P131 **Review areas in the search for a primary: Learning points from our cancer of unknown primary MDT experience**

*Nicholas Chua; **Anjali Sujith**; Anita Lazarevska*
Basildon University Hospital NHS Foundation Trust

Background: The incidence of cancer of unknown primary (CUP) occurs in about 0.5-9% of all cancer patients[2]. Identification of the primary lesion is vital to predict the natural progression, treatment options and prognosis for the patient. Patients with cancer of unknown primary have a significantly worse prognosis, with median survival between 6-14 months, than those with readily identifiable primaries either through time delay to treatment or unfavourable aggressive histology[1]. At our institution patients without a readily identifiable primary are referred to the CUP MDT upon which their imaging and histology are reviewed. Through our experience we note a small subset of patients referred to CUP MDT, upon review, actually have an identifiable primary that was not fully appreciated on initial reporting.
Purpose: We describe a series of cases to highlight the various imaging features that radiologists need to be aware of in the search for a primary and thus to avoid delay in appropriate MDT referral and oncological treatment and to afford the patient the subsequent survival benefits.
Summary: The most common radiological discrepancy was found to be pancreatic lesions followed by gastro-esophageal junction lesions and lung and pleural lesions. This study serves to highlight the important review areas for all radiologists with the view to reducing delays in cancer diagnosis and treatment.

1. Pavlidis N. Cancer of unknown primary site: 20 questions to be answered. Annals of Oncology. 2010; 21:vii3003-vi307 2. van de Wouw AJ. Eur J Cancer 2002; 38:409-413

P132 **Nodal staging with TNM 8 in head and neck cancer: How can the radiologist help?**

***Rhys Thomas**; Chris Greenall; Rhian Rhys*
Cwm Taf UHB

We review the new TNM 8 nodal staging for H&N cancer, concentrating on two important changes - extracapsular spread and the occult primary. We present a practical approach to these significant changes in the form of a pictorial review. We demonstrate their implications and how the radiology is key to correct staging and an accurate prognosis for the patient.

1. Lydiatt, W.M. et al.(2017) Head and Neck Cancers—Major Changes in the American Joint Committee on Cancer Eighth Edition Cancer Staging Manual. CA Cancer J. Clin **67**, 122-137.

RADIATION PROTECTION, DOSE OPTIMISATION & QUALITY ASSURANCE

P133 **Saying sorry when a patient receives an unintended radiation dose in the imaging department**

***Nicholas Barlow**; Lisa Field*
Mid Yorkshire NHS Trust

The Francis report highlighted requirements for openness and transparency when things go wrong. The Health and Social Care Act 2008 - ensures that providers are honest with patients and relatives in relation to their care. Other professional bodies have emphasised the importance of duty of candor (DoC); including the National Patient Safety Agency (NPSA), the Department of Health and the Royal College of Radiologists. The NPSA categorise harm into low/minor, moderate, severe and death and advise candour in those of moderate harm. There is confusion regarding this guidance; particularly for unintended doses of radiation as often no direct harm is caused. Radiation dose and risk are often weighted in relation to cancer risk, which causes anxiety and confusion amongst patients when investigation findings are discussed.
This poster will discuss the responsibilities of duty of candour in radiology for unintended doses of radiation and clearly define the professional's role in this process. A comparison between dosage and relevant risk will be provided for reference in local department policy. To assist colleagues with patient feedback (and for everyday explanation of dose to patients) a table of comparative radiation dose sources will be provided that can be tailored to provide a more patient-friendly resource.
The poster will contain the following:
1. Introduction - The need for DoC in radiology
2. Levels of harm - With relative radiation dose
3. DoC Procedure - In flow chart form
4. Patient feedback - Table of comparative doses
5. Conclusion/Recommendations offering advice for clinical practice and scenarios.

P134 **Understanding the patient journey in MRI: the good, the bad and the ugly**

Darren Hudson
InHealth

Background: Understanding the experiences of patients undergoing MRI is fundamental to providing truly patient centred care. The nature of the modality itself is not the most patient friendly and many factors contribute to the ability of patients to successfully complete a scan and have a positive experience. It is an acknowledged barrier to patient compliance and the consequences are important as it can delay or inhibit diagnosis and treatment. Demand and throughput for MRI has increased

rapidly and there is ever increasing pressure to do more for less which places tremendous time constraints on appointment slots. As a result, the imaging process has become more task focused meaning patients can't always be given the time they need. The short period of time in our care also means there is less time to establish a rapport and rapidly connect with patients.
Purpose: To better understand the current patient journey in MRI, some observations of various locations across the business were conducted by an external organisation, the Patient Experience Network (PEN), which highlighted the good, the bad and the ugly.
Summary of content: The patient journey map presented highlights some key themes around patients knowing what to expect, consideration over time and efficiency, how to get results, and recognition of the importance of visual cues. It also supports results from a 'What Matters...' survey conducted with patients to gain insight into what's important to their experience. All of which is helping us define patient experience in MRI.

P135 **Radiation exposure and related risks for pediatric patients undergoing percutaneous intervention (PCI) procedures**
*Ali Abdelrazig [1]; **Mohamed Abuzaid** [2]; Esameldeen Babikir [3]; Esaam Mattar [3]; Batil Alonazi [4]; Abdelmoneim Sulieman [4]*
[1]Radiation Safety Institute, Sudan Atomic Energy Commission, Khartoum, Sudan; [2]University of Sharjah; [3]Department of Radiological Sciences, King Saud University, Riyadh, Saudi Arabia; [4]
Department of Radiology and Medical Imaging, Prince Sattam bin Abdulaziz University, Alkharj, Saudi Arabia
Cardiac catheterisation is an interventional procedure used for the diagnosis and treatment of coronary arteries diseases. Patients are exposed to prolonged radiation exposure during the procedure. Therefore, accurate dose optimisation is recommended to keep the radiation dose as low as reasonably achievable. The aim of this study was to determine patient radiation doses for interventional cardiology procedures, to identify procedures associated with high irradiation doses, and to determine the effects of various parameters on patient doses. A total of 51 patients were examined for a different clinical indication in this study from two cardiology departments. Calibrated X-ray machines were used to perform all the procedures. Patient dose measurements were performed using Dose Area Product (DAP) meter. The mean and range of patient age (year), weight (kg) were 4.9 (0.03-15) and 11.7 (10.0-46.0) respectively. While the mean and range exposure parameters were 63.2 (53-74.2) kVp, 173.2 (134-835) mA and 3.8 (1.7-21.6) min for tube potential, tube current and fluoroscopic time, in that order. The mean and range of the number of films per procedure are 3.8 (1.0-7.0). The mean cumulative average dose (CAD) (cGy/cm2) and effective doses (mSv) were34.08 (32.8-35.9) and 465.61 (380.65-501.13). The dose values are comparable than in the recent literature. Patient dose reduction is of a prime importance and practitioners should optimize the radiation dose for further dose reduction without compromising the diagnostic and therapeutic findings.
1. M. Alkhorayef, E. Babikir, A. Alrushoud, H. Al-Mohammed,A. Sulieman.A Patient radiation biological risk in computed tomography angiography procedure. Saudi Journal of Biological Sciences. 24(2):235-240. (2017). 2. A. Sulieman, K. Alzimami K, R. Gafar.E. Babikir, K. Alsafi, I.I. Suliman. Occupational and patient exposure in coronary angiography procedures . Radiation physics and Chemistry Journal. Vol 104,68-72 (2014). 3. Nada A. Ahmed A. I. Nayel. Pediatric radiation dose during cardiac catheterization procedures in Sudan. Radiation Protection Dosimetry, Vol 174(4) 495–500 (2017).

P136 **Image quality and radiation dose interrelationships during paediatric pelvis radiography - a factorial phantom study**
***Ali Mohammed Ali**; Peter Hogg; Andrew England*
University of Salford
Background: Paediatric pelvic radiography exposure factor selection is difficult due to age/size variations; this study evaluates image quality and dose for a range of acquisition parameters.
Method: 2,016 DR images were acquired using a 5-Year-old pelvis phantom. Acquisition parameters included: KVp (56-89, 3 kVp increments), mAs (1-16, 1 or 2 mAs increments), SID (100, 115, 130 and 145 cm) and filtration (0, 2 mm Al and 1mm Al + 0.1 mm Cu). Image quality (IQ) was assessed using physical and visual methods. Physical included SNR and CNR. Visual involved observers scoring sharpness and noise. Entrance surface dose was measured. Regression and main effect plots were conducted.
Results: Adjusted (R2) was 0.76 for radiation dose; range = 0.31-0.78 for IQ. Increasing additional filtration had the greatest impact decreasing IQ (physical Beta coefficient (B)=-6.72 and visual B=-1.13) and radiation dose (B=-50.0). mAs increased radiation dose (B=17.32) and IQ (physical B=0.63 and visual B=17.32). Elevating KVp increases radiation dose (B=4.92); initially it increases IQ, then it reduces (physical B=-0.15 and visual B=0.49). As SID increases dose reduces (B=-2.60) and IQ remained unchanged (physical B=-0.80 and visual B=-0.09). Main effect plots for each exposure parameter showed different relationships when compared to others: either linear, or non-linear, with plateauing. SID=115cm produced the highest levels of image sharpness.
Conclusion: Paediatric optimisation studies should consider a full factorial design to identify the impact of all acquisition parameters. Increasing KVp whilst reducing mAs produces lower dose and maintains IQ, but only for specific levels of filtration and SID.

P137 **An analysis of paediatric gonadal protection - a quality assurance audit based upon a local protocol**

Fahad Rathore; *Khalid Khan*
Barking, Havering and Redbridge University Hospitals NHS Trust

Background: The Institute of Physics and Engineering in Medicine (IPEM) in their Medical and Dental Guidance Notes state: "For all children, and for all persons of reproductive capacity, gonad shields should be used in examinations which are likely to give a significant gonad dose, unless the shields interfere with the proposed examination". There have been many studies that have highlighted the problem of high rates of inaccurate placement of gonad shielding in children having pelvic x-ray radiographs.
Purpose: We have a protocol on paediatric gonadal shielding in our Trust. We audited it to check how well our practice adheres to the protocol as well as check how easy to implement the protocol is in real life. This was done to improve our practice & patient care as a result because...

- It makes all relevant staff aware of the standards set by the protocol
- It allows the department to highlight areas where practice is falling below the standard set
- It also allows us to highlight areas of practice in which we are excelling.

Summary: Various issues arose with regards to paediatric gonadal protection at our Trust. These include...

- Issues with protocol compliance
- Issues with record keeping (which makes it harder to verify compliance)
- Odd exclusion criteria in the protocol which are hard to justify.

Our poster highlights our performance, our issues and a 7 point action plan for improvement in the future. We hope these can be used to help other Trusts evaluate their protocols too.

1. Medical and dental guidance notes. (2002). York: Institute of Physics and Engineering in Medicine.
2. Sikand, M., Stinchcombe, S. and Livesley, P. (2003). Study on the use of gonadal protection shields during paediatric pelvic X-rays. Annals of The Royal College of Surgeons of England, 85(6), pp.422-425.
3. Fawcett, S. and Barter, S. (2009). The use of gonad shielding in paediatric hip and pelvis radiographs. The British Journal of Radiology, 82(977), pp.363-370.

P138 **Evaluation of image quality, lesion visibility and entrance surface dose for routine adult chest radiography examinations in 8 hospitals**

Sadeq Al-Murshedi; *Peter Hogg; Andrew England*
Salford University

Background: To investigate image quality and radiation exposure when imaging a Lungman adult anthropomorphic chest phantom using routine adult chest X-ray protocols and X-ray machines.
Method: The chest phantom (with and without a 'fat jacket' to represent increased BMI) was used to acquire radiographic images in eight hospitals and 17 X-ray machines, using their existing routine adult chest X-ray protocols. Image quality (IQ) and lesion visibility (LV) were evaluated visually using a relative visual grading analysis (VGA) by six observers. Signal to noise ratio (SNR), contrast to noise ratio (CNR) and conspicuity index (CI) were measured as physical measures of image quality. The entrance surface dose (ESD) was measured using a solid state dosimeter. A figure of merit (FOM) was calculated.
Results: For phantom without the fat jacket, IQ ranged from 10.00-21.83, LV 4.5-12, SNR 13.39-67.39, CNR 9.60-45.51, CI 18.75-66.51, ESD 28.34-200.35 µGy and FOM 0.18-1.19. With fat jacket, IQ ranged from 13.17-26.00, LV 5.83-13.67, SNR 11.33-66.25, CNR 7.48-30.10, CI 10.37-64.93 and ESD 40.25-565.56 µGy and FOM 0.08-1.07. Correlations between IQ and ESD for the phantom without and with fat jacket were r= 0.32 and r=0.60, respectively and the correlation between ESD and LV were r=0.31 and r=0.49 respectively.
Conclusion: Between hospitals there was a considerable variation in image quality and radiation dose. A weak correlation between dose and IQ / LV existed. Differences are likely to be the result of different types of x-ray imaging equipment and protocols used.

P139 **Inpatient chest X-rays: Frequently requested; rarely reported**

Palany Parameshwaran [1]; *Essam Lakha* [2]; *Qaiser Malik* [3]
[1]North Middlesex University Hospital; [2]University College London Hospital; [3]Basildon & Thurrock University Hospital

Images are requested fundamentally because they impact patient management. IRMER states that any medical exposure should be clinically evaluated; and the resulting information, outcomes, and implications be recorded. Many trusts delegate the duty of reporting plain films to the responsible doctor. A retrospective audit was performed for inpatient chest X-ray requests at Basildon & Thurrock University Hospital during 2017. The aim was to assess the number of requests that had a corresponding evaluation documented in the notes - the expectation 100 %. A sample of 95 patients was obtained from across 14 departments and specialities, and information gathered from ORMIS, PACS, and patient records. Only 40 % (38/95) had been formally reported. There was an equal distribution for both males and females, with a mean time of 2 days (range 1 - 9 days) between the image being performed to documentation evidenced in the patient's notes.
Chi-square analysis was performed between gender and whether the image was reported, and was not significant at $p < .05$. There were two outcomes of this audit - firstly, staff education; and secondly, patient safety. Consequently, a sticker was designed to prompt doctors to report images. If 60 % of patients' chest

X-rays are not being reported - it must be considered if they are even being looked at, and whether they are actually necessary? Ideally, all images would be reported by a Radiologist, but there are obvious time and financial constraints. One factor that cannot be counted is the number of missed pathologies.

1. Department of Health (2000). The Ionising Radiation (Medical Exposure) Regulations 2000. London: The Stationery Office.
2. Society and College of Radiographers, British Institute of Radiology (2015). A guide to understanding the implications of the Ionising Radiation (Medical Exposure) Regulations in diagnostic and interventional radiology. BFCR(15)2.

P140 **An investigation into the upper limits of added filtration for projectional radiography of the lumbar spine**

Robert Meertens*; Aaron Box; Ryan Knight; Paul Miles; Suleiman Mohammedbrhan*
University of Exeter

Background: The use of added filtration to reduce patient dose during projectional radiography examinations is established practice. However, most existing evidence is based pragmatically around levels of added filtration available in radiographic equipment, and involves film-screen or computed radiography (CR) systems. We aimed to investigate the extreme upper limits of added filtration and whether there may be scope to further reduce patient dose without detriment to image quality when using digital radiography (DR) systems.

Methods: Repeated antero-posterior projections of the lumbar spine were acquired using an anthropomorphic phantom with increments of 0.1mm added copper filtration added up to a total thickness of 1.0mm added filtration. This was repeated at 70, 81 and 90 kVp. mAs was varied between exposures to ensure images of a comparable exposure index (EI). Dose Area Product and entrance surface dose measurements were recorded and image quality was subjectively reviewed by four experienced radiographers.

Results: As expected, patient dose was reduced as added filtration increased, although the beneficial effects appeared minimal above 0.3mm of added copper filtration. All images were deemed diagnostically acceptable, but there was perceivable differences in image contrast with increasing levels of added filtration greater than 0.4mm of added filtration, despite DR post processing algorithms.

Conclusion: Results suggest that the upper limits of 0.3mm copper filtration on our projectional radiography system are an appropriate balance between minimising patient dose whilst maintaining image quality and protecting against tube loading.

P141 **The impact on image quality with variations in the placement of lead rubber during the lateral lumbar-spine radiographic examination: a phantom study with DR equipment**

Ellie Carter*; Anthony Manning-Stanley; Anthony Ward*
University of Liverpool

Background: The lateral lumbar-spine radiographic examination is a relatively high radiation dose technique[1]. Anecdotal evidence suggests that there is variation in practice as to the placement of lead rubber shielding during this examination; a phantom study with DR equipment was conducted to investigate the impact of this variation on image quality and radiation dose.

Method: An anthropomorphic phantom was exposed at constant tube voltage (75kV$_p$) and 19 tube current-time increments from 1mAs to 63mAs under three experimental conditions; 1) no lead rubber; 2) lead rubber placed against phantom lumbar-spine; 3) lead rubber placed on table. Post-processing was applied to optimise image quality and further collimate the resultant 57 images for blinded review by two reporting radiographers, who scored two aspects of the image exposure and overall image quality on a 3-point scale (1=inadequate, 2=adequate, 3=perfect), giving a maximum score of 9. 10% of images were re-reviewed to determine intra-rater reliability. Effective dose was calculated using PCXMC dose-modelling software.

Results: Median image quality score was highest for setting 2 and lowest for setting 1 (6.0 v 4.5). The mAs beyond which overall image quality was consistently rated as adequate varied by setting; setting 2 the lowest (6.3mAs), setting 1 the highest (32mAs) with an effective dose 5 times higher. A high inter-class correlation coefficient (0.974) indicated reliable image quality ratings.

Conclusion: Variation in the use of lead rubber during lateral lumbar-spine radiographic examinations has image quality and radiation dose implications; lead placed against the back is the optimal setting.

1. Institute of Physics and Engineering in Medicine DRL Working Party. Guidance and Use of Diagnostic Reference Levels for Medical X-Ray Examinations. IPEM Report 88 (IPEM, York) 2004.

P142 **Dose reduction in an alternate lumbar spine projection**

Mei Zi Henrietta Goh [1]*; Wei Yow Sim* [1]*; Yew Mun Kwok* [1]*; Mak May San* [1]*; Lim Chee Yeong* [1]*; Bak Siew Steven Wong* [2]
[1]Singapore General Hospital; [2]Sengkang Health and Singapore General Hospital

Radiology departments routinely perform weight-bearing antero-posterior (AP) lumbar spine X-ray examinations. The postero-anterior (PA) projection has been advocated for certain examinations as a means for dose reduction. Previous studies done on screen-film and computed radiography have compared dose reduction and image quality between AP and PA lumbar radiographs. However, no study investigating dose reduction has been done using digital radiography (DR). This study aims to compare radiation doses and image quality of the erect weight-bearing AP and PA radiographs of the lumbar spine using DR. Ethics approval was obtained.

Conducted in two phases, phase one involved exposing an anthropological phantom at various kVp values. Annealed TLD-100 chips were placed in radiosensitive portions of the phantom to measure the absorbed doses of radiosensitive organs as well as entrance and exit doses. Phase two involved comparing image quality of AP and PA lumbar radiographs. Lumbar spine radiographs were obtained retrospectively from patients with supine and erect abdomen X-rays done from January 2010 to July 2016. Three blinded musculoskeletal radiologists evaluated AP and PA lumbar spine images (N=140) independently using a scale modified from the Commission of European Community (CEC) guidelines. Any discrepancy among reviewers was resolved by consensus.
The PA position demonstrated mean reduction in entrance surface dose of 8.3% and a mean organ dose reduction of 33.7%. No significant differences in image quality were seen between the two positions.
Absorbed dose and entrance surface doses can potentially be reduced for patients by performing their lumbar X-rays in the PA position.

1. Brennan, P. and Madigan, E. (2000) Lumbar spine radiology: analysis of the posteroanterior projection. European Radiology. **10**(7), 1197-1201.
2. Davey, E. and England, A. (2015) AP versus PA positioning in lumbar spine computed radiography: Image quality and individual organ doses. Radiography. **21**(2), 188-196.

P145 An audit on the compliance to the NICE guidelines on head injury and the quality of CT scan referrals

Priyancaa Jeyabaladevan [1]; *Vishnu Naidu* [2]; *Hayder Hassan* [3]
[1]King's College London; [2]Barts Health NHS Trust; [3]Lewisham and Greenwich NHS Trust, Queen Elizabeth Hospital

Background: Approximately 200,000 patients are admitted annually in the UK whereby the presenting complaint is head injury[2]. Although most recover, it's a major cause of physical, cognitive and psychological morbidity. Timely detection, diagnosis and intervention significantly improves prognoses. iRefer and NICE guidelines in 2014 (updated 2017) recommend CT head scans be completed within 1 hour of request, and for suitable patients, be reported within 1 hour of the scan[1,2].
Methods: 50 patients who had a CT head within the 1 hour protocol in A+E were randomized between 01/09/2017 - 30/09/2017. Duration from request to scan completion and scan completion to report availability were calculated. Furthermore, request quality was audited; adequate referrals had a clinical question.
Results: Inadequate clinical information in the request caused 1 patient's data exclusion. 15/49 (31%) patients had CT scans within 1 hour of request. 34/49 (69%) of patients waited more than 1 hour. 44/49 (90%) patients had reports available within 1 hour of scanning with 5/49 (10%) taking more than 1 hour. 39/49 (80%) requests were adequate quality referrals; 10/49 (20%) were inadequate.
Discussion: Although majority of scans were reported within 1 hour, there remains scope for improvement. Majority of referrals were adequate in quality, but 1/5 were not as they lacked a clinical question. Majority of scans also weren't completed within 1 hour. To identify and address sources of delay, a teaching session and discussion with the emergency department and radiologists on NICE guidelines has been organized. A re-audit will be completed in 2018.

1. iRefer. The Royal College of Radiologists. Making the best use of clinical radilogy services 7th Edition. 2012. www.rcr.ac.uk/content.aspx?pageid=995 2. National Institute for Health and Clinical Excellence. CG176. Head Injury :assessment and early management. London. January 2014. https://www.nice.org.uk/guidance/cg176

P146 Investigating the utility of a small field of view gamma camera for radioiodine dosimetry

Alexandra Mackenzie [1]; *Sarah Bugby* [2]; *Layal Jambi* [2]; *Mohammed Alqahtani* [2]; *Alan Perkins* [3]; *John Lees* [2]
[1]University Hospitals of Leicester NHS Trust; [2]University of Leicester; [3]University of Nottingham

Background: Radioiodine therapy (RAIT) is a treatment for hyperthyroidism and thyroid cancer. Patients are administered a set activity of 131I, but differences in uptake, retention and clearance of the radionuclide result in a large variation of thyroid tissue dose between patients. Individual assessments of dose can be made using gamma camera imaging (MIRD method). However, less than 50% of NHS hospitals are currently performing dosimetry on RAIT patients. This may be due to lack of gamma camera availability, or the high cost of imaging every patient at multiple time-points. In this work we investigate whether a small-field-of-view gamma camera (SFOVGC) could be used for RAIT verification instead of a standard gamma camera (LFOVGC). The SFOVGC is portable, meaning that imaging could be performed in a patient side room or local community hospital. In addition, it is likely to be more affordable than a gamma camera.
Method: In this study, we determine whether the technical parameters of the SFOVGC (sensitivity, resolution and count-rate capability) are suitable for RAIT dosimetry. We then use a 3-D printed thyroid phantom to determine whether the SFOVGC can measure thyroid activity as accurately as a commercial LFOVGC.
Results: This study is currently in progress and is due to be completed in April 2018. Initial results demonstrate that the camera is able to detect 131I, and has a linear response up to 50MBq.
Conclusions: The SFOVGC may present a user-friendly and cost effective alternative to standard gamma cameras for RAIT dosimetry. This may increase the uptake of dosimetry.

[1] Bugby, S. L., Lees, J. E., Ng, A. H., Alqahtani, M. S., & Perkins, A. C. (2016). Investigation of an SFOV hybrid gamma camera for thyroid imaging. Physica Medica **32**(1), 290–6.

P147 **Radiation dose optimization: Investigating how planning CT scans on inadequate scanogram affects radiation dose**

Li Jun Lim; *Jia Jun Ng; Siew Teng Boon*
Sengkang Health, Singapore

Introduction: Scanograms are acquired to allow radiographers to plan CT scans of patients. Modern technology uses ATCM technique to dispense appropriate radiation dose to patient based on scanograms. However, at times acquired scanograms may missed areas which requires imaging. This gives radiographers to choose; if to estimate and plan their scans, or to repeat the scanogram. The study aims to investigate if there is a drastic difference in radiation dose to patient when the CT scan is planned on inadequate scanograms.

Method: We reviewed 42 CT body scans over a period of 4 months on a Toshiba Aquilion 64 CT scanner. Adult CT body scans were collected based on the following criteria:

- >18years old
- 50-80kg
- 140-175cm

From the data sets collected, half are planned upon an adequate scanograms while the other half of the studies was scanned based on inadequate scanograms. Patient information and radiation dose incurred were analyzed.

Results: For studies where the scan was performed on adequate scanograms,the average CTDI was 11.3mGy and the average scan length was 41.0cm, while scans performed based on inadequate scanograms,the average CTDI was 11.1mGy and the average scan length was 41.9cm. The mean DLP based on adequate and inadequate coverages were 457.05 mGy.cm and 457.32 mGy.cm.

Conclusion: In conclusion, CT scans planned on inadequate coverage has no significant difference compared to scans planned on adequate coverage.While common practice advocates proper patient positioning,which has its benefits and merits,radiographers should weigh the advantages and disadvantages of repeating scanograms,especially in urgent clinical settings where time is essential.

P148 **Investigation of spatially diverse nodesets for Cyberknife**

James Bedford; *Peter Ziegenhein; Simeon Nill; Uwe Oelfke*
The Institute of Cancer Research and The Royal Marsden NHS Foundation Trust

Background: Cyberknife is used to treat tumours from a large number of non-coplanar directions, allowing a high-quality dose distribution. This study investigates the use of spatially diverse nodesets (SDN) for delivery of a high-quality treatment in a short delivery time using a multileaf collimator (Asmerom et al. 2016).

Methods: An Accuray-developed heuristic method was used to select either 20 or 25 nodes from the standard body nodeset of 110 nodes, such that orientations were as diverse as possible (SDN20 and SDN25). The heuristic was started with each of the 110 nodes in turn, leading to a variety of spatially diverse nodesets. These were then compared with a standard short path of 36 nodes (STD36). Five stereotactic cases were considered, consisting of prostate (homogeneous), prostate (brachytherapy-style), liver, lung and partial breast. Treatment plans were produced using a fast in-house direct-aperture optimisation scheme (Ziegenhein et al. 2013). For two cases, a beam-angle optimisation (Wild et al. 2015) was also used (BAO20 and BAO25). Treatment plans were compared using final objective value, dose-volume histograms and delivery time.

Results: Figure 1 shows the objective values produced for prostate (brachytherapy-style), lower values representing higher quality. Table 1 shows the median objective values for all cases, normalised to STD36. Median estimated delivery time is 37 minutes (STD36), 39 minutes (SDN20) and 40 minutes (SDN25).

Table 1. Final objective function values, normalised to STD36

CASE	STD36	SDN20	SDN25	BAO20	BAO25
Prostate (Uniform)	1.00	0.95	0.95		
Prostate (Brachy)	1.00	0.88	0.84	0.81	0.72
Liver	1.00	0.66	0.65		
Lung	1.00	0.95	0.95	0.80	0.78
Partial breast	1.00	0.92	0.90		

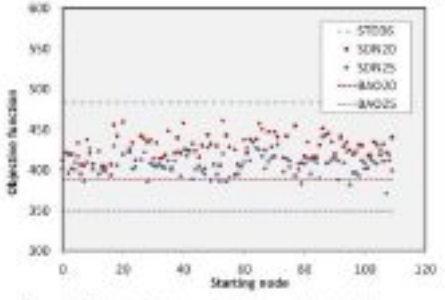

Figure 1. Objective function values in the prostate (brachytherapy-style) case for standard (STD36), spatially diverse (SDN20 and SDN25) and beam-angle optimised (BAO20 and BAO25) nodesets.

Conclusions: The spatially diverse nodesets are able to produce higher quality treatment plans than the standard short path, with comparable treatment time. The authors thank Accuray Inc. for funding this work.

1. Asmerom, G., Bourne, D., Chappelow, J., Goggin, L.M., Heitz, R., Jordan, P., Kilby, W., Laing, T., Maurer, C.R. Jr, Noll, J.M., Sayeh, S. and Weber, A. (2016) The design and physical characterization of a multileaf collimator for robotic radiosurgery. Biomed. Phys. Eng. Express **2**, 017003.
2. Wild, E., Bangert, M., Nill, S. and Oelfke, U. (2105) Noncoplanar VMAT for nasopharyngeal tumors: Plan quality versus treatment time. Med. Phys. **42**, 2157-2168.
3. Ziegenhein, P., Kamerling, C.P., Bangert, M., Kunkel, J. and Oelfke, U. (2013) Performance-optimized clinical IMRT planning on modern CPUs. Phys. Med. Biol. **58**, 3705-3715.

P149 **Proctography radiation dose reduction: An audit at St Peter's and Ashford District General Hospital**

Chandni Patel; *Antoni Sergot*
Ashford and St Peter's Hospital NHS Foundation Trust

Proctography is a dynamic fluoroscopic examination performed for anorectal or pelvic floor dysfunction with many young patients referred for the examination. Therefore, dose reduction should be optimised. This audit evaluates the dose-area product (DAP) of voiding proctography following a in change in examination protocol at St Peter's and Ashford district general hospital. The protocol for performing the examination was changed from multiple single exposure image acquisitions to fluoroscopic screen grab images. Screening times were correlated with radiation dose. With this change in protocol it was found that there was an overall reduction in average total dose for the examination (651 cGycm2) with 85% of examinations now falling under the diagnostic reference level. The overall dose reduction was observed without compromising the diagnostic quality of the examination.

Hart D. Hillier M.C. and Shrimpton P.C.(2010) Doses to Patients from Radiographic and Fluoroscopic X-ray Imaging Procedures in the UK – 2010 Review. Health protection agency HPA-CRCE-034. Hare C. Halligan S. Bartram C.I. Gupta R. Walker A.E. and Renfrew I. (2001). Dose reduction in evacuation proctography. Eur Radiol. 11(3) 432-434.

P150 **Measurement of operator scatter for endoscopy procedures employing tube over couch system**

Paul Charnock; *Ryan Jones; Alex McKillop; Jonathon Mitchell*
IRS Limited

Background: An optimised setup for endoscopy procedures when considering scatter to eye of operators is an undercouch setup. This is topical in light of the change in eye dose limits under IRR17. Manufacturers are now offering multi-purpose overcouch solutions which allow projection radiography, fluoroscopy and tomosythesis. This work will show scatter to staff for standard endoscopy procedures using an overcouch setup.
Method: A Rando-Alderson head phantom was positioned in the approximate positions of the gastroenterologist and the head-end nurse. Mirion Instadose and Landauer TLDs were positioned around the head, neck and shoulders. The patient was simulated using two different anatomically correct tissue equivalent phantoms and 22 cm Perspex slabs from a standard physics QA kit.
Results: Initial results show that the scatter per DAP to the eye at 1 metre was 10 µGy/Gycm2. This is in line with published values for other fluoroscopy procedures. There was no difference in results between the anatomical phantoms and the Perspex. Further results are being collected to determine how monitoring position effects eye dose measurements.
Conclusion: Although a dedicated endoscopy room with undercouch system is preferable under ALARP, an overcouch system could be employed to supplement workload using a multi-purpose room. However, whichever system is used, a detailed risk assessment should be performed as shielding will be required. To inform the risk assessment, the scatter per DAP can be used to estimate eye dose, and where measurements are performed, Perspex slabs, which are more likely to be readily available, are sufficient

1. Martin C, (2011) Personal dosimetry for interventional operators: when and how should it be done. Br J Radiol 84, 639-648 2. Statutory Instruments, (1999) The Ionising Radiations Regulations 1999, HMSO, London, 1999. 3. European Union, (2013). Council Directive 2013/59/Euratom . L13, 57.

P151 **Hospital managers must acknowledge RPE and MPE roles, responsibilities and expertise**

Hugh Wilkins
University of Exeter

Radiation Protection Experts (RPEs) and Medical Physics Experts (MPEs) play crucial roles in the safe and effective use of radiation in medicine. European Basic Safety Standards define an RPE as a recognized individual/group having the necessary knowledge, training and experience to give radiation protection advice and identify MPE responsibilities, which include responsibility for dosimetry of medical exposures[1].
ICRP has recently consulted on a draft report on the 'Ethical Foundations of the System of Radiological Protection'. The report notes that the system is built on three pillars: the science of radiological protection; ethical and social values; and experience accumulated from the day-to-day practice of radiation protection professionals[2]. IRPA has identified knowledge, skills and competences required by an RPE, noting that competences of an RPE include substantial elements of radiation safety management[3]. IRPA emphasize that radiation protection (RP) professionals within an organization must take the central role in supporting management to drive and embed RP culture throughout the organization[4].
RPEs have been instrumental in creating the systems designed to ensure the safe use of radiation in medicine, and play a leading role in managing radiation safety in healthcare. There is a risk that these management roles and responsibilities may be overlooked, particularly during organizational change. Few general managers have a good understanding of radiation dosimetry/risk, and may be unfamiliar with fundamental radiation safety concepts. If managers ignore or over-rule the advice of RPEs they place the safety of patients and staff at risk, and must be prepared to be held to account.

1. EUROPEAN COUNCIL (2013) Basic Safety Standards for protection against the dangers arising from exposure to ionising radiation. 2013/59/EURATOM.
2. ICRP (2017) Ethical Foundations of the System of Radiological Protection [draft report for consultation] http://www.icrp.org/page.asp?id=348.
3. IRPA (2016) Guidance on certification of a radiation protection expert http://www.irpa.net/page.asp?id=54718.
4. IRPA (2014) Guiding principles for establishing a radiation protection culture (2014), http://www.irpa.net/.

P152 **Review of the IAEA international conference on radiation protection in medicine (Vienna, December 2017)**

Hugh Wilkins
University of Exeter

The International Conference on Radiation Protection in Medicine: Achieving Change in Practice, organised by the International Atomic Energy Agency (IAEA) and co-sponsored by the World Health Organization and Pan American Health Organization, was held at the Vienna International Centre, 11-15 December 2017. This was five years after the landmark 2012 conference in Bonn, from which had emerged the Bonn Call-for-Action which identifies 10 priority actions to improve radiation protection in medicine.

The purpose of the 2017 Conference was to review actions taken and developments since the 2012 Bonn conference, especially focusing on actions taken by all relevant parties in line with the Bonn Call-for-Action. This will enable review of the overall approach to implementation of these actions and harmonization of activities between international organizations and other stakeholders, as well as allowing stakeholders to look ahead at new developments impacting on radiation protection in medicine.

Whilst the medical benefits of the use of ionizing radiation in medicine are unquestionable, there is growing evidence of unintended and unnecessary use of radiation in medicine. The conference dealt with justification and optimization in medical exposure; safety in medical use of ionizing radiation; and radiation protection of medical staff and public when ionizing radiation is used for diagnosis, intervention, therapy or research.

The 2017 conference was attended by 534 participants from 97 countries. Invited papers from authorities in the field were supplemented by approximately 200 contributed papers and 80 posters. This presentation will outline the structure of the 2017 Conference, and offer a summary of key points.

IMAGING TECHNOLOGIES & INFORMATICS

P153 **An investigation into the impact of aging on the performance of LCD 2.4 MP colour display monitor when visualising low contrast detail using a CDRAD phantom**

Sadeq Al-Murshedi*; Peter Hogg; khouloud Alzyoud; Andrew England*
Salford University

Background: To Investigate the influence of deterioration of 2.4MP LCD colour display monitor luminance as a result of the long-term use on its performance in visualising low contrast details with different image quality. **Method:** A 2.4 MP LCD colour display monitor was set at three different maximum luminance values (250, 140, and 116 cd/m2) to simulate the monitor in initial use, after 1 year and after 4.6 years. This was based on the monitor being used 24/7. Six CDRAD images were generated using adults chest radiography protocols with different levels of image quality. The images were assessed on the monitor by four observers in three different sessions with the three different levels of luminance to investigate its influence on image scoring. **Results:** Data analysis was conducted via repeated measures of variance (ANOVA). The overall ANOVA has shown that there is no significant difference (p=0.30) between the three ages (the three levels of luminance) of the monitor. Furthermore, the pairwise comparisons between the mean scores of monitor in initial use with that of the other two ages have shown that there is no significant difference among them p=1.00 and p=1.00 respectively. **Conclusion:** The study shows that the monitor aging has no significant influence on its performance for detection of low contrast details and the monitor can be used for clinical practice without needing to be replaced.

P154 **An investigation of the influence of image viewing parameter settings on the performance of 5 MP monochrome liquid crystal display (LCD) monitor in visualising low contrast-detail**

Sadeq Al-Murshedi*; Peter Hogg; Andrew England*
Salford University

Background: To investigate the relation between the observer performance for low contrast-detail detectability and the image viewing settings (magnification, window setting) for a wide range of image quality on a 5 MP monochrome LCD monitor. **Method:** Six images of CDRAD phantom were generated, using adults chest radiography protocols with different image quality.Five observers evaluated the images on a 5 MP monochrome LCD monitor.The images were assessed in four different ways: firstly, the observers were not free in adjusting the contrast, intensity, and magnification of the image; secondly, only the magnification was allowed to be adjusted; thirdly, only the contrast and intensity were allowed to be adjusted; finally, the observers were free to adjust the contrast, intensity and magnification of the image. **Results:** Data analysis was conducted via repeated measures of variance (ANOVA). For the images with high quality, using magnification only, windowing only and using both magnification and windowing have a significant difference on improvement of image scoring p=0.001, p=0.002 and p=0.004 respectively. Furthermore, it was found that image viewing manipulation has a negative influence on image scoring for the ones characterised by low quality.