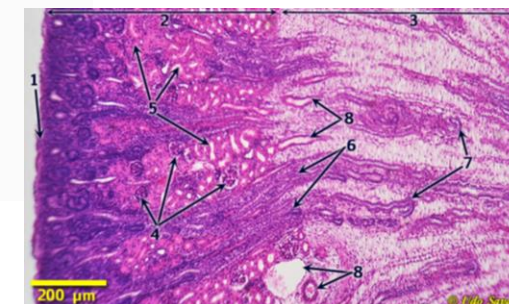
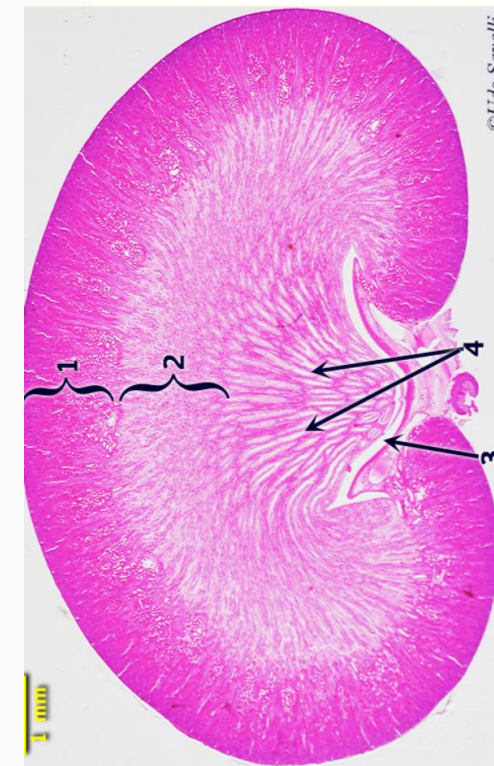


0.25 mm isotropic pig kidney



T₁ mapping

Whole organ histology



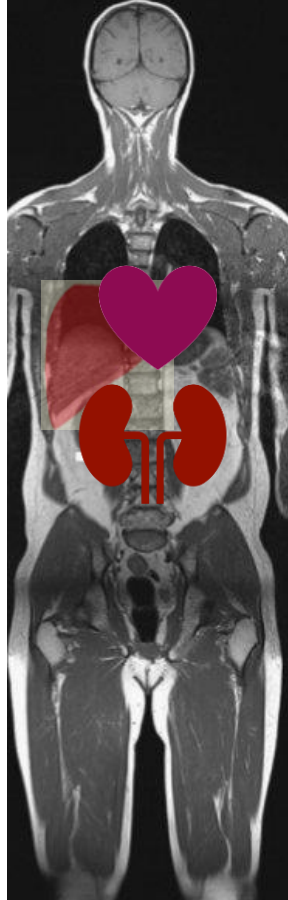
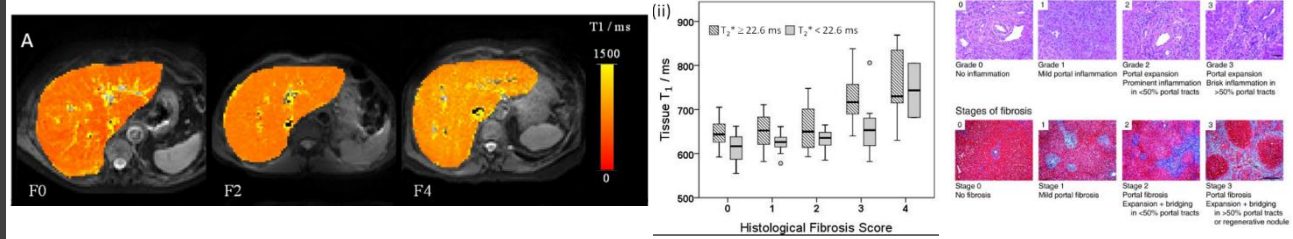
Using imaging in multimorbidity

‘Diseases across organ systems often co-exist due to shared risk-factors, inflammation or fibrosis are common to many organ systems.’

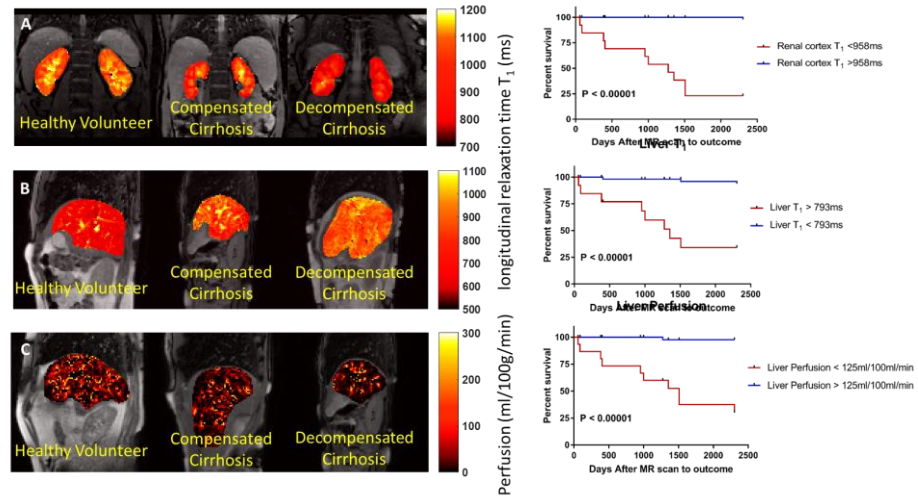


Cardiovascular, metabolic and kidney disease: crosscutting science and best practice

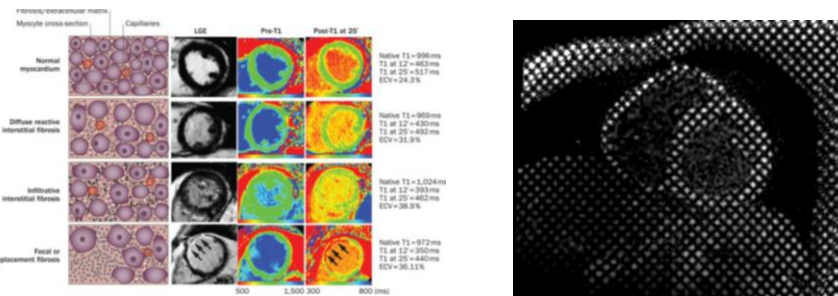
Liver fibrosis and portal hypertension



Predicting decompensation of liver cirrhosis



Cardiac imaging in kidney disease



Everyone involved with the



Website:

<https://www.kidneyresearchuk.org/research/uk-renal-imaging-network>

Twitter handle: @UKRenalImaging



**MAPS - MRI Acquisition and
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Website:

<https://www.nottingham.ac.uk/research/groups/spmic/research/uk-renal-imaging-network/ukrin-maps.aspx>

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