WEST MIDLANDS
IMAGING NETWORK
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PHYSICS REGIONAL SCIENTIFIC MEETING 2024

After the successful relaunch last year, we are pleased to announce the Physics Regional Scientific Meeting 2024. This provides an opportunity to learn more about the West Midlands Imaging Network, meet colleagues from across the West Midlands and share projects that are happening across the region.

Clinical Sciences Building,
University Hospital, Clifford Bridge Rd,
Coventry CV2 2DX

17 September 2024
09:30 - 16:00

wmidsimagingnetwork.nhs.uk
dgft.wmimagingnetwork@nhs.net

NHS

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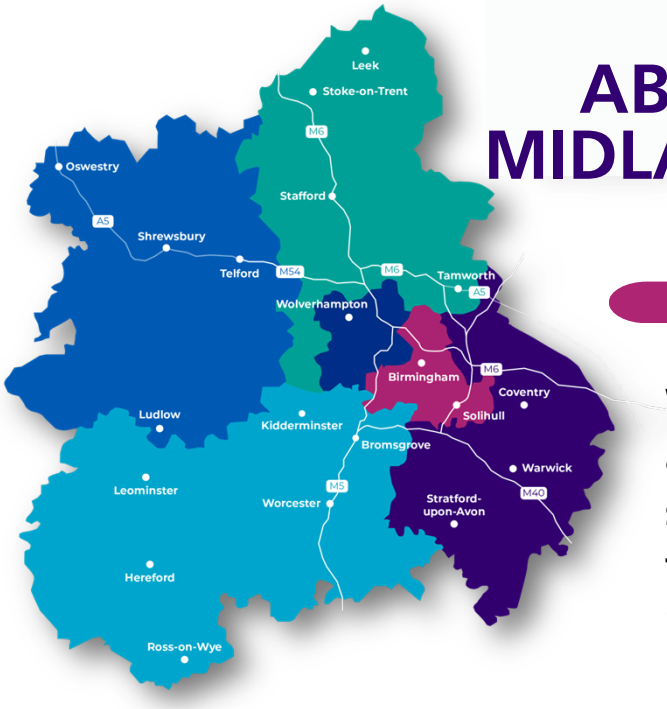

ABOUT THE WEST MIDLANDS IMAGING NETWORK

WMIN has collaboration at its heart that will support the delivery of the National Imaging Strategy

There are 22 Imaging Networks in the Country and West Midlands Imaging Network is the largest network in England.

Networks are used to bring together stakeholders across traditional professional and geographic boundaries. We work with partners to support a collaborative, networked approach to the planning, design, and delivery of integrated, holistic, person-centred care pathways.

High-level key aims of the programme are to improve service resilience, reduce duplication and use economies of scale to enable the latest technology to be purchased in order to develop imaging service provision. The network works to reduce variation in practice, enhance workforce opportunities, and bring equity to patient access.

To find out more visit our website: https://wmidsimagingnetwork.nhs.uk/

Birmingham Women's and Children's NHSFT	The Robert Jones and Agnes Hunt Orthopaedic Hospital NHSFT	University Hospitals Coventry and Warwickshire NHST
George Eliot Hospital NHST	The Royal Orthopaedic Hospital NHSFT	University Hospitals of North Midlands NHST
Sandwell and West Birmingham Hospitals NHST	The Royal Wolverhampton NHST	Walsall Healthcare NHST
South Warwickshire University NHSFT	The Shrewsbury and Telford Hospital NHST	Worcestershire Acute Hospitals NHST
The Dudley Group NHSFT	University Hospitals Birmingham NHSFT	Wye Valley NHST

6.6m
Population

6
Integrated Care Systems

15
NHS Trusts

50
Imaging Sites

125
CT and MRI Scanners

423k
Examinations each month

11%
All activity within England

MORNING PROGRAMME

Time		Presenter
09:30	**Registration and Tea and Coffee**	
10:00	Welcome	
10:05	Introduction to West Midlands Imaging Network	Holly Warriner, WMIN
10:15	Introduction to WMIN Medical Physics Special Interest Group	Mark Rawson, WMIN MPSIG Deputy Chair
	Next Generation of Equipment **Chair: Mark Rawson**	
10:25	Photon Counting CT: Technical Principles, Clinical Use, and Beyond	Dr. Ana Lourenco Pascoal, CT Collaboration Scientist, Siemens Healthineers
10:45	Comparison of Image Quality Between Photon Counting and Energy Integrating CT with Detectability Index	Angus Fraser, Oxford University Hospitals
11.05	Sustainability in Physics (MS Teams)	Gerry Lowe, East and North Hertfordshire NHST
11:25	In-house Developed Software (MS Teams)	Matt Memmott, Manchester University NHSFT
11:45	**Coffee Break and Networking**	
	Proffered Papers **Chair: Lisa Rowley**	
12:05	Assessing the Implementation of SPM and FSL Analysis Software for fMRI within an NHS Trust	Adam Studd, University Hospitals of North Midlands NHST
12:20	MR Spectroscopy in the study of Sports Related Concussion	Robert Flintham, University Hospitals Birmingham NHSFT
12:35	Temporal Resolution in the Use of VDI for Home Reporting	Roger Aukett, University Hospitals Coventry and Warwickshire NHST
12:50	**Lunch and Networking - 2nd Floor Gallery**	

AFTERNOON PROGRAMME

Time		Presenter
	Proffered Papers **Chair: Bahadar Bhatia**	
13:45	C-Arm Dosimetry	Keenan Ngo, University Hospitals Coventry and Warwickshire NHST
14:00	Automation of Treatment Planning System Quality Assurance	Sharon Sandford, University Hospitals Birmingham NHSFT
14:15	An independent comparison of VARSKIN v1.2 and Geant4 Monte Carlo code for skin dose calculations	Greg James, University Hospitals of North Midlands NHST
14:30	Trainee Networking Session - 1st Floor	Chris Prickles and Keenan Ngo
14:30	WMIN MP-SIG meeting	Chair: Mark Rawson
15:50	Prize Giving and Reflections on the day	
16:00	**Close**	

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https://future.nhs.uk/westmidlandsimagingnetwork

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10:45-11:05

COMPARISON OF IMAGE QUALITY BETWEEN PHOTON COUNTING AND ENERGY INTEGRATING CT WITH DETECTABILITY INDEX

Angus Fraser
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Oxford University Hospitals NHS Foundation Trust

Prostate artery embolisation (PAE) is a minimally invasive treatment for benign prostatic hyperplasia (BPH) with reported benefits of lower risk of complications and sequelae than surgical resection [1]. PAE is a technically challenging procedure that demands a highly skilled operator with precise knowledge of the patient's prostatic vasculature. Currently, the procedure is planned through contrast enhanced CT angiography. Visualising the arteries of interest is particularly challenging for CT systems due to their small size, their varied origin, and typical comorbidities of patients with BPH [2]. Recently, patients have been directed to a novel photon-counting CT (PC-CT) scanner for PAE planning as its technical specifications indicate that it is particularly well suited for this task.

The aim of this study is to compare image quality (IQ) of the PC-CT against the current standard of care for PAE planning, a dual-energy, energy integrating CT (DE-CT) for PAE planning. IQ will be assessed for already acquired PAE planning CT images on a qualitative and quantitative basis. The chosen metric for quantitative assessment of IQ is detectability index (d') for visualisation of the prostatic artery, normalised for contrast concentration in the aorta. Calculating d' will enable meaningful assessment of clinical performance across different systems, and thus facilitate more clinically driven and effective optimisation of image quality. This will allow clinicians to plan PAE with more accuracy and confidence, and thus reduce the risk of complications and potentially expand accessibility for this treatment.

References:

[1] "Prostate artery embolisation for lower urinary tract symptoms caused by benign prostatic hyperplasia," NICE, Manchester, 2018.
[2] A. Kobe, G. Puippe, E. Klotz, H. Alkadhi and T. Pfammatter, "Computed Tomography for 4-Dimensional Angiography and Perfusion Imaging of the Prostate for Embolization Planning of Benign Prostatic Hyperplasia," Investigative Radiology, vol. 54, no. 10, pp. 661-668, 2019.

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12:05-12:20

ASSESSING THE IMPLEMENTATION OF SPM AND FSL ANALYSIS SOFTWARE FOR FMRI WITHIN AN NHS TRUST

Adam Studd
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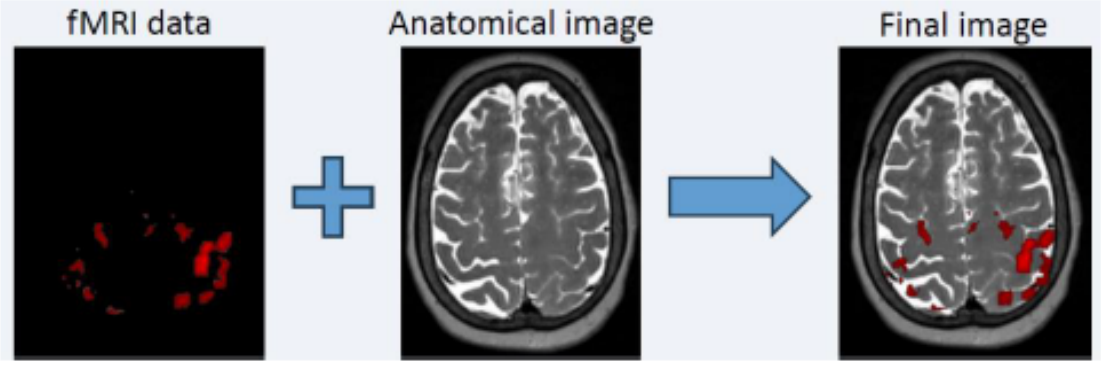
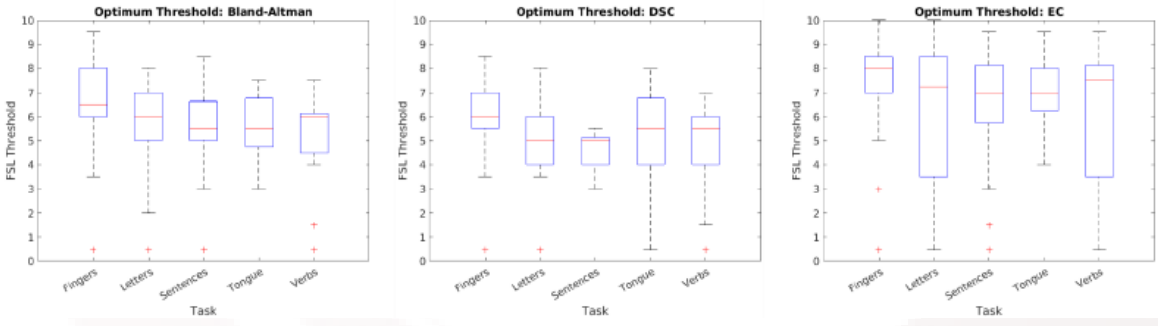
Introduction:
Functional magnetic resonance imaging (fMRI) is an advanced imaging technique that is often used for patients due to undergo brain surgery. Generation of fMRI images requires specialised processing software, with trusts across the UK successfully adopting a range of different analysis packages. This work used statistical and spatial analysis techniques to compare two common analysis packages for use within the UHNM Physics department: Statistical Parametric Mapping (SPM, currently used) and FMRIB Software Library (FSL, a potentially faster alternative).



Methods:
All work was performed with singular relevance to the local Medical Physics department. Methods used closely followed that presented by Bowring et al. (2019)1. This study included 30 clinical datasets from patients that had previously undergone fMRI as part of routine clinical care. Clinical data was reanalysed using SPM (RRID:SCR_007037) to match clinical output. The same data was then analysed using FSL (RRID:SCR_002823) to generate multiple statistical maps with varying thresholds (increments of 0.5 within the range 0.5-10.0). Wherever possible, all other settings were consistent with local clinical analysis processes. A MATLAB analysis program was created to compare SPM and FSL data using Bland Altman, Dice similarity coefficient, and Euler characteristics analysis.

Results:



Conclusion:
Results indicate successful development of a MATLAB comparison script, and support the possibility of adopting FSL for local fMRI analysis. An FSL threshold of 6.0 ± 0.6 should initially be adopted to maximise agreement with local SPM analysis.

References:
1. Bowring, A., Maumet, C. & Nichols, T. E. Exploring the impact of analysis software on task fMRI results. Hum Brain Mapp 40, 3384 (2019).

12:20-12:35

MR SPECTROSCOPY IN THE STUDY OF SPORTS RELATED CONCUSSION

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R. Flintham1, S. Momin2, A. Stevens2, P. O'Halloran2, K. Yakoub2, D. Davies2, A. Belli2, V. Sawlani3, N.P. Davies1
1Medical Physics, University Hospitals Birmingham; 2Neurosurgery, University Hospitals Birmingham, 3Radiology, University Hospitals Birmingham

Background:
Sports related concussion (SRC) injuries disrupt the microstructure of the brain, especially in white matter [1]. However, this cannot be seen using standard Magnetic Resonance Imaging (MRI) and SRC is not assessed with imaging. Clinical symptom monitoring remains the primary marker of recovery, but symptom recovery likely happens before the physical brain injury is fully healed [2]. This risks more severe symptoms and longer recoveries with subsequent injuries, with the effects potentially compounding with each repeated SRC. As part of a wider University of Birmingham study, advanced MRI techniques have been tested to study this subclinical structural damage to the brain, including diffusion imaging (DTI/DKI), resting state functional MRI (rs-fMRI) and Magnetic Resonance Spectroscopy (MRS) to look for indicators of concussion injury that cannot otherwise be seen in MRI in order to better guide return to play and reduce the risk of long-term cognitive effects.

Methods:
Patients were scanned on a 3T MRI scanner (Siemens MAGNETOM Skyra) at multiple clinically-dictated timepoints. Two PRESS [ref] single voxel spectroscopy (SVS) sequences were acquired in white matter and grey matter respectively. MRS was analysed and fitted using the TARQUIN package [3] for metabolite quantification. Patients also underwent clinical symptom testing using the SCAT5 [4] and other assessment tools, and statistical analysis was performed to compare MRS metabolite concentrations with other clinical information and cognitive tests. Retrospective collation of clinical symptom data is ongoing, and approximately 40 of the 240 available MRS datasets are currently included in the analysis.

Results:
Early analysis suggests that the NAA/Cr ratio in white matter is positively correlated with days since concussion injury (r=0.62; p<0.01), which may be suggestive of recovery of brain health following the injury [figure 1]. However, this relationship is not apparent for patients who have suffered multiple concussion injuries [figure 2], which suggests recovery may be disrupted in the event of re-injury. Near significant (p~0.01) differences in NAA/Cr are also seen between groups with more (6+) or fewer (3-6) cognitive symptoms following SRC.

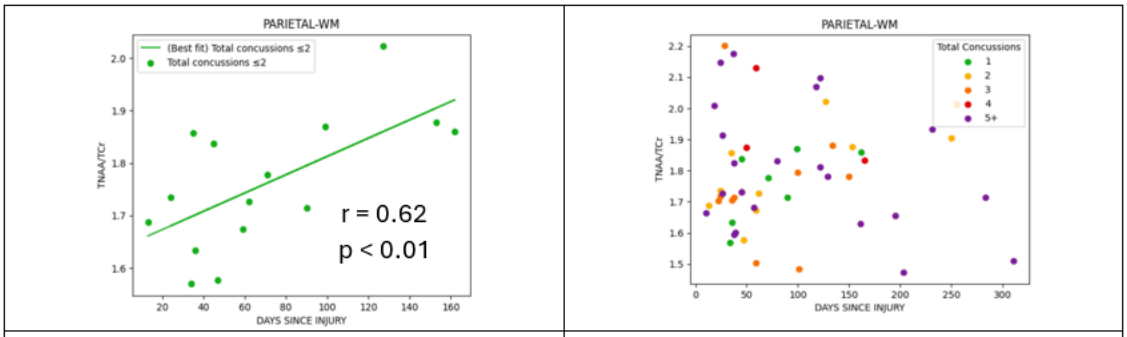

Figure 1: NAA/Cr vs Days since SRC (2 or fewer concussions) – positive correlation

Figure 2: NAA/Cr vs Days since SRC (all patients) – no correlation

Conclusions:
Although a large amount of data collation and analysis remains outstanding, early results are suggestive of a relationship between metabolite concentrations measurable with in vivo MRS and recovery from SRC injuries. However, much more detailed analysis is needed on a larger proportion of the available cohort before any firm conclusions can be drawn, and current statistical power is severely limited by the number of clinical symptom datasets available. Further work will continue collation of clinical data to enable better definition of study cohorts and expand the analysis to a greater number of MRS metabolites.

12:35-12:50

TEMPORAL RESOLUTION IN THE USE OF VDI FOR HOME REPORTING

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In Virtual Desktop Infrastructure (VDI) the PACS software is hosted on a data centre server and the reporting workstation acts as a dumb terminal. For home reporting this has the advantage that the amount of data which need to be downloaded to the workstation is much reduced. Long waits for this to happen are therefore eliminated. However, judder and temporal overlap artefacts may be introduced when scrolling rapidly through an image sequence.

The report of the American Association of Physicists in Medicine Task Group 270 (which superseded TG 18) introduced a multi-frame temporal resolution test pattern TG270-TR.

Some of the radiologists at University Hospitals Coventry & Warwickshire had been encountering long delays in downloading large image sequences to their home workstations. The IT Department proposed introducing VDI running on hospital servers as a solution to this.

The 3 radiologists with the slowest internet speeds were chosen. The TG270-TR pattern was run at 15, 30 & 60 fps. The results were compared with a reference workstation in Radiology Physics running the PACS software internally and via a local-ethernet based VDI. It was found that delay times were driven by display characteristics. The effects of internet bandwidth were not significant.

Following this success VDI was rolled out to all UHCW home reporting users. (In the course of these tests it was noted that the use of lossless compression was essential in maintaining image quality.)

13:45-14:00

C-ARM DOSIMETRY

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University Hospitals Coventry and Warwickshire NHS Trust

Environmental radiation monitoring is an important aspect for radiation safety. At UHCW, for mobile image intensifiers (II), this is undertaken by attaching an environmental dose monitor to the inner part of the C-Arm.

The project aimed to fulfil two key hypotheses: 1) comparing results with published data on scattered doses including relationship between scattered radiation dose and dose area product (DAP) [1], and 2) critiquing the technique on the monitoring of environmental doses; observing whether mean kVs (x-ray tube voltage) for examinations exceeded 100kV, to guide the choice of thickness for lead-equivalent aprons in theatres.

It was found that the relation between the dose and DAP for 9-inch and 12-inch mobile IIs agreed with published data on scatter factors [1].

The average kVs for all 9-inch mobile IIs were below 100kV, whereas a few results exceeded 100kV in 12-inch mobile IIs due to its use for more abdominal work such as endovascular aneurysm repair (EVAR) examinations.

We recommended that 0.35mm lead-equivalent aprons should continue to be used on 12-inch mobile IIs in theatres and most definitely when conducting EVAR examinations. Since all average kVs for 9-inch mobile IIs were below 100kV, 0.25mm lead-equivalent aprons can be considered for use in theatres instead of the current 0.35mm lead-equivalent aprons.

Limitations included the assumption that environmental badges were changed regularly and routinely, so that results can be attributed to a particular month without any overlap. Furthermore, when imaging limbs, it is not always possible to collimate to the anatomy so the recorded scatter will be lower for a given DAP.

References:

[1] Sutton D.G., Martin C.J., Williams J.R. and Peet D.J., Radiation Shielding for Diagnostic Radiology, 2nd Edition, Report of a BIR working party (2012).

14:00-14:15

AUTOMATION OF TREATMENT PLANNING SYSTEM QUALITY ASSURANCE

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Treatment planning system quality assurance (TPS QA) is an essential check to ensure there are no issues in the patient pathway of radiotherapy patients, from receiving their CT images to successfully planning their treatment. TPS QA falls in the bracket of CT tests which confirm image quality and geometric accuracy of CT scans used to plan a patient's treatment. This particular QA verifies the consistency of the Hounsfield units (HU) produced by the CT scanner, checks distances within images are accurate and ensures there are no issues transferring patient data between CTs and TPSs. It's simple test where scans are sent from the CT to various TPSs where the HU and mass densities of a various phantom inserts on a CT scan are extracted and known distances between features on the phantom measured.

Currently TPS QA is carried out manually, however, given its simple and tedious nature it is a perfect candidate for automation. In accordance with IPEM 81, the test must be done for all imaging protocols on a yearly basis and conducted monthly which can accumulate to a considerable amount of time. The work completed reduces TPS QA to a few clicks and a minute or so of time per scan. This have been achieved through utilising the scripting capabilities of RayStation and practicality of QATrack+. Through this work, the time taken to complete TPS QA can be reduced severalfold and results can provide a higher level of thoroughness which would be far too time intensive to match though manual effort. In addition, the script produced can easily be adjusted to work with a myriad of other phantoms and any future imaging protocols that may be implemented within the department.

14:15-14:30

AN INDEPENDENT COMPARISON OF VARSKIN (V1.2) AND GEANT4 MONTE CARLO CODE FOR RADIONUCLIDE SKIN DOSE CALCULATIONS

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Aim
VARSKIN is a software package used for radionuclide skin dosimetry calculations in nuclear medicine and the wider nuclear industry. The aim of this study was to independently compare the VARSKIN (v1.2) skin dose module against Geant4 Monte Carlo code for a variety of typical skin contamination scenarios in a nuclear medicine department.

Method
The geometries available in VARSKIN v1.2 were replicated in Geant4 including disk sources (representing skin surface contamination) and cylinder sources (representing droplet contamination). Four basal depths 70, 140, 220 and 370μm were considered in combination with two glove layers defined by 0.1mm and 0.2mm of natural rubber (ρ=0.92 g/cm3). The instantaneous dose rates (mSv/MBq/hr) were compared for 48 different geometries and 27 radionuclides (N=1296) ensuring a wide range of charged particle and photon energies.

Results
The median relative difference between VARSKIN and Geant4 was +6% (N=1296) however the confidence interval was wide with a large positive skew (95% CI: -30% to +280%). The median absolute difference between VARSKIN and Geant4 was +0.5 mSv/MBq/hr (N=1296). Again, the confidence interval was wide (95% CI: -260 to +40 mSv/MBq/hr) but the absolute differences showed a large negative skew.

Conclusion
VARSKIN tended to give higher dose rates than Geant4 for radionuclides considered to be photon emitters (e.g. 57Co, 51Cr, 123I, 111In, 201Tl) with large relative differences but low absolute differences. Conversely, VARSKIN tended to give lower dose rates than Geant4 for radionuclides considered to be high energy beta particle emitters (e.g. 68Ga, 42K, 82Rb, 90Y) with large absolute differences but low relative differences. Low energy beta particle emitters (e.g. 18F, 131I, 177Lu, 153Sm, 89Zr) showed the best agreement between VARSKIN and Geant4. Overall, the differences between VARSKIN and Geant4 are reasonable in the context of the accuracy required for skin dosimetry. This work indicates that VARSKIN v1.2 is a reliable tool for skin dose assessment for a variety of geometries and radionuclides.

GETTING HERE

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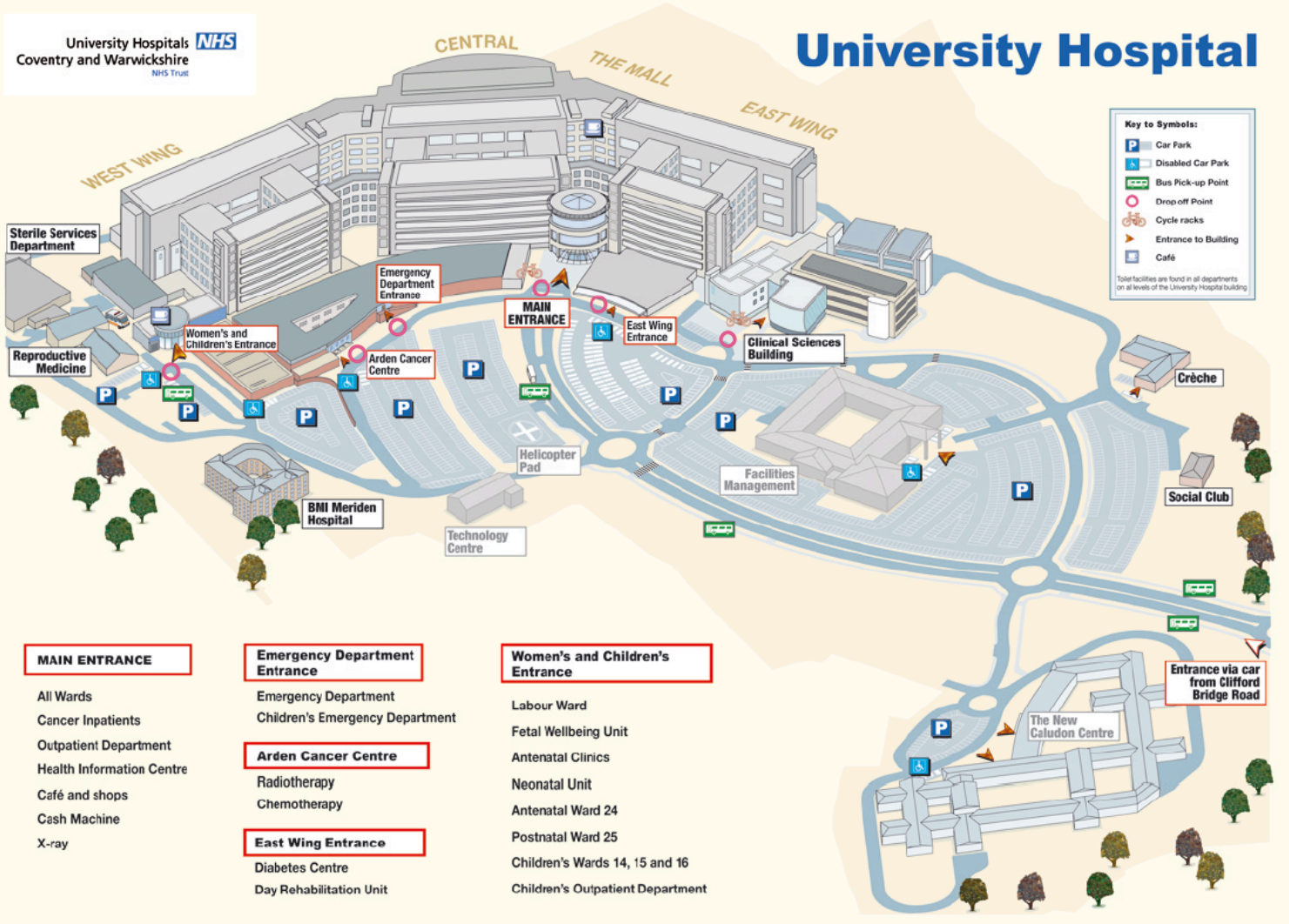

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Thank you for your participation. Best use the QR code below to feedback on the event, which will help us improve this event in the future.

If you have any topics for next year please let us know.

We look forward to seeing you in 2025!

TBC - looking for volunteers

September 2025

NHS

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