Guide for STP Trainees : Imaging with Non-Ionising

IPEM Institute of Physics and Engineering in Medicine

DOPS

	DOPS	Examples of evidence which may relate to this DOPS	Competencies which may share evidence with this DOPS
INIR DOPS	Measure the output of a source of non-ionising radiation	Perform power balance measurement of physiotherapy equipment/output from UV, laser, blue or red light using appropriate meter and detector/filter if needed	
	Perform a risk assessment of a non-ionising radiation facility	ultrasound dept, new/existing laser in theatre/clinical room, UV light therapy suite, risk assessment of an MRI suite	
	Measure and analyse quantitative equipment performance	perform ultrasound/MRI QA and electrical safety test on an ultrasound scanner	
	Measure and analyse quantitative imaging equipment performance	MRI/US QA, T1 mapping (MRI) if available at centre	

CbD

	Examples of possible subjects for CbD. Note that these are not prescribed within the Learning Guide	Examples of possible evidence	Competencies which may share evidence with this CbD
INIR CbD	DVT scan case study (from patient referral/ history, scan, result following patient through to treatment/management in the haematology department	US -write up of DVT patient case study (scan performed by trainee), including scan images, discussion of reasons for referral, symptoms, risk factors for DVT, scan protocol (including choice of imaging controls), patient management following scan (DVT clinic)	PP1-C-1, PP1-c-3, PP1-C-8, PP1-C-8, PP1-C-19
	Discuss non-ionising radiation safety	Discussion on bio-effects of ultrasound/MRI/UV/lasers, current guidelines and standards in non-ionising radiation (e.g. MHRA, BMUS COAR at work regs)	INIR-C4
	Carotid Doppler case study (from patient referral/history , scan, result, through to management (endarterectomy)	write up of Carotid stenosis patient case study (scan performed by trainee), including scan images, discussion of reasons for referral, symptoms, risk factors, disease processes, scan protocol (including choice of imaging controls), patient management following scan (endarterectomy, surgical referral (follow patient through to vascular surgeon and attend surgery if feasible)	PP1-C-1, PP1-c-3, PP1-C-8, PP1-C-8, PP1-C-19
	Design & management of MRI/UV/Laser facility	Discussion on design & management of: MRI facility (e.g. controlled areas, signage, staff/patient screening, categories of staff , patient set-up/coils, MR safety, acoustic noise, contrast agents), UV (e.g. light therapy facility), laser (risk assess a new laser in theatres)	

Competencies

Learning Outcome Subject	Code	Competency	Examples of evidence	Other competencies which may be demonstrated by this evidence
Ultrasound	INIR-C-1	Use Doppler to determine blood flow characteristics, appropriately selecting harmonic imaging, Doppler and other techniques to maximise the diagnostic potential	Formal write up of project: "Investigate the effects of Doppler controls on blood flow measurements". Which covers Initial investigation of the controls using the Doppler flow Phantom, followed by the practical use of the controls in a range of basic clinical Doppler scans (DVT, Carotid, Arterial - both observed and performed by the trainee). To include examples of flow phantom images to demonstrate the effect of the controls, and images from clinical scans performed by the trainee with a discussion of their choice and adjustment of the Doppler and imaging settings: a summary of the controls , how they work, advantages and disadvantages, errors, artefacts, when and why they are used clinically. Attendance at US clinics to observe or assist with Doppler measurements e.g. carotid scans, vein mapping, transcranial monitoring, Obstetric scanning. Documenting types of Doppler used, velocity profiles, PI & RI measurements	INIR-C-2, INIR-C12
Ultrasound	INIR-C-2	Investigate the effects of user-selectable parameters such as Time-Gain Compensation (TGC), gain, power, etc. on the viewable image	Formal write up of project: "Investigate the effects of user-selectable B-mode parameters". Which covers Initial investigation of the effect and use of B-mode controls using QA Phantoms, followed by the practical use of the controls in a range of basic clinical Doppler scans (DVT, Carotid, Arterial - both observed and performed by the trainee). To include examples of phantom images to demonstrate the effect of the controls, and images from clinical scans performed by the trainee with a discussion of their choice and adjustment of the Doppler and imaging settings: a summary of the controls , how they work, advantages and disadvantages, errors, artefacts, when and why they are used clinically. Provide phantom (and clinical if possible) images showing effects of scanner controls image quality. Provide explanations of the how these parameters affect image quality	INIR-C-1, INIR-C12,
Ultrasound	INIR-C-3	Perform routine quality control measurements on ultrasound scanners, including general, small parts and cardiac scanners	Written report of routine B-mode QA tests performed by the trainee, including a summary and discussion of the test regime and procedures, IPEM guidelines, including the reasons/purpose of each test, choice of test phantom, frequency of test and tolerance levels, and any action required. With examples (including images) of test measurements performed by the trainee. As above for Doppler QA measurements with a string phantom	INIR-C6,INIR-C10, INIR-C11, INIR-C12
Ultrasound	INIR-C-4	Make measurements of ultrasound power output	Formal write up of Power balance/hydrophone project by taking measurements using a diagnostic ultrasound power balance and / or suitable hydrophone for B-mode and Doppler mode pulses. Note: Not all departments have the specialist equipment / expertise needed to complete this competency - training courses should be available	INIR-C6,INIR-C10,INIR-C12, INIR-C14
MRI	INIR-C-5	Perform routine quality control measurements on a clinical magnetic resonance scanner	Formal written report of routine MR QA tests performed by the trainee, including a summary and discussion of the test regime and procedures, IPEM/international guidelines, including the reasons/purpose of each test, choice of test phantom, frequency of test and tolerance levels, and any action required	INIR-C5, INIR-C12,
MRI	INIR-C-6	Undertake online and offline analysis and interpretation of the results	Formal written report on analysis of routine MR QA tests including methods/choice of analysis techniques, tolerance levels, and any action required	INIR-C5
MRI	INIR-C-7	Investigate the methods of varying the tissue contrast weighting using a contrast phantom	Formal written report on scanning an "in-house" simple phantom (e.g. test-tubes containing water, oil, sugar solution, paramagnetic salt) including discussion of simple sequences (T1W, T2W, proton density, water/fat saturation) and image contrast	INIR-C12
MRI	INIR-C-8	Review a range of normal and pathological images obtained in one common application using simple pulse sequences	log of MR clinical observations or written case report for common applications (e.g. brain, spine, knee)	

Non-Imaging Modalities	INIR-C-9	Measure and record the output of a range of equipment, e.g. lasers, UV and physiotherapy ultrasound	Formal write up of Power balance measurements performed on a physiotherapy machine, BECA system measurements for a range of ultrasound imaging equipment, UV output measurements, UV clinic (dermatology), laser output measurements. To include discussion of test equipment and test methods, test regimes, reasons for testing , possible faults, tolerance and relevant action. Laser power or energy (per pulse) measurement using an appropriately calibrated head/meter combination. Also, laser spectral output, beam profile (using a camera based system or simple photographic paper), pulse length (using fast photodiode) UV - Make measurement from UVA, UVB, and other intense light sources, e.g. Blue, Red lights, using a spectroradiometer and/or hand held radiometer with the appropriate detectors and filters. Use of work instructions and spreadsheets US - Measurement of power from an ultrasound physio unit over a range of intensities, frequencies, pulsing regimes and transducer sizes. Use of work instructions and spreadsheets Note: Not all departments have the specialist equipment / expertise needed to complete these competences - training courses may be sought as an alternative	RADS4-C-1 to 4 , INIR-C4,
	INIR-C-10	Perform safety and quality control checks on a range of equipment, e.g. lasers, UV and physiotherapy ultrasound	Examples of test reports from ultrasound QA, laser QA, UV QA etc. Laser: visual inspection of external optics, electrical components, warning signs, PPE (goggles). Check warning signals, emergency stop. Assess output as above UV - Completed work instructions documenting visual inspection of UV tubes (type), panels, door interlocks for cabins. Key control, warning signage and irradiance checks. US - Completed work instructions documenting power output checks, timer checks, transducer electrical safety checks. Note: Not all departments have the specialist equipment/expertise needed to complete this competency - training courses may be sought as an alternative	RADS4-C-1 to 4, RADS5-C-1 to 10, INIR-C3, INIR-C5
	INIR-C-11	Measure and analyse quantitative measurements of non-imaging equipment performance	Formal reports and examples of UV QA, laser QA, physiotherapy output measurements. Analysis of laser measurements described above - consider energy/power output in relation to effect on treatment and requirements from standards. Determine cause of any anomalies found, e.g. measurement technique/calibration/accuracy, damage to optics UV -Make measurements for calibrating cabin and Hand/foot machines - considering calibration of the measuring instrument, occupied vs. non-occupied calibration for cabins, tolerances and action levels. US - Analysis of differences between expected and measured power for physio units both in terms of detector inaccuracies, measurement technique and equipment performance Note: Not all departments have the specialist equipment/expertise needed to complete this competency - training courses should be available	RADS4-C-1 to 4, RADS5-C-1 to 10
	INIR-C-12	Work safely in rooms where exposure to non-ionising radiation may present a hazard	US-Example of safe working when performing B-mode/ Doppler ultrasound scans: ALARP, MI, TI, infection control techniques (hand washing, gloves, apron, probe/machine decontamination inc. MRSA, HIV, Cdiff), manual handling techniques, patient safety (chaperoning) MRI- performing MRI QA measurements & investigating tissue contrast Laser-Present during laser treatments and/or measurements. Performing laser measurements/ Provide recommendations to theatre staff regarding use of PPE, Controlled areas and working procedures for laser and UV UV - Performing UV measurements using appropriate PPE and adherence to Risk Assessments and Local Rules	INIR-C3, INIR-C5

	INIR-C-13	Perform a risk assessment of a non-ionising radiation facility	US- checking scanner/probes/cables for damage, trip hazard from cables, ALARA principle scanning volunteer/patients, infection control, correct posture when scanning to avoid RSA MRI - consideration of dangers of working with strong magnetic fields (static, gradient, RF), controlled areas, identifying MR unsafe/MR-safe/MR conditional equipment, acoustic noise Laser-consideration of relative risks in theatre, for example (e.g. for door locking/access to room vs. NOHD, use of goggles/comfort during long surgical procedures with low risk of accidental exposure) UV - Do risk assessments, include: measurement of stray light hazard for AORD calculation for different areas of the clinic, access restriction, and infection control. Audit of appropriate warning signage. Audit of Risk Assessment and Local Rules documentation	RADS4-C-1 to 4, RADS5-C-1 to 10
Equipment Performance	INIR-C-14	Make patient exposure measurements and performance testing on a range of non-ionising equipment	US - formal write-up output measurements (hydrophone/power balance) & QA measurements. MRI - measure acoustic noise, measure static magnetic field using a gauss meter, formal write-up of QA measurements. UV - Do MED calibration and observe MED testing of patients. Treatment dose plan for topical / bath PUVA (Trust/dept. dependent). Formal write up of UV dermatology clinic patient observations. Note: Not all departments have the specialist equipment/expertise needed to complete this competency - training courses may be sought as an alternative	RADS4-C-1 to 4, RADS5-C-1 to 10, INIR-C4
Emerging Modalities	INIR-C-15	Critically appraise an emerging modality	Project write up- i.e.. SMI for EVAR surveillance, US -Implications of tissue specific optimisation on ultrasound QA measurements etc. Document on Elastography imaging / contrast enhanced ultrasound imaging / gene transfection / High Intensity focussed Ultrasound / MRI -short report on emerging/research techniques e.g. MR elastography, MRI-linacs, PET/MR/Raman Spectroscopy	PP1-C-16, PP1-C-25