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# ABSTRACT BOOK


The British Institute of Radiology,
The College of Radiographers and
The Institute of Physics & Engineering in Medicine

## 2A Brachytherapy

**Evaluation of MR-CT fusion for image guided brachytherapy for gynaecological cancer**

Nancy Lewis; Dianne Hussey ; Julia Nevinson

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**Background** Image guided brachytherapy is well-established for the treatment of gynaecological cancers. ICRU Report 89 recommends delineating the target volume on MR to utilise the superior tumour visualisation. At our centre, a para-axial T2 volumetric MR image taken after applicator insertion is fused with CT to enable the HR-CTV to be transferred for organs at risk contouring and treatment planning. This process needs to be accurate and streamlined. The fusion functionality from three commercially available programmes were analysed and compared.

**Methods** The fusion feature on Oncentra Brachy version 4.5.1 was compared with the fusion on Prosoma version 3.3 and Mirada RTx Advanced 1.4. Six patients with Elekta Utrecht or Ring applicators were included. The accuracy achieved was compared by quantifying any difference in applicator positioning once a best-fit fusion had been achieved. Ease of use was also compared.

**Results** Prosoma and Mirada acheive similar standards of fusion (within 1.0mm) for both ring and Utrecht applicators. Oncentra Brachy does not currently offer manual fusion adjustment, and this results in increased time spent and discrepancies of up to 3mm. Prosoma version xx does not import highly oblique MR scans, although this has been corrected in later versions. Mirada Rtx offers a fusion package which is customisable and flexible.

**Conclusion** The disadvantages in using an extra computer programme are outweighed by the time saved and the superior result obtained. Prosoma has the advantage of familiarity within our department, but the fusion and contour transfer process in Mirada is more straightforward and intuitive.

*1. Dolezal M, Odrazka K, Zizka J, Vanasek J, Kohlova T, Kroulik T, Spitzer D, Ryska P, Tichy M, Kostal M and Jalcova L (2012) MRI-based preplanning using CT and MRI data fusion in patients with cervical cancer treated with 3D-based Brachytherapy: feasibility and accuracy study. International Journal of Radiation Oncology Biology and Physics **84** (1) 146-152 2. Mayadev J, Lihong Q, Lentz S, Benedict S, Courquin J, Dieterich S, Mathai M, Stern R and Valicenti R (2014) Implant time and process efficiency for CT-guided high-dose-rate brachytherapy for cervical cancer. Brachytherapy **13** 223-239 3.Tait L, Hoffman D, Benedict S, Valicenti R and Mayadev J. (2016) The use of deformable image registration for CT-based brachytherapy in locally advanced cervical cancer. Brachytherapy **15** 333-340*

## 3B Molecular radiotherapy

**Two-year outcomes of Radium 223 Therapy in metastatic castrate resistance prostate cancer: The Northern Centre for Cancer Care (NCCC) experience**

Sarah Atkinson [1]; Xue Yan Jiang [2]; John Frew [2]; Rhona Mcmenemin [2]; Ashraf Azzabi [2]; Shahid Iqbal [2]; Ian Pedley [2]; Darren Leaning [3]

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**Introduction**: Radium 223 is an alpha particle emitting radiopharmaceutical which is used in the treatment of adults with castration resistant prostate cancer with symptomatic bone metastases and no known visceral disease.

In the Alpharadin™ in Symptomatic Prostate Cancer (ALSYMPCA) phase III study, radium-223 was associated with significantly improved overall survival compared with placebo, making it the first bone-targeted CRPC therapy for which an overall survival benefit has been demonstrated. It also demonstrated the beneficial effects of radium-223 on disease-related symptomatic skeletal events, pain and health-related quality of life.

Radium 223 first became available via CDF funding in Feb 2014 and we started our first patients in March 2014. NICE approval was granted for the treatment in Feb 2016. It is administered intravenously in the Nuclear Medicine Department; and consists of 6 cycles at 4 weekly intervals. We report our experience of treating 143 patients over 2 years with over 600 doses of Radium 223 delivered. We aimed to review our clinical outcomes including survival data.

**Methods:** Baseline pre-treatment data was collected. This included patient's age, performance status and pre or post docetaxel status. Blood parameters were evaluated both at the start and end of treatment and survival information was also extracted from the data. We also measured quality of life during the treatment of these patients, using an abbreviated FACT-P QOL questionnaire and collated the information alongside the survival data.

**Results:** Total number of patients treated n= 143, mean age 71 years (medium 72 years, range 51-84 years). Overall median survival was 8.5 months (c.f ALSYMCA 14.9 months) however patients that completed all 6 cycles of treatment had a median survival of 12.4 months (HR 0.33, 95% CI, P value 0.0001) compared with those patients that did not complete all 6 cycles (4.7 months). There appeared to be benefit with each additional cycles completed (Logrank test for trend, p<0.0001).

Survival by PSA showed those who had a PSA response of >50% from base line (8 patients) have a median survival of 26.8 months. Alkaline Phosphatase reduction during treatment does not correlate with a survival advantage although a clinically significant Alkaline Phosphatase reduction was seen in almost 50% of patients.

Other predictors of survival were performance status with patients who had a survival status of 0-1 at the start of treatment having almost double the median survival (11.9 v 6.6 months). Over 2/3 patients (62.5%) reported improvement in pain levels over the course of treatment with 45.8% reported functional improvement.

**Conclusion:** Our overall survival times did not reach those published but this was calculated from when patient commenced the treatment rather than time of randomisation as was in ALSYMPCA trial. Our quality of life data shows a clear improvement in pain management within this patient population which conforms with the main indication of this treatment.

**Impact of non-rigid registrations for a clinical trial in Peptide Receptor Radionuclide Therapy**

Salvatore Berenato [1]; Elisa Grassi [2]; Federica Fioroni [2]; Domenico Finocchiaro [2]; Mauro Iori [2]; Emiliano Spezi [1]

*[1]School Of Engineering, Cardiff University, Cardiff, Uk; [2]Arcispedale Santa Maria Nuova-Ircss, Reggio Emilia, Italy*

Peptide Receptor Radionuclide Therapy (PRRT) is currently the most effective therapy for the treatment of patients with neuroendocrine tumours (NETs).

To determine the cumulated activity in volumes of interest, serial measurements of activity should be performed following the administration of the radiopharmaceutical, through the analysis of multiple quantitative functional imaging. When sequential scans are tomographic, they should be co-registered to calculate an accurate and reliable patient specific 3D dosimetry. Registration algorithms are normally applied to activity maps. The aim of this study was to investigate the application of deformable image registration algorithms to dose maps, instead of activity maps. The two different workflows used in this study are shown in figure 1.

The accuracy of the registration was quantified using the Dice Conformity Index and verified as excellent in all cases.

Twenty patients treated with PRRT were imaged five times, post-injection of therapeutic administration of 177Lu-labeled peptides with a SPECT/CT scanner. 3D dose calculations were carried out using Raydose Monte Carlo code for both image registration work.

Mean doses to organs at risk calculated with the dose deformation workflow were consistently higher than those calculated with the activity deformation workflow. Such a correlation was not found for the mean dose to the lesions. The percentage difference between the mean dose to organs and lesions is shown in figure 2.

Deformable image registration algorithms were significantly influenced by the different integration method used. A possible optimization to the dose deformation workflow is to use effective decay constants in dose deformation workflow.

*[1] Dewaraja et al. MIRD Pamphlet No. 23: Quantitative SPECT for Patient-Specific 3-Dimensional Dosimetry in Internal Radionuclide Therapy J Nucl Med 2012; [2] Roussakis YG, Dehghani H, Green S, Webster GJ. Validation of a dose warping algorithm using clinically realistic scenarios. Br J Radiol 2015; [3] Schultheiss TE, Tome WA, Orton CG. Point/counterpoint: It is not appropriate to "deform" dose along with deformable image registration in adaptive radiotherapy. Med Phys. 2012. [4] Siegel J. et al. MIRD Pamphlet No. 16: Techniques for Quantitative Radiopharmaceutical Biodistribution Data Acquisition and Analysis for Use in Human Radiation Dose Estimates J Nucl Med 1999; [5] Yeo UJ, Taylor ML, Supple JR, Smith RL, Dunn L, Kron T, et al. Is it sensible to "deform" dose.3D experimental validation of dose-warping? Med Phys. 2012; [6] Zaknun J. et al. The joint IAEA, EANM, and SNMMI practical guidance on peptide receptor radionuclide therapy (PRRNT) in neuroendocrine tumours Eur J Nucl Med Mol Imaging 2013;*

**Comparison of quantitative lutetium-177 (177Lu) measurements in European hospitals**

Jill Wevrett [1]; Andrew Fenwick [2]; James Scuffham [3]; Andrew Nisbet [3]

*[1]University of Surrey; National Physical Laboratory; Royal Surrey County Hospital; [2]National Physical Laboratory; [3]Royal Surrey County Hospital*

Molecular radiotherapy (MRT) is prescribed in terms of administered radioactivity, but this method takes no account of differences in pharmacokinetics between patients, which results in wide variations in absorbed doses. As a result, the dose-effect correlation for many of these therapies are poorly characterised. There is growing demand to perform accurate dosimetry in order to better optimise MRT treatments. One of the therapies for which this is of interest is 177Lu peptide receptor MRT, used to treat neuroendocrine tumours. MRT dosimetry calculations are highly dependent on the quantitative accuracy of the images used to measure the organ-level pharmacokinetics of the radiopharmaceutical. To assess this key step in the dosimetry process, we provided seven clinical centres across Europe with an accurately calibrated 177Lu source consisting of two concentric spherical compartments filled with different radioactivity concentrations, placed within a water-filled phantom to represent a patient's abdomen. The centres were unaware of the true concentrations, and were asked to report their best estimate of the radioactivity concentrations in the two sections of the source, using their own protocols. For the inner source compartment, which contained the higher concentration, all hospitals reported values that were within 20% of the true value, whilst for the outer compartment, deviations of up to 100% from the true value were reported. Our work demonstrates the

need for the development of standardised protocols for both camera calibration and patient acquisitions to enable accurate quantitative imaging, in order for accurate patient dosimetry to be performed that is comparable between hospitals.

## 4E Data

### Effects of registration uncertainties in image-based data mining

Eliana Vasquez Osorio; Alan McWilliam; Marcel Van Herk

*University of Manchester*

**Objective:** Image-based data mining identified dose to the base of the heart as an important predictor for survival in lung cancer patients receiving radiotherapy [1]. Data mining relies on non-rigid registration (NRR) to set inter-patient images into a common reference. Uncertainties in NRR may affect results. We quantified registration uncertainties for two popular NRR open-source packages and assessed the effects on our data mining results.

**Material/methods:** CT data and heart delineations of 386 lung cancer patients were used to estimate NRR uncertainties. An initial affine registration was initialized by scaling based on the lung contours, followed by automatic intensity-based registration. Subsequently, a NRR was performed using two open-source packages: NiftyReg (http://cmictig.cs.ucl.ac.uk/wiki/) and Elastix (http://elastix.isi.uu.nl/). All registrations ignored bony anatomy. Random registration uncertainty was estimated by quantifying the standard deviation of all centres of mass of the heart after registration. Data mining was then repeated with each registration method using a data of 538 patients.

**Results:** The random uncertainties for all registrations are summarized in the following table.

Clearly, NRR uncertainties are significant, and differ considerably.

Large changes are visible in the data mining results, however the same anatomical region was identified for predicting survival for all NRR methods:

**Conclusion:** Registration uncertainties related to NRR vary depending on the registration method. In our results, NiftyReg outperformed Elastix and Elastix was also outperformed by affine registration only, which suggests overfitting of the input data. Results clearly identify the base of the heart as a dose sensitive region affecting survival regardless of the NRR.

*1. A McWilliam et al. (2016) International Journal of Radiation Oncology. Biology. Physics. 96(2S), S48-S49.*

### Towards a state-wide distributed learning and datamining network in radiation oncology to support clinical decisions

David Thwaites [1]; Lois Holloway [2]; Matthew Field [3]; Samir Barakat [3]; Shalini Vinod [2]; Geoff Delaney [2]; Martin Carolan [4]; Michael Bailey [4]; Andrew Miller [4]; Jonathan Sykes [5]; Roland Alvandi [6]; Eric Hau [6]; Verity Ahern [6]; Joerg Lehmann [7]; Jane Ludbrook [7]; Aditya Ghose [3]; David Stirling [3]; Tim Lustberg [8]; Johan Van Soest [8]; Sean Walsh [8]; Andre Dekker [8]

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**Introduction**: Radiotherapy treatment guidelines are based on randomised clinical trial (RCT) evidence. However, many patients are not eligible for RCTs. The concept of a distributed learning network, where data remains at local centres but can be modelled and learnt from jointly, has been reported (1,2) and can provide additional clinical evidence.

**Method**: A NSCLC radiotherapy dataset of 298 patients was evaluated at a single centre to determine the percentage of patient numbers meeting RTOG 9410 criteria. Based on initial single centre machine learning and modelling (3,4), a distributed learning network has been established in NSW, linking to international partners. It has been tested on NSCLC patient datasets across four centres, using lung radiotherapy data extracted and modelled at each centre and then sharing and combining models.

**Results**: Only 25% of patients within the cohort met RCT criteria. Lung cancer radiotherapy data was successfully extracted at the four centres and modelled in each. Imputation of missing values allows more data to be used. Transfer of model learning parameters has been demonstrated between centres.

**Conclusion**: Many patients don't meet RCT criteria on which clinical guidelines are based. A distributed learning radiotherapy data network for datamining and machine learning is shown to enable generation of additional clinical evidence to support treatment decisions for such patients. Models of other treatment sites and the inclusion of more centres are being developed, including exploring the potential for radiomics to inform the models. This can impact on clinical practice and also on improvement of data collection and data quality.

*1. Lambin P, Roelofs E, Reymen B, Velazquez ER, Buijsen J, Zegers CML, Carvalho S, Leijenaar RTH, Nalbantov G, Oberije C, Scott Marshall M, Hoebers F, Troost EGC, van Stiphout RG, van Elmpt W, van der Weijden T, Boersma L, Valentin V, Dekker A, (2013) "Rapid Learning health care in oncology" - an approach towards decision support systems enabling customised radiotherapy'. Radiother Oncol.; 109(1):159–64. 2. Lambin P, van Stiphout RGPM, Starmans MHW, RiosVelazquez E, Nalbantov G, Aerts HJWL, Roelofs E, van Elmpt W, Boutros PC, Granone P, Valentini V, Begg AC, De Ruysscher D, Dekker A. (2013) Predicting outcomes in radiation oncology--multifactorial decision support systems. Nat Rev Clin Oncol. 10(1):27–40. 3. Dekker A, Vinod S, Holloway L, Oberije C, George A, Goozee G, Delaney GP, Lambin P, Thwaites DI, (2014) Rapid learning in practice: A lung cancer survival decision support system in routine patient care data Radiotherapy*

*and Oncology, 113, 47-53 4. Lustberg T, Bailey M, Thwaites DI, Miller A, Rios E, Carolan M, Holloway L, Dekker A, (2016) Implementation of a rapid learning platform: Predicting 2 year survival in laryngeal carcinoma patients in a clinical setting. OncoTarget 7 (24), 37288-96*

## 4F Proffered papers

### Clinical implementation of a knowledge based planning tool for prostate VMAT

Richard Powis; Andrew Bird; Gareth Webster ; John Sage

*Worcestershire Acute Hospitals NHS Trust*

**Background**: Full optimisation of VMAT radiotherapy plans is a complex process with final plan quality dependent upon numerous factors including patient anatomy and planner experience. A knowledge-based planning tool, based upon the work of Moore et al. [1], has been developed and clinically implemented to guide the plan optimisation process for prostate VMAT by highlighting plans that are suboptimal in terms of average rectum dose.

**Methods**: A data mining script was written within the RayStation scripting interface and used to collate plan data for a historical cohort of 97 VMAT prostate plans. This data formed a knowledge base that was used to develop a local model for predicting optimum average rectum dose based on the extent of PTV-rectum overlap. The predictive model was incorporated into a second RayStation script and used during the clinical planning process to provide a patient specific-prediction of average rectum dose enabling the planner to efficiently optimise the plan.

**Results**: Clinical implementation of the knowledge-based planning tool reduced the population averaged mean rectum dose by 5.6Gy. There was a small but statistically significant increase in total MU and femoral head dose and a reduction in conformity index however these did not affect the clinical acceptability of the plans. No significant changes to any other plan quality metrics were observed.

**Conclusions**: The knowledge-based planning tool has enabled substantial reductions in average rectum dose for prostate VMAT patients, particularly those exhibiting low PTV-rectum overlap. This suggests plans are improved when planners receive quantitative feedback on plan quality against historical

*1] Moore KL, Brame RS, Low DA, Mutic S, Experience-based quality control of clinical intensity-modulated radiotherapy planning. Int J Radiat Oncol Biol Phys. 2011; 81(2):545-551.*

### Evaluating a fully automated VMAT planning system with a clinically intuitive site-based calibration

Rosemary Holmes [1]; Micheal Chu [1]; Owain Woodley [1]; Ceri Jones [1]; Rhydian Maggs [1]; Geraint Lewis [1]; John Staffurth [2]; Emilino Spezi [3]; Anthony Millin [1]; Phil Wheeler [1]

*[1]Velindre Cancer Centre; [2]Cardiff University, School of Medicine; [3]Cardiff University, School of Engineering*

**Background** Automated planning has shown to yield high quality treatment plans and improve efficiency [1-3], however incorporating oncologist's knowledge and decision making within the autonomous process is a non-trivial problem. This work evaluates a fully automated VMAT planning solution where a novel, clinically intuitive, site-based calibration has been implemented.

**Method** An automated solution was developed using scripting in RayStation. Calibration was performed on a small cohort of patients for each site, using a GUI to navigate between plans with differing trade-off emphasis. Observing the effect on the DVH and isodoses in real-time during this navigation allowed the operator to precisely select the optimum clinical trade-offs. The calibration was then used for fully automatic, patient-specific, planning.

Automated plans were generated for 40 randomly selected patients (20 prostate & seminal vesicles (PSV) and 20 prostate & pelvic nodes (PPN)). Plans were compared against current clinical practice and ideal plans created by expert dosimetrists in the absence of time pressure. Plan quality was assessed using DVH metrics and a blind qualitative comparison by an oncologist.

**Results** Automated plans met clinical constraints and were dosimetrically equivalent to ideal plans (Table 1). Mean time to create clinical plans was 22mins for PSV and 42mins for PPN. Automated plans were generated in 12 and 32mins respectively with no user interaction.

**Conclusion** Our solution offers a practical approach to include clinical expertise in automated planning, yielding high quality plans. Automated planning reduces dosimetrist workload and can run on a 24h basis, resulting in significant efficiency savings.

*1. Song Y, Wang Q, Jiang X, et al. Fully automatic volumetric modulated arc therapy plan generation for rectal cancer. Radiother Oncol 2016. doi:10.1016/j.radonc.2016.04.010. 2. Voet PWJ, Dirkx MLP, Breedveld S et al. Fully automated volumetric modulated arc therapy plan generation for prostate cancer patients. Int J Radiat Oncol Biol Phys 2014;**88**: (1175 — 1179). doi:10.1016/j.ijrobp.2013.12.046. 3. Wu B, McNutt T, Zahurak M, et al. Fully automated simultaneous integrated boosted-intensity modulated radiation therapy treatment planning is feasible for head-and-neck cancer: A prospective clinical study. Int J Radiat Oncol Biol Phys 2012;**84**:(647—653). doi:10.1016/j.ijrobp.2012.06.047.*

**The impact of electron return effect on radiotherapy plan quality for peripheral sarcomas**

Julie Webb [1]; Robert Chuter [1]; Ananya Choudhury [1]; Marcel Van Herk [2]; Alan McWilliam [2]

*[1]The Christie NHS Foundation Trust; [2]Manchester Academic Health Science Centre (MAHSC), University of Manchester*

**Background:** The electron return effect (ERE) can cause an increase in dose at tissue-air interfaces. Certain cancer types, such as sarcomas, can benefit from on-line MR imaging, with improved soft tissue definition, though it is essential to understand the effect of the magnetic field on plan quality. This study aims to evaluate the impact of the ERE on plan quality parameters such as skin dose and dose to target volumes for peripheral sarcomas.

**Method:** A retrospective analysis of 5 patients was performed using Monaco v5.19 (ELEKTA AB, Stockholm, Sweden) to determine the dose to the skin and the target volume for peripheral sarcoma plans. Simple and complex IMRT plans were created using 8MV beams with a 60Gy in 30# prescription initially at 0T. The magnetic field was then applied and the plans were re-calculated. Finally, the plans were fully re-optimised with the magnetic field on. Plan quality parameters were evaluated to determine the impact of the ERE and whether plans should be fully re-optimised once the field is applied.

**Results:** The mean of the dose to 98% of the CTV over all patients was ~55.5Gy for all simple plans and ~57.5Gy for all complex plans. The max dose to 2cc of the skin was lowest (~59Gy) for plans optimised at 0T and was highest for plans recalculated at 1.5T (~67Gy). This reduced to ~60Gy after re-optimisation.

**Conclusion:** The effect of the ERE on plan quality can be decreased by fully re-optimising plans once the magnetic field has been applied.

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**Volumetric modulated arc therapy (VMAT) for complex breast radiotherapy treatments - planning, delivery and QA experience**

Ali Esmail; Daniel Emmens; Sue Downes; Christine Mackenzie; Charu Joshi

*Ipswich Hospital NHS Trust*

**Background** During the past 12 months, VMAT has been utilised to treat eight complex whole breast cases (four right and four left) where our standard tangential technique could not be clinically utilised. The main reasons for not being able to use conventional tangents included medial tumour beds, proximity of heart to chest wall, involvement of IMC nodes, and previous treatment to contralateral breast. This work presents our experience in the planning, delivery and QA of complex whole breast VMAT treatments.

**Method** Our complex whole breast planning technique utilises a method outlined by Nicolini et al [1] to account for intrafractional respiratory motion and uses 2-4 partial arcs. The number of arcs and collimator settings are determined by the distance that the MLCs need to travel to cover the PTV. Location of the isocentre is very important for arcs that need to rotate under the treatment couch and avoid the patient's elbows. Organ at risk (OAR) doses were optimised using IMPORT HIGH dose constraints and evaluated using QUANTEC data. VMAT is delivered using Varian RapidArc. Verification QA is performed using the PTW 2D array and Octavius phantom.

**Results** Clinically acceptable plans were achieved in all cases. Clinical summary and dosimetric data are outlined in Tables 1 & 2.

OAR doses were comparable to those published in literature. The QA results showed a mean gamma result of 94.2%±2.3% using a DTA of 3%/2mm (Local dose).

**Conclusion** We are now able to treat complicated whole breast volumes in a safe and effective manner.

1. *Giorgia N. (2011) Planning strategies in volumetric modulated are therapy for breast. Med. Phys.* ***38*** *(7), 4025-31.* 2. *Wu Q. (2003) Simultaneous integrated boost intensity-modulated radiotherapy for locally advanced head-and-neck squamous cell carcinomas: Dosimetric results. Int J Radiat Oncol Biol Phys.* ***26****, 573-85.*

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**Hypofractionated dose painting IMRT with 20 fractions for intermediate to high risk prostate cancer**

Joachim Chan [1]; Thelma Rowntree [1]; John Brunt [1]; Laura Howard [1]; John Staffurth [2]; Isabel Syndikus [1]

*[1]Clatterbridge Cancer Centre NHS Foundation Trust; [2]Velindre Cancer Centre NHS Trust*

**Background** The CHHiP trial has shown non-inferiority of 60Gy/20# schedule compared to conventional 74Gy/37# for biochemical control at 5 years. Prostate dose-painting (boosting intra-prostatic tumour volumes, standard dose to the prostate outside the boost volume) may improve biochemical relapse-free survival similar to whole organ dose-escalation, whilst avoiding increased associated toxicity. We present dose painting radiotherapy results for a prospective phase II trial: intermediate to high risk patients treated with 60Gy/20# and concurrent 68Gy boost to intra-prostatic lesions.

**Method** Patients had a multi-parametric MRI and $^{18}$F choline PET/CT prior to androgen deprivation (ADT), and planning MRI and CT following 2 months' ADT. Registration used fiducial markers. Intra-prostatic boost volumes were outlined by combining visually identified lesions on MRI and PET. Rotational IMRT planning was performed. Patients with unexpected regional lymph

node PET uptake also received pelvic radiotherapy with boost. Toxicity evaluation was performed with the IPSS and RTOG scale. Endpoint was acute toxicity at 18 weeks.

**Results** 61 patients have been planned and treated, 5 with concurrent pelvic radiotherapy. At 18 weeks, median IPSS score was 5.5 (range 0 to 28). Worst acute bladder and bowel was grade 2 which returned to pre-treatment levels by week 18. GU toxicity was more prevalent than bowel toxicity.

**Conclusion** Prostate radiotherapy with hypo-fractionated dose painting schedule of 60Gy/20# with 68Gy boost to intra-prostatic lesions was technically feasible and well tolerated in this cohort study.

## 6B Adaptive IGRT

### Spotlight mode: reducing imaging time and dose to improve the patient experience

Kirstie Smith [1]; Carl Horsfield [2]; Robins Kpaul [2]

*[1]Hull & East Yorkshire Hospitals; [2]Hull And East Yorkshire NHS Trust*

**Background** Progress in radiotherapy is driven by the need to increase tumour dose whilst decreasing the dose to surrounding structures. On-treatment imaging enables greater precision and accuracy of radiotherapy. With the advent of Cone-Beam CT (CBCT) it is possible for Therapy Radiographers to visualise soft tissue and correct for discrepancies on-line. With the Varian Truebeam it is possible to take a Spotlight image.

**Method** Truebeam V2.6 Spotlight modes for Thorax and Pelvis were introduced in January 2016 for all SABR patient images beyond the first CBCT and for 4 out of 5 days a week for prostate patients respectively. Full CBCT for prostate patients weekly was maintained for the assessment of shape change. Spotlight Pelvis was introduced for prostate only due to concerns regarding visualising PTVs and OARs for larger nodal volumes.

**Results** Spotlight reduced CTDI significantly by 25% and 40% for SABR and Pelvis respectively. The 44% faster quicker timescan reduced motion blurring for lung patients as fewer respiratory cycles are observed, ultimately providing sharper tumour visualisation. Anecdotally, prostate patients tolerated treatment imaging better where repeat scans were necessary. A move to more patients imaged using Spotlight can reduce treatment times and improve machine availability.

**Conclusion** Spotlight imaging can improve image quality, reduce concomitant dose and improve the patient experience. Care should be taken in application as it may not be suitable for all patients e.g. where the external contour is pertinent. Future developments include optimising spotlight imaging parameters, introducing them to other suitable patient groups and developing modes.

### Reduced 4D CBCT scan time in lung cancer patients

Abigail Bryce-Atkinson [1]; Alan Mcwilliam [1]; Tom Marchant [2]; Corinne Faivre-Finn [1]; Gillian Whitfield [2]; Marcel Van Herk [1]

*[1]University of Manchester; [2]The Christie NHS Foundation Trust*

**Background** Image guided radiotherapy based on respiration correlated cone-beam CT (4D CBCT) provides accurate tumour localisation by taking into account respiratory motion when deriving setup correction[1]. However, normal scan times are quite long, e.g. 4 minutes. This study aims to assess the feasibility of reduced scan times by evaluating the effect on image quality, registration accuracy and tumour motion detection.

**Methods** 4D CBCT images were reconstructed from 8 lung cancer patients with minimum 800 projections (120kV, 16mA, 10-40ms), sorted into 10 respiratory phase bins. Reduced scan time and dose was simulated by discarding projections for every other respiratory cycle, equivalent to halving scan time. Image quality was assessed by visual comparison and testing registration accuracy for bone (3D) and tumour (4D), assessing tumour motion in superior-inferior direction in comparison to full projection scan.

**Results** Discarding half the respiratory cycles had little impact on registration accuracy or ability to detect tumour motion. The maximum discrepancy compared to the full projection scan for tumour registration was 0.7mm and 1mm for tumour amplitude, with all others below 0.5mm. All visual image quality was poorer in the simulated 2 minute scans; however both tumour and bony anatomy remained visible.

**Conclusion** We used a new simulation method to evaluate the effect of halving the scan time on 4D CBCT. With half the scan time, registration and motion detection accuracy is maintained, while image quality remains acceptable. Halving the scan time improves patient throughput (especially when multiple scans are made) and limits radiation exposure by half.

*1. Sonke, J. J., Zijp, L., Remeijer, P. and van Herk, M. (2005) Respiratory correlated cone beam CT. Med Phys, 32(4), pp. 1176-86.*

**Modelling daily anatomical changes in patients undergoing radical radiotherapy for head and neck squamous cell carcinoma**

Yaolin Zheng [1]; David Noble [2]; Khojasta Talash [1]; Daniel West [1]; Sambavi Sritharan [1]; Yori Endo [1]; Jin-Min Yuan [1]; Neil Burnet [2]

*[1]School of Clinical Medicine, University of Cambridge; [2]Department of Oncology, Addenbrooke's Hospital*

**Background** Patients undergoing radical radiotherapy (RT) for head and neck squamous cell cancer (HNSCC) undergo substantial anatomical change during treatment. Adaptive RT can mitigate this risk, but data to guide when this should take place is scarce. We sought to model intra-treatment anatomical change in a population of HNSCC patients.

**Method** We devised a measure, lateral neck diameter (LND, the skin-to-skin distance of a line passing behind the mandibular rami and anterior to the C1 vertebra), to approximate mid-parotid level. Daily LND measurements were made on every image-guidance mega-voltage CT from 66 patients with HNSCC in the [*name removed*] study who had undergone IG-IMRT with TomoTherapy.

**Results** Kolgomorov-Smirnov testing showed daily separation reduction data were normally distributed. Mean final reduction in LND was 12.9 mm (95% CI ±1.9). LND stayed approximately static until fraction 4, after which it followed an overall downward trend (approximating line of best fit $y = 0.0068x2 - 0.4903x + 0.1493$, $R^2 = 0.98$). 45% of this change occurred by the start of week 3 (fraction 11). Interestingly, a greater drop occurred over weekends; whilst LND was static or increased slightly over weekdays (see Fig. 1).

**Conclusion** The overall trend of our results supports previous studies, but our finer temporal resolution reveals a previously unreported 'weekend effect'. Much of the reduction in LND occurs early, which is mechanistically interesting and has implications for timing of adaptive RT. Further research will aim to explore this 'weekend effect', and link anatomical changes with toxicity outcomes.

## 9A UKRO proffered papers

**Clinical outcome and hippocampal dosimetry in patients treated with stereotactic radiosurgery for brain metastases across South Wales**

Iqbal, Najmus Sahar[1]; Powell, James[2]; Tilsley, Owen[2]; Bryant, Andrew[2]; Millin, Anthony[2]; Lewis, David Geraint[2]; Staffurth, John[2]

*[1]Cardiff University; [2]Velindre Cancer Centre*

Stereotactic radiosurgery (SRS) has demonstrated improved survival and neurocognitive function (NCF) in patients with 1-3 brain metastases and high functionality compared to whole brain radiotherapy (WBRT) [6]. Significant proportion of patients experience worsening neurocognition post-treatment despite its precision [3]: 63.5% of patients undergoing SRS alone had neurocognitive decline [2]. The hippocampus has been implicated in neurocognitive impairment following radiation although the tolerance dose of hippocampus remains unclear for SRS. A dose of >7.3Gy delivered to >40% of the hippocampi during fractionated radiotherapy correlated with worsening neurocognition [3,4]. In animals, low dose of 2Gy exhibited increased apoptosis in hippocampi [1].

We performed a retrospective review of all patients treated with SRS without WBRT over 1year. Patients with 1-3 brain metastases and WHO performance status 0-2 were included. We studied dose delivered to hippocampi. Bilateral hippocampi were outlined manually according to RTOG0933-atlas and dose volume histograms were recreated using iPlan-RT-Dose4.5[4]. 30 patients were treated between January2015-2016. Mean age was 61years. Common primary sites were lung, kidney and melanoma. 19 patients had a single metastasis. 70% patients were alive for more than 6-months after SRS; median survival was not reached. Dose to 0.1cc of the hippocampus was >5Gy in 8 and 2-4.9Gy in 12 patients. 6 patients received >5Gy and 8 received 2-4.9Gy to 50% of the hippocampus.

Objective neurocognitive assessment was not attempted due to the challenges of collecting such data retrospectively. We are about to launch a prospective study in patients undergoing SRS to correlate detailed radiation dosimetry, NCF and functional MRI measurements of the hippocampus.

*1. Acharaya M. M. et al (2010) Consequences of ionizing radiation-induced damage in human neural stem cells. Free Radical Biology and Medicine 49: 1846–1855 2. Brown P. D. et al (2016) Effect of radiosurgery alone vs radiosurgery with whole brain radiation therapy on cognitive function in patients with 1 to 3 brain metastases: A randomized clinical trial JAMA 316(4):401-409. 3. Chang, E. L. et al (2009) Neurocognition in patients with brain metastases treated with radiosurgery or radiosurgery plus whole-brain irradiation: a randomised controlled trial. Lancet Oncol 10:1037-44 4. Gondi V. et al (2013) Hippocampal dosimetry predicts neurocognitive function impairment after fractionated stereotactic radiotherapy for benign or low-grade adult brain tumors. Int J Radiat Oncol Biol Phys 85(2):348-54 5. Gondi V. et al (2010) Hippocampal contouring: An contouring atlas for RTOG 0933 6. Tsao, M. et al (2012) A meta-analysis evaluating stereotactic radiosurgery, whole-brain radiotherapy, or both for patients presenting with a limited number of brain metastases. Cancer 118: 2486-93*

**Implementation of sabr for pancreatic tumours**

Peter Enever; Richard Garratt ; Kelly Picken ; Catriona Buchan

*Leeds Cancer Centre*

**Introduction** - Radiotherapy for locally advanced pancreatic cancer is rapidly gaining interest with advancements in patient immobilisation, planning and imaging. Through strong MDT collaboration at Leeds Cancer Centre we have implemented SABR for pancreatic tumours.

**Methodology** - To enable SABR for pancreas we purchased immobilisation equipment including Elekta Bodyfix vac bags and the CIVCO compression arch. New contrast enhanced CT scanning protocols along with abdominal 4DCone Beam CT (4DCBCT) were developed and tested.

**Outcome** - Although abdominal compression offers a reduction in organ motion for some patients it presents many challenges. The requirement for 4DCBCT due to organ motion has a reduced image quality making anatomical visualisation harder. Due to these challenges a full MDT presence was required at each treatment to aid in tumour and organ at risk matching.

**Discussion** - Pancreatic radiotherapy is very challenging however with our MDT approach we can optimise the radiotherapy delivery. Increased accuracy of radiotherapy allows dose escalation and availability for patients who would have been ineligible previously; consequently the increase in knowledge and skills has led to the introduction of abdominal SABR and recruitment in to the SPARC trial. As a result radiotherapy becomes a more viable option for patients with pancreatic cancer.

**A UK collaborative approach to MR-only radiotherapy treatment planning: improving the patient experience and treatment accuracy**

Richard Speight [1]; Hazel Mccallum [2]; Jonathan Wyatt [2]; Emily Johnstone [3]; Charles Kelly [2]; Ann Henry [3]

*[1]Leeds Cancer Centre; [2]Northern Centre For Cancer Care; [3]Leeds Institute of Cancer And Pathology*

An MR-only based radiotherapy planning process offers advantages in treatment accuracy and improved patient experience over conventional CT-MR based techniques. The Leeds Cancer Centre and Northern Centre for Cancer Care are collaborating to implement an MR-based planning pathway which can be adopted by other NHS hospitals. This approach is intended to be suitable for those with conventional linear accelerators with X-ray-based image guidance, as well as centres with access to MR-guided treatment machines. The project covers a number of studies which will investigate clinical, technical and practical aspects of MR only planning throughout the patient pathway:

- The impact of geometrical distortion on the production of individual treatment plans
- Methods of generating pseudo CT from MRI for treatment dose calculation
- The accuracy of dosimetric calculation for patient plans
- Development of a rigorous quality assurance program to ensure the accuracy of a single modality pathway
- Evaluation of auto-contouring options to optimise clinical volume delineation
- Investigation of methods of treatment verification to ensure accurate treatment delivery

An overview of the overall project will be presented, providing an outline of the technical and practical challenges which the sub-studies seek to address. Initial results from work performed in the first year of the three year project will be described including:

- Early results in developing an MR-only prostate cancer planning technique
- Initial investigations into an MR-only solution for brain cancer patients
- Quality assurance developments required to provide clinical confidence in an MR-only pathway.

**Assessment of the effect of geometric distortion in diffusion-weighted magnetic resonance imaging on positional errors in a bladder phantom**

Jane Rogers [1]; Victoria Sherwood [2]; Spyros Manolopoulos [2]; Jon Duffy [1]

*[1]University of Warwick; [2]University Hospital Coventry and Warwickshire*

There is increasing interest in the use of multi-parametric magnetic resonance imaging (MRI) such as diffusion weighted imaging (DWI) and the resulting apparent diffusion coefficient (ADC) maps for informing radiotherapy treatment and assessing tumour burden or response [1]. The next step is to assess the feasibility of using this information to directly influence radiotherapy planning. However, the relatively large inherent geometric distortions in such images mean it is difficult to use them to directly infer position of tumour volumes. This study assesses the magnitude of geometric distortion using a clinically appropriate in-house phantom designed to mimic the bladder and muscle-invasive bladder cancer. Using CT, T2-weighted MR and DWI, the position of 17 markers on the surface of the 'bladder' was assessed and correlated using rigid and deformable registration algorithms.

The position of each marker on the surface of the spherical bladder was identified, and positional agreement found to be on average (range) 2.6 +/- 0.9 mm (1.2 - 4.7) with rigid registration and 1.8 +/- 0.7 mm (0.6 - 2.9), 1.8 +/- 0.6 mm (0.4 - 2.8), 1.8 +/- 0.7 mm (0.2 - 2.6) with various deformable registration algorithms.

These results are in keeping with others in the literature [2] and indicate that there is potential to incorporate the added information from DWI into the radiotherapy treatment plan, provided such errors are further quantified and accounted for.

*1. Malayeri, A. a, El Khouli, R. H., Zaheer, A., Jacobs, M. a, Corona-Villalobos, C. P., Kamel, I. R., & Macura, K. J. (2011). Principles and applications of diffusion-weighted imaging in cancer detection, staging, and treatment follow-up. Radiographics: A Review Publication of the Radiological Society of North America, Inc, 31(6), 1773-91. 2. Weygand, J., Fuller, C. D., Ibbott, G. S., Mohamed, A. S. R., Ding, Y., Yang, J., ... Wang, J. (2016). Spatial precision in magnetic resonance imaging-guided radiation therapy: The role of geometric distortion. International Journal of Radiation Oncology Biology Physics*

## 11H UKRO proffered papers

**Dose to patients from X-ray imaging in Radiotherapy -- an update from the IPEM working party**

Tim Wood [1]; Matthew Williams [2]; Mark Cowen [3]; Anne Davis [4]; Rosy Plaistow [5]; Rebecca Lindsay [6]

*[1]Hull And East Yorkshire Hospitals NHS Trust; [2]Velindre Cancer Centre; [3]Peterborough NHS; [4]Portsmouth Hospitals NHS Trust; [5]Cambridge University Hospitals; [6]Leeds Teaching Hospitals NHS*

In June 2016, a new working party was formed by IPEM to audit typical imaging doses and image quality for the full range of X-ray imaging procedures undertaken in Radiotherapy departments. This includes planning CT scans, on treatment CBCT imaging, and may also consider other modalities such as planar X-ray and fluoroscopy. As there is currently no definitive guidance on radiation dose levels for the numerous imaging procedures associated with modern radiotherapy, this working party will aim to publish a range of typical doses for common procedures (in much the same way as PHE do with national reference doses in diagnostic imaging). It is hoped that making this data available to the UK Radiotherapy community will enable better optimisation of imaging to ensure doses are ALARP, whilst maintaining image quality that is sufficient for the clinical task (so in some cases, doses in some centres may need to increase!). It is hoped this work will identify best practice that will ultimately benefit patients. This talk will discuss the background to project and give a brief overview of the plan for data collection and analysis, including dose audit and image quality assessment. An overview of initial results for CT planning scans will be presented and the plan for CBCT audit will be outlined.

**Utilising non-invasive mechanical ventilation to facilitate rapid shallow breathing: controlling motion in radiotherapy**

Nicholas West [1]; Shahid Iqbal [1]; Christopher Walker [1]; Michael Parks [2]; James Prentis [1]; Christopher Snowdon [1]; Jill McKenna[1]

*[1]Newcastle Upon Tyne Hospitals NHS Foundation Trust; [2]School of Sport Exercise And Rehabilitation Sciences. Birmingham University*

**Background** In radiotherapy, accounting for respiratory motion increases the volume of normal tissues irradiated, increasing radiation induced complications. There has been limited work using mechanical ventilation to control breathing in a radiotherapy setting with previous studies utilising frequency transrespiratory techniques which are invasive, uncomfortable and impractical for routine use. This study evaluates a new rapid shallow non-invasive ventilation (rsNIV) technique to regularise and minimise lung volume variations over a period long enough to deliver complex high dose radiotherapy.

**Method** rsNIV was used on normal volunteers in 2 respiratory modes; eupneic frequency and rapid shallow cycles, up to a maximum of 35 cycles per minute. Sagittal datasets, focussed on the diaphragm, were acquired on an MR scanner to assess respiratory motion in eupnea and mechanically ventilated modes. Repeat scans were performed to assess reproducibility over multiple sessions.

**Results** Subjects reported rsNIV to be comfortable and tolerable with basic physiological responses measured during and after controlled respiration periods, confirming no adverse effects.

Motion analysis of the diaphragm in the superior-inferior direction (largest component of tumour motion), showed that rsNIV was successful in both regularising and reducing respiratory motion.

**Conclusion** For the first time, rsNIV has demonstrated feasibility and reproducibility in regularising and minimising lung volume variations in a radiotherapy setting. This work will be extended to patients undergoing radiotherapy and if successful, used to reduce uncertainty margins, doses to normal tissues and hopefully complications associated with radiotherapy to thoracic and abdominal regions.

**Cost effectiveness analysis of PET-CT for oesophageal cancer**

Nor Aniza Azmi [1]; Hairil Rashmizal Abdul Razak [2]; Sobhan Vinjamuri [3]

*[1]University of Technology Mara Malaysia; [2]University Technology of Mara, Puncak Alam, Selangor, Malaysia; [3]Royal Liverpool Broadgreen University Hospital Trust, L7 8Xp Liverpool, United Kingdom*

**Background**: Review of publication and retrospective data to develop decision making model-based economic evaluation to investigate the relative cost-effectiveness of PET/CT in oesophageal cancer management staging compared with conventional pathway.

**Materials & methods**: Retrospective analysis of patient data from 2001-2008 taken from medical records and Cancer Intelligence Services database. A decision tree was developed using TREEAGE software. The model estimated the mean cost associated with each diagnostic procedure and assumed that patients entering the model were aged 35-75 years. The results of the cost-effectiveness analysis are presented in terms of the incremental cost-effectiveness ratios (ICERs).

**Results**: The ICER for the strategy of PET compared with conventional work-up was estimated at £29,300 per QALY; the ICER for PET/CT compared with PET was £ 31,000 per QALY; and the ICER for PET/CT combined with conventional work-up versus PET/CT was £ 42,100. Clearly, for each additional diagnostic test that is added to PET, the more expensive the package becomes, but also the more effective it becomes in terms of QALYs gained. The probabilistic sensitivity analysis shows that at a willingness-to-pay threshold of £ 20,000 per QALY.

**Conclusions**: Result of the current analysis suggests that the use of PET/CT in the diagnosis of oesophageal cancer is likely to be cost-effective given the current willingness-to-pay thresholds that are accepted by decision-making bodies. Future studies need to secure robust cost data that can be verified from more than one source for the diagnostic tests and reliable and verifiable data on quality of life.

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**Developing a communication tool for assessment and mobilisation of patients with metastatic spinal cord compression**

Chowdhary, Rahul; Cornelius, Nicola; Pitts, Deborah; Ward, Erica; Wilkinson, Jenni; Carr, Leanne
Lincoln County Hospital

**Aim and objectives:** The aim of this review was to develop a reliable tool to assess spinal stability and establish the optimal timeline to mobilise the patient, leading to the development of a guideline for consistency of care.

**Background**: Assessment of spinal stability is vital to plan for treatment and mobilisation strategy in patients with metastatic spinal cord compression (MSCC). There is evidence to indicate that care for patients with unstable MSCC is based on individual clinician preference rather than evidence-based guidelines which has been shown to cause delays and discrepancies in patient treatment. This institution established a multi-disciplinary group to develop a tool to assess stability and aid communication to ensure clarity of patient mobilisation and avoid unnecessary bed rest.

**Results:** The review identified that evidence relating to spinal stability, bracing, patient mobilisation and positioning is limited. However, using the spinal instability in neoplastic disease (SINS) criteria, as a key resource, a multidisciplinary team within this institution was able to develop a guideline which assessed spinal stability and gave clear indications for mobilisation with or without brace

**Conclusion:** An institutional guideline was developed for identifying unstable spine and treat patients accordingly so as to cause minimum delay in treatment and minimally disrupt quality of life of a patient balanced against patient safety.

Currently, the evidence base to plan care is limited, and further research in this area is necessary

*Fourney D; Frangou E; Ryken T et al; (2011) Spinal instability neoplastic score: An analysis of reliability and validity from the spine Oncology Study Group: Journal of Clinical Oncology: 29 (22) 3072-3077 Sheehan C. (2016) Defining spinal instability and methods of classification to optimise care for patients with malignant spinal cord compression: A systematic review Radiography 22 77e83 Lee S, Grant R, Kennedy C, Kilbride L (2015); Positioning and spinal bracing for pain relief in metastatic spinal cord compression in adults (Review) National Institute for Health and Clinical Excellence (2008). Metastatic spinal cord compression: diagnosis and management of adults at risk of and with metastatic spinal cord compression. London. The Association of Chartered Physiotherapists in Oncology and Palliative Care (2014) GAIN MSCC Rehabilitation Guidelines*

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**Potential impact on patients of proposed reconfiguration of radiotherapy provision in England**

Katharine Chase ; Andrew Bird ; Richard Hayden ; Gareth Webster

*Worcestershire Oncology Centre*

**Background** Recent proposals for Modernising Radiotherapy services [1] suggest smaller radiotherapy centres could treat only a sub-set of eligible patients within their population, the justification being that for less-frequent indications centralised expertise could enhance treatment quality. However, for indications where sufficient expertise can be assured locally, patient experience must be considered. This work uses patient demographic data to quantify the impact of the proposed change on patient travel time and distance.

**Method** Postcodes for all (n=50) upper GI patients treated over a 12 month period at a centre with catchment population of approximately 500,000 were obtained from the Oncology Management System. Distance and time of travel was established using Python scripting and Google Maps API [2] for each patient journey assuming treatment (i) locally, (ii) at a neighbouring regional centre (Centre 1) and (iii) at the likely regional Lead Provider (Centre 2).

**Results** Mean additional daily travel distance to Centre 1 was 66.8 miles (i.e. 1336 miles for 20 fractions) and 18.7 miles to Centre 2 (i.e. 374 miles in total). 10% of patients would have to travel an additional 49.5 miles or more per fraction to reach their closest alternative centre. Mean additional daily travel time is approximately 1.2 hours (24 hours overall) to Centre 1, 0.6 hours (12 hours overall) to Centre 2.

**Conclusions** The proposed changes by NHS England could have significant negative impact on patient experience. Provider networks should strive to establish governance measures that will enable high-quality local provision wherever it can be safely

*1. NHS England. 2016. Modernising Radiotherapy Services in England – developing proposals for future service models. Specialised Commissioning. https://www.engage.england.nhs.uk/survey/264ceb37/supporting_documents/rtdiscussionguide.pdf 2. Google maps API Documentation https://developers.google.com/maps/documentation/*

## 2B Proffered papers: clinical Monday 11.30-12.50

### Interpretation of TMJ pathology - a jaw-dropping review

Gary Cross [1]; Joseph Barnett [2]; Fern Adams [2]; Kevin Lotzof [3]

*[1]London Deanery; [2]Royal Free Hospital; [3]Barnet Hospital*

The TMJ is a joint with complex and dynamic anatomy. Disease of the joint is common and present in up to 28% of the adult population. The most frequent pathology is internal derangement, although the joint is also subject to systemic and congenital diseases. The Wilkes classification is the clinical and radiological classification of TMJ disorders that is widely accepted by oral and maxillofacial surgeons, but under-utilised by radiologists. It provides a logical and systemic approach to the radiological interpretation of TMJ pathology. We first demonstrate the dynamic anatomy of the joint and optimal imaging protocols. We will provide an overview of the Wilkes classification and its utility as an approach to interpretation of the joint. A radiological pictorial review of TMJ internal derangement is then presented, covering each stage of disease as classified by Wilkes. We provide examples of internal derangement that fall outside of the classification. Finally we present differential diagnoses, including the TMJ manifestations of systemic and congenital diseases.

*1. Sommer, O., Aigner, F., Rudisch, A., Gruber, H. et al (2003). Cross-sectional and Functional Imaging of the Temporomandibular Joint: Radiology, Pathology, and Basic Biomechanics of the Jaw. Radiographics **23**(6), e14. 2. Wilkes, C.H. (1989). Internal derangements of the temporomandibular joint. Pathological variations. Arch Otolaryngol Head Neck Surg.**115**(4), 469-77.*

### Assessing the appropriateness of requests for lumbar spine radiography for low back pain in the community

Ken-Win To; Jonathan Delf ; Leena Naidu

*Kettering General Hospital NHS Foundation Trust*

**Background**: The 2009 NICE guidance on management of persistent non-specific low back pain proposes no useful role for lumbar radiography. iRefer limits indications for lumbar radiography in chronic back pain lasting between 6 weeks and 12 months with no red flags if presentation suggests osteoporotic collapse in the elderly. This study retrospectively assesses the appropriateness of the indications provided in plain lumbar spine X-ray requests in the community, as per RCR iRefer guidelines.

**Method:** 108 lumbar X-ray referrals from General Practitioners (GPs) performed by local radiology departments were included over a 3 week period. The clinical history and clinical question were compared against the RCR iRefer guidelines for appropriateness. Target was 100% to meet iRefer criteria, and 0% lumbar radiographs performed for non-specific low back pain or insufficient clinical details.

**Results:** Overall 69% of requests were inappropriate according to iRefer guidelines. 36% did not specify the duration of low back pain. 42% did not ask a specific clinical question. 69% of requests were for chronic, long term or unspecified duration of low back pain. Of these 61% were for non-specific low back pain, and 12% mentioned or implied ?osteoporotic collapse.

**Conclusion:** The 100% iRefer criteria was not met and NICE guidelines have not been completely followed. With appropriate education, there is a huge scope for improvement.

### Renal disease in northern territory, Australia - a matter of life choices?

Tu Anh Dao; Cherie Kim

*Alice Springs Hospital, Northern Territory, Australia*

At Alice Springs Hospital, Northern Territory, Australia, 70 percent of hospital admissions, and 93 percent of renal dialysis services are provided to patients of Indigenous background . Moreover, the Northern Territory's Indigenous population reportedly has the highest incidence rate and prevalence of chronic kidney disease (CKD) in Australia . Unfortunately, there is a stigma associating CKD solely with alcohol abuse and high risk life-style choices. Hence, it is crucial for us as radiographers at Alice Springs Hospital to gain an insight on the underlying causes of this complex disease. From our investigation, it is not just a single factor that causes such high incidence of CKD in Central Australia. It is rather a constitution of multiple risk factors that our patients are exposed to throughout different stages of their lives. Amongst these, biomedical and socioeconomic factors have the most significant impacts. Studies suggested that Indigenous patients may suffer from a genetic condition of nephron deficiency . In addition, poor hygiene, poor infrastructure, poor nutrition and limited access to health services are the most predominant issues on the socioeconomic platform . Together, this leads to low birth weight, high rate of acute and chronic infections, diabetes and obesity. These are the major risk factors to the development of CKD. Perhaps it takes more than an effective alcohol intervention program to reduce the incidence rate of CKD in Central Australia.

*Department of Health Northern Territory Government 2014 , Annual Report 2013-14, Department of Health Northern Territory Government, . Australia& New Zealand Dialysis& Transplant Registry (ANZDATA Registry) 2016, 38th Report, Chapter 12: Indigenous People and End Stage Kidney Disease, ANZDATA, Adelaide, Australia, viewed 3 March 2016 < http://www.anzdata.org.au>. Brenner BM, Garcia DL, Anderson 1988, 'Glomeruli and blood pressure: Less of one, more of the*

*other?', Am J Hypertens, vol. 1, pp. 335 –34. Brenner BM, Mackenzie HS 1997, 'Nephron mass as a risk factor for progression of renal disease', Kidney Int Suppl ,vol. 63, pp.124 –127. Hoy, W., White, A., Tipiloura, B., Singh, G., Sharma, S., & Bloomfield, H. et al. 2014, 'The influence of birthweight, past poststreptococcal glomerulonephritis and current body mass index on levels of albuminuria in young adults: the multideterminant model of renal disease in a remote Australian Aboriginal population with high rates of renal disease and renal failure', Nephrol. Dial. Transplant., vol.31,no.6,pp. 971-977. http://dx.doi.org/10.1093/ndt/gfu241*

**Mature and immature ovarian teratomas: A spectrum of features and multimodality problem solving**

Kelsey Watt ; Bramham Marc ; Diane De Friend

*Plymouth Hospitals NHS Trust*

**Background**: Ovarian teratomas are derived from the three germ cell layers of pluripotent stem cells, and thus exhibit a broad spectrum of imaging appearances, which may be confusing for less experienced practitioners. Many sonographers, registrars and consultant radiologists are expected to undertake general lists which include gynaecological cases. Therefore, recognising the broad spectrum of appearances of these common conditions is crucial. Accurate and timely diagnosis, appropriate follow-up and recognition of complications are where those working in general ultrasound and radiology add value in patient management.

**Purpose**: 1. Recognise the broad spectrum of appearances of mature and immature ovarian teratomas on ultrasound, CT and MRI. 2. Describe the potential complications and sequelae of ovarian teratomas.

**Summary**: We retrospectively review over 10 years of multimodality imaging of ovarian teratomas to present a pictorial review of their characteristic appearances, primarily on ultrasound, but also CT and MRI. We discuss atypical features, appropriate follow-up imaging, and appearances of associated complications. Mature teratomas are the most common germ cell neoplasm, accounting for up to 20% of ovarian neoplasms, and will be encountered by most practitioners who undertake pelvic ultrasound. Immature teratomas are histologically closely related and far less common than mature teratomas, but are just as important to recognise on ultrasound, particularly as they demonstrate clinically malignant behaviour.

**MRI-TRUS fusion-guided prostate biopsy - initial clinical experience**

Maeve O'Sullivan ; Mary-Louise Gargan ; Ciara O'Brien ; Elizabeth McEvoy ; Barbara Loftus ; Ted McDermott ; Robert Flynn ; Rustom Manecksha ; William Torreggiani ; Ronan Browne ; Emily Ward

*Tallaght Hospital, Dublin*

**Background** Magnetic resonance imaging (MRI) has evolved to become an integral component in the diagnosis of prostate cancer. The PIRADSv2 MRI scoring system is in widespread clinical use, however few studies have validated it's accuracy in detecting clinically significant cancers. Targeted biopsy of the prostate using MRI data has also been shown to improve detection of significant cancer [1]. We correlate the histology from our MRI-US fusion guided prostate biopsies with PIRADS-v2 scores.

**Method** We reviewed patients who underwent fusion biopsy between August 2015 and November 2016. We collected data on age, prior TRUS biopsy results, lesion location on MRI and subsequent fusion biopsy histology. Each MRI had a PIRADSv2 score prospectively assigned by two consultant radiologists in consensus. Histological results were reviewed and correlated with PIRADSv2 score.

**Results** 51 patients total, mean age 66.2 years.
31/51 had positive histology (61%). 20/51 had negative histology (39%).
Of 31 patients with positive histology, 8 had prior positive TRUS biopsies. All 8 (100%) were upgraded to a higher Gleason score following fusion biopsy.
Lowest grade of disease detected G3+4.
*PIRADS-v2 Score Number of patients % with positive histology*
P1 0 0%
P2 3 0%
P3 14 7%
P4 12 75%
P5 22 95%
**Conclusion** Our results to date add to the burden of proof that MRI-TRUS fusion biopsy can be a very useful tool in the diagnosis and management of prostate cancer, with significant potential to change management. We have also demonstrated excellent correlation between high PIRADSv2 scores and positive histology.

*1. Pokorny, M.R. (2014) Prospective Study of Diagnostic Accuracy Comparing Prostate Cancer Detection by Transrectal Ultrasound Guided Biopsy Versus Magnetic Resonance Imaging with Subsequent MRI-Guided Biopsy in Men Without Previous Prostate Biopsies. European Urology Volume 66, Issue 1, July 2014, pages 22-29*

**MRI characterisation of incidentalomas in the liver: Is intravenous contrast required?**

Vincent Leung ; Sahithi Nishtala ; Jonathan Dawkins ; Biju Thomas

*University Hospitals of North Midlands*

**Background**: Our institution performs MRI without intravenous contrast as a first line for characterisation of incidentalomas detected on ultrasound or CT. Patients are recalled for contrast MRI if the non-contrast scan returns either an indeterminate result or identifies a lesion needing further assessment. The overall benefit of this approach depends on recall rate.

**Method:** Retrospective review at a single UK-based university hospital. All non-contrast MRI liver examinations performed for incidentaloma characterisation in the period 01/01/14 to 01/01/15 were included. Data collected on whether or not patients were recalled, the final MRI diagnosis and any further imaging diagnoses at 1 year follow-up.

**Results:** 79 patients were included, of which only 13 required recall for contrast. The most common non-contrast diagnoses were T2 light bulb intense lesions (33 of 69 cases) and fat deposition (14 of 69 cases). The most common diagnosis following recall was FNH (4 of 13 cases). Over a 1 year follow up period of imaging records, none of the lesions classified as benign on non-contrast imaging were proven to be malignant.

**Conclusion**: Our experience shows that intravenous contrast is not essential in characterising incidentalomas in the liver. Most lesions have non-contrast characteristics of benign or malignant aetiologies. This approach reduces the need for intravenous contrast, and the associated risks. It also has cost implications, directly by reducing the use of intravenous contrast and indirectly in reducing examination duration, radiologist supervision time and reporting time.

**Aunt Minnies of uroradiology**

Jonathan Bevan ; Alistair Cowie ; Catherine O'Dwyer ; Syahminan Suut

*Salford Royal Foundation Trust*

Throughout radiology there are many examples of metaphorical radiological signs which aim to associate the familiarity of everyday objects to patterns of disease seen in imaging. Uroradiology is no exception, and from the bear's paw and manta ray sign to perirenal cobwebs and the spotted nephrogram, there are a wide variety of distinctive "Aunt Minnies" within this specialty that add colour and aid in recognition and interpretation. An Aunt Minnie is a term used to describe a distinctive, recognisable finding that cannot be mistaken for anything else.

By presenting a pictorial review of many of the Aunt Minnies of uroradiology we aim to educate and add insight for those who may not be familiar with some of these signs and to enthuse our colleagues to seek them out within their own practice. All images have been obtained from within the last five years within the North West region and are accompanied by a short description to add context and clinical information to the picture.

Metaphorical and eponymous signs aid in learning, recall and recognition and although by no means comprehensive, this article may act as an educational tool to showcase some of the more striking and memorable signs encountered in uroradiology.

## 4G Proffered papers - service optimisation and innovation Monday 16.10-17.20

**On call provisional CT reporting - are we getting it right?**

Harmeet Chana ; Jaymini Patel ; Rajiv Patel ; Gillian Bain ; Arun Gupta ; Maureen Quigley

*London North West NHS Trust*

**Background** Following the introduction of Seven Day Services, Health Education England Standards and Royal College guidelines, the importance of identifying the reporting discrepancy rate between registrar and consultant emergency computed tomography (CT) scan has been highlighted. No large recent UK studies address this. We propose a robust grading system and aim to identify factors to improve patient safety and report accuracy.

**Methods** All out-of-hours CT scan reports in a two-month period were retrospectively reviewed for discrepancies between provisional and final reports. Two consultant radiologists independently graded potential severity of discrepancies according to the proposed grading system: no change; 'minor' (wording/potential clinical nonsignificant impact); 'major' (potentially serious/potentially life threatening). Inter-reader discrepancies were consensed by a third subspecialist consultant radiologist.

**Results** Of the 1416 on call scans, 964 (68%) were reported by supervised pre-FRCR SpRs. 857/964 (89%) of these were unchanged on consultant review. 80 (8.3%) were graded as 'minor' discrepancy; 27 (2.8%) as 'major'. The 'major' discrepancy rates vary according to body part, highest for abdominopelvic scans (9.6% 'error rate) but only 2/47 (4.3%) for post-FRCR SpRs.

CT heads were reported accurately (1% 'major' error rate). Individual SpR 'major' discrepancy rates ranged from 0 to 6% (median 1.4% [0-3.2%]).

**Conclusion** This large study demonstrated interobserver variability between consultants and registrars for acute CT reporting to be within accepted standards. The 'major' error rate diminishes with experience. Several opportunities for focused training/improved patient safety have been identified. The described grading system allows report accuracy to be monitored.

*1. RCR Guidance regarding on call for clincal radiology trainees, Jan 2015,*

**Automatically populated worklist enhances safety of on call CT scan checking systems**

Rajiv Patel ; Nemi Gandy ; Harmeet Chana

*London North West NHS Trust*

**Background** Registrar learning opportunities in the out-of-hours (OOH) setting are highly valuable in radiology training. Consistent with Royal College guidelines, feedback should be provided and cases should be checked the following working day to ensure patient safety. Many review systems require any examination performed OOH to be manually flagged up, either using paper form, or by populating an electronic worklist - complicated by varying levels of autonomy of on call registrars. We examine the impact of changing from a manual, electronic system to an almost completely automated system, and the impact of safety net features.

**Methods** Retrospective analysis of all OOH CT scans performed in February-March 2016 (period 1) and post-intervention in September-October 2016 (period 2) with analysis of the presence/absence of a consultant review, and the time taken for each scan to be checked. The intervention included implementation of an automated keyword-populated worklist. Results Initial audit in period 1 showed that 15/1115 (1.35%) OOH CT scans went unchecked compared with 7/1531 (0.46%) following implementation of the electronic system (p=0.01). 1015/1115 (91%) were checked the next working day in period 1 compared with 1399/1531 (91.4%) in period 2 (p>0.05). The rate of SpRs failing to flag up reports as a provisional report fell from 0.63% to 0.26% (p=0.15).

**Discussion** This study demonstrates that a technologically driven solution for automation of worklist population can facilitate enhanced safety in OOH reports checking. This brings new efficiency and reliability to a risk-prone system and should be considered in other centres and wider workflows.

**An audit of waiting times for patients with known or suspected malignancy undergoing CT-guided percutaneous biopsy**

Frances Sheehan ; Sue Buckingham ; Donna Piper

*East and North Hertfordshire NHS Trust*

**Background**: Lengthy waiting times have been associated with poorer outcomes in cancer patients. The NHS Cancer Plan outlines waiting time targets for all cancers of 14 days from receipt of GP referral to first outpatient assessment, and 62 days to commencement of treatment. CT-guided percutaneous biopsies are performed as part of the diagnostic work up for various types of malignancy. Here we determine whether requests received for CT-guided biopsy for cancer patients are acted upon in a timely manner.

**Method**: Data was collected for 391 patients with known or suspected malignancy referred for CT-guided biopsy over a 3 year period. The number of days between date procedure requested, date request received, date appointment booked and date appointment attended were calculated for each patient then compared for each year and procedure type.

**Results**: Overall 23% procedures were not performed within 14 days of receipt of request (15% lung, 33% renal and 46% bone biopsies). Delays frequently occurred between date appointment booked and date appointment attended with moderate correlation between the total number of requests received per month and the incidence of delays > 14 days occurring in that month (r = 0.482, P = 0.0039). Peaks of delays occurred around key holiday periods and during junior doctor strikes.

**Conclusion**: Results suggest that not enough appointment slots are available to handle all requests within 14 days at current levels of demand. By re-structuring service delivery and re-auditing in 1 year, we hope improvements will be made.

*1 Department of Health. (2000) The NHS cancer plan: a plan for investment, a plan for reform. London: The Stationery Office. 2 Department of Health. (2007) Cancer reform strategy. London: The Stationery Office. 3 Elit L. (2015) Wait times from diagnosis to treatment in cancer. J Gynaecol Oncol. Oct;26(4): 246-248.*

**The consultant breast radiographer - a role innovation exemplar**

Anne-Marie Culpan ; Paul Marshall

*University of Leeds*

**Aim** This study explored the evolving role of consultant radiographers in symptomatic breast services.

**Methods** Unstructured interviews with radiologists and radiographers (n=39); non-participant observation of clinics and MDT meetings (8 NHS Trusts in England); mixed method framework analysis.

**Findings** After formal task-specific training and extended periods of practical experience, consultant radiographers undertook and reported the full range of routine diagnostic tests performed in symptomatic clinics. Expertise across all diagnostic techniques in a single clinical (breast) domain gave consultant radiographers a holistic overview of the patient journey; multiskilling enabling a single practitioner to perform all examinations for an individual patient. Specialisation in breast imaging enabled development of expertise across all technical disciplines (radiography, ultrasound, intervention, MRI, clinical examination) but required consultant radiographers to give up tasks they were trained for originally - general radiography and other non-breast imaging. Backfilling with lower grade assistant / radiographer practitioners gave experienced radiographers enough time to undertake the training and repetition (volume of cases) needed to develop expertise in advanced breast diagnostic techniques. As consultant breast radiographers took on more tasks usually performed by radiologists, they also gave up mammography image acquisition. Although consultant radiographers were able to lead symptomatic MDT meetings, lack of expertise in whole body cross-sectional and non-breast imaging was a barrier to contributing to clinical decision making for cancer staging and cases with co-existent non-breast disease.

**Conclusion** Consultant breast radiographers had created a new innovative technical-clinical hybrid role in which they were 'more than a radiographer, but not quite a radiologist'.

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**A five year longitudinal evaluation of the impact of a bespoke professional development programme for consultant radiographers**

Julie Nightingale [1]; Beverley Snaith [2]; Maryann Hardy [3]

*[1]University of Salford; [2]Mid Yorkshire Hospitals NHS Trust; [3]University of Bradford*

**Background** Radiographer consultant practice is not yet embedded within many radiology departments, and the role has been criticised for not truly encompassing all four domains of consultant practice. A large acute NHS Trust seconded five radiographers to an apprenticeship-style consultant development programme, and the outcomes of the secondment were evaluated via a longitudinal qualitative research study.

**Methods** The host organisation created secondment objectives linked to the four domains of consultant practice. Individual semi-structured interviews were conducted at 1, 6 and 12 months to assist consultant trainees to benchmark their achievements against the objectives. Group interviews were conducted at 18 months and 5 years to enable validation of findings and impact analysis. Qualitative analysis generated themes relating to process, outcomes, barriers and facilitators.

**Results** All five radiographers secured a consultant post. The 0-18 month period was a highly emotional personal development journey. While secondment objectives were achieved between 12-18 months, the five year review demonstrated much deeper engagement with the objectives. Consistent themes observed at 5 years included growth in confidence, leadership, proactive approaches and recognition of 'being consulted'. These culminated in a well-recognised increase in maturity and differentiation of the role.

**Conclusion** Radiographers require an 18 month period of preceptorship and systematic objective setting to prepare them for this challenging role, with a further 2-3 years of supported development. The secondment objectives are an appropriate tool for initially benchmarking progress at the apprenticeship stage, and subsequently assessing the impact of consultant practice in more experienced consultants.

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**Is radiography ready for apprenticeships? A critical review of the evidence and reflection on its implications**

Denise Baker

*University of Derby*

The introduction of the Apprenticeship Levy in April 2017 appears to be driving a significant and fundamental change of the way in which pre-registration education could be funded in the future. The nursing degree apprenticeship was announced in November 2016 and there is already an indication that radiography will look to become an apprenticeship quickly. When coupled with the removal of commissioning of training places and the student bursary, the pace and scale of change is significant. Research into apprenticeships has demonstrated positive and negative impacts to this model. (Fuller & Unwin, 2003a). Evidence suggests that the apprenticeship model offers many opportunities to learners but only when the employer is engaged and committed to this model. Additional evidence from (Fuller & Unwin, 2003b) describes the expansive / restrictive continuum in relation to apprenticeships and explores how different communities of practice will influence the apprentice's learning experiences. This paper will explore the government's mandate to increase apprenticeship places (which also obliges

public sector employers to assure a growth in apprenticeships set against an ambitious target. (Burnett et al., 2016) explore many facets to the current apprenticeship agenda, many of which will have implications for radiography: How will apprenticeships differ from current pre-registration education? How can communities of practice support or scupper apprentices? Will radiography be able to support the on programme learning required for apprenticeships? How will putting the employer in the driving seat impact on pre-registration education? Do we have enough and suitably qualified mentors and assessors in practice?

*Burnett, K., Clarke, L., Fuller, A., Keep, E., Lanning, T., McCormick, D., & Relly, S. J. (2016). Apprenticeships, Where Next. Cipd, (August). Retrieved from http://www.cipd.co.uk/binaries/where-next-for-apprenticeships_2016.pdf Fuller, A., & Unwin, L. (2003a). Creating a "Modern Apprenticeship": a critique of the UK's multi-sector, social inclusion approach. Journal of Education & Work, 16(1), 5. https://doi.org/10.1080/1363908022000032867 Fuller, A., & Unwin, L. (2003b). Learning as Apprentices in the Contemporary UK Workplace: creating and managing expansive and restrictive participation. Journal of Education and Work, 16(4), 407–426. https://doi.org/10.1080/1363908032000093012*

**An audit on the impact of a regional collaborative out of hours service on trainee feedback**

Christopher Keegan [1]; Shruthi Patel [1]; Fatma Bayam [2]

*[1]Mersey School of Radiology; [2]University Hospital Aintree*

In August 2015 the Merseyside collaborative out of hours (OOH) service was formed, providing a central hub for OOH reporting within the region. This enabled registrars to work a less frequent rota, increasing time for training at their base hospital. Traditionally OOH reporting feedback was given in person at the base hospital. This is now no longer practical due to the scale of the collaborative system.

An online survey was distributed amongst the 35 registrars in the region who participated in OOH provision. The questions were concerned with the frequency and quality of consultant feedback from OOH reports from the collaborative, as well as for individual trusts.

Of the 35 registrars, 21 responses were received (60%). 15% stated they received feedback always or frequently, 60% occasionally or rarely and 25% stated they never received feedback. 63% of respondents felt that checking consultant's addendums on their reports was insufficient feedback. 37% report not always checking these addendums. If feedback was given explicitly, 58% of the time it was via email. Since forming the collaborative, consensus amongst the registrars is that feedback has deteriorated.

The collaborative benefits trainees by reducing the on call frequency and increasing training opportunities during working hours. However this has had a negative impact on individual feedback for trainees. As a result of this survey, trainees email addresses have been distributed to each trust and clinical supervisors are encourage to feedback directly via email. A regular discrepancy meeting is in progress to encourage learning for all trainees from on call studies.

**Variations in reporting radiographer report structure**

Anthony Manning-Stanley

*University of Liverpool*

**Background:** Radiographer reporting is a well-established advanced practice in the United Kingdom. No studies have examined variations in report content for this group, specifically report structure, word count and word length.

**Method:** The radiology information system for a major trauma centre in the north-west of England was interrogated for a 12-month period; data including report text for every radiographic knee examination performed via A&E was obtained (Microsoft Excel spreadsheet). For five reporting radiographers, report text was copied and pasted into Microsoft Word, with word and character counts (without spaces) for the overall report, the report title/header, the main body of the report and the report signature recorded. Word length was calculated.

**Results:** 1,530 reports were analysed. Overall variation in report structure was found; 83.1% of reports included a title, whilst 55.4% included a signature. Individually, 4 out of 5 radiographers always included a report title; 3 out of 5 never included a signature. For 2 of 10 radiographer pairings, the mean overall report length demonstrated significant differences (range 17.8 to 60.8 words per report, ANOVA t-test; $p<0.001$); for 3 out of 10 radiographer pairings, mean word length for the overall report demonstrated significant differences (range 5.5 to 6.2 characters long, ANOVA t-test $p<0.001$).

**Conclusion:** Significant variations exist in report structure in a group of five reporting radiographers from a single Trust. This has implications for communication with referrers. Similar trends should be investigated for other examinations, other Trusts and for other reporting groups.

## 6D Proffered papers - science, education and radiation protection Tuesday 11.20-12.40

### Writing about radiation in your IRAS application

Andrea Shemilt

*Nottingham University Hospitals NHS Trust*

There are many guidance documents relevant to ionising radiation used in medical research. In the process of approval and set-up for research involving the NHS, the IRAS [1] application is reviewed by the HRA [2], incorporating ethics review. It's submitted to the competent authority, if relevant, and the NHS Trust sites involved, to obtain Organisation Confirmation of Capacity and Capability (previously known as NHS Permission). This means that the content of the IRAS form is vital in getting all the elements of approval in place for recruitment to commence.

The author describes the requirements to communicate radiation procedures in the IRAS application in light of the changing HRA guidance. This includes discussion of the role of the Lead Medical Physics Expert and Lead Clinical Radiation Expert, the various legislations and policies applicable to the context, and discusses the rationale behind articulating radiation exposures in the process of ethical review. Examples are given of the radiation questions in the IRAS application and how they may be accurately completed.

*1. Integrated Research Application System https://www.myresearchproject.org.uk/ 2. HRA Approval http://www.hra.nhs.uk/about-the-hra/our-plans-and-projects/assessment-approval/*

### An audit into radiation awareness and a qualitative assessment into requesting and interpretation of common imaging modalities: A junior doctor and final year medical student survey

Ahmed Ali [1]; Muhammad Khan [1]; Sam Booth [2]; Aniket Sonsale [2]; Reshma Bharamgoudar [2]; Shahid Hussain [1]

*[1]Birmingham Heartlands Hospital; [2]University of Birmingham*

**Introduction**: An essential component of patient safety is the clinician's understanding of risks associated with imaging, including radiation exposure. Evidence suggests that only a third of clinicians receive formal training in radiation dosing and protection[1]. Additionally, effective communication with the radiology department and the ability to refer patients 'effectively, timely and appropriately' are vital as per the Royal College of Radiologists (RCR) Undergraduate Curriculum[2]. Junior doctors must also be able to perform basic interpretation of radiographs with an emphasis on spotting common emergencies.

**Aims and methods**: A survey based on the RCR audit-live template 'Awareness of Radiation Doses Incurred in Diagnostic Investigations[3](Standard: 50% cohort awareness) was circulated around to all foundation year doctors and final year medical students in a UK based Trust. The survey was modified to include assessment of radiation doses, radiation legislation awareness, subjective confidence in the interpretation of basic imaging modalities and ability to appropriately request imaging.

**Results**: There were 71 respondents, 80.28% were not aware of any governmental regulations regarding radiation. Majority of respondents failed to correctly identify radiation doses of commonly requested imaging with 14.08% correctly identifying the radiation dose of a CT head. 36.62% felt confident or very confident in their ability to request appropriate imaging. Over 45% did not feel confident in interpreting skeletal and abdominal radiographs. Action plan: A one day radiology teaching day addressing the above themes will be organised in March 2017. The survey will be recirculated and the outcomes re-audited.

*1.Soye & Paterson. A survey of awareness of radiation dose among health professionals in Northern Ireland. BJR 2008; 81: 725-729. http://bjr.birjournals.org/cgi/content/abstract/81/969/725. 2. The Royal College of Radiologists. Undergraduate Radiology Curriculum. London: The Royal College of Radiologists, 2012. 3. Duncan K, Remedios D. Awareness of Radiation Doses Incurred in Diagnostic Investigations | The Royal College of Radiologists [Internet]. rcr.ac.uk. 2008 [cited 9 December 2016].*

### Radiation safety culture initiatives in X-ray imaging optimisation

Hugh Wilkins

*University of Exeter*

**Background** Risks from radiological imaging are generally poorly understood by patients and many healthcare professionals. The familiarity of X-ray imaging procedures in modern medical practice and the evident benefits of imaging, coupled with the absence of immediate adverse effects of exposure to radiation, can lead to complacency. The breaking of the link between over-exposure and image quality deterioration associated with the transition from screen: film radiography to digital imaging can lead to the phenomenon of dose creep, with doses to patients not as low as reasonably practicable.

**Method** Whilst never losing sight of the benefits of medical imaging, there is increasing recognition that radiation safety practice in medicine is markedly more lax than in other industries where people are exposed to radiation, notably in comparison with the

nuclear power sector. This has led to a number of global developments in recent years aimed at improving radiation protection in medicine, such as the Bonn Call for Action[3]. However, some individuals who have championed improvements in this area have encountered surprising resistance when seeking to encourage optimisation of X-ray imaging.

**Results** Such experiences have created an increased focus on improving radiation safety culture in medicine. IRPA guiding principles[4] have led to UK initiatives, such as those published by Croft et al[2] and Chapple et al[1], which not only outline the problem but suggest novel solutions.

**Conclusion** There is growing recognition of the need to improve radiation safety culture in X-ray imaging, to protect patients from unnecessary exposure to radiation.

*1. Chapple C-L., Bradley A., Murray M. et al (2016). Radiation safety culture in the UK medical sector: a top to bottom strategy. Rad. Prot. Dos. advance access published 1 December, 1-7 2. Croft J, Coates R, Edwards C et al (2016). Promoting radiation safety culture in the UK. IRPA14 Conference Proceedings. Available from https://srp-uk.org/resources/radiation-safety-culture (accessed 18.12.16) 3. International Atomic Energy Agency and World Health Organisation (2013). Bonn Call for Action. Available from https://rpop.iaea.org/RPOP/RPoP/Content/News/poster-on-bonn-call-for-action.htm (accessed 18.12.16) 4. International Radiation Protection Association (2014). IRPA guiding principles for establishing a radiation protection culture. Available from http://www.irpa.net/page.asp?id=54669 (accessed 18.12.16)*

**A review of MR labeling information related to IEC 62570 labeling requirements of commercially available MRI accessories**

Gina Stateczny [1]; Gregor Schaefers [2]

*[1]MRI-Tec; [2]MR:comp GmbH*

Commercially medical accessories such as furniture, wheel chairs, instruments, gas cylinders, etc. can be ferromagnetic or electrically conductive. Those are not designed, thus contraindicated to be used in the MR environment (MRE). Several health injuries have been reported by use of incorrect or unlabeled MR devices. Outcome: MR safety labeling MR Safe, MR Conditional and MR Unsafe are the standardized terms used in MR labeling, which is created for MR product approval at worldwide regulatory agencies.

**Methods** About 96 conventional available MRI products have been selected randomly and from throughout the daily use of MR clinical application:

* MRI audio and video systems
* MRI gurneys
* MRI goggles
* MRI injection systems etc.

The product documentation has been investigated for required MR marking/labelling and the completeness of MR labelling information 96 Products have been analyzed. More than half of the investigated products have never been properly tested and assessed for safety in the MR environment. There could be fatal consequences if products contain ferromagnetic materials, be conductive, thus hurt the patient or have its function affected as well as Interfere the MR system, if a device is not fully tested. ASTM F2503-13 and IEC 62570:2014 require that all medical devices/accessories entering the MRE have to be tested at least to the following MR safety test methods dependent of the position of use of the accessories inside the MRE and marked comprehensively for MRE safety required.

*[1] ASTM F2503-13 standard practice for marking medical devices and other items for safety in the magnetic resonance environment [2] IEC 62570:2014 Standard practice for marking medical devices and other items for safety in the magnetic resonance environment [3] Guidance for Industry and FDA Staff; 2014; Establishing Safety and Compatibility of Passive Implants in the Magnetic Resonance (MR) Environment [4] Curr Radiol Rep (2016) Planning an MR Suite: What can be done to ensure MR safety? Gregor Schaefers, Björn Mierau Published online: 10 May 2016 [5] ÖNROM S 1125-1. Safety officer for magnetic resonance equipment for medical diagnosis-part 1; responsibilities and competences. Vienna: Austrian Standards Institute; 2009 [6] DIN 6876. Operation of medical magnetic resonance systems. Berlin: German Institute for Standardization; 2014. [7] Kanal E, Barkovich AJ, Bell C, et al. ACR guidance document on MR safe practices: 2013. J Magn Reson Imaging. 2013;37:501-30.*

**Improving from an IR(ME)R inspection**

Toni Hall

*Oxford University Hospitals NHS Foundation Trust*

**Background** In August 2016 we received 72 hours notice of an IR(ME)R inspection. The feedback had positive elements but resulted in the issuing of an improvement notice over 8 specific areas

**Method** A comprehensive action plan was developed alongside the Trust assurance team Weekly progress meetings were held involving Radiology, Medical Physics and the assurance team Tasks were focused on achieving compliance with the improvement notice across all 8 sites Results Due for reinspection in January 2017, although significant improvements shown by internal audit

**Conclusion** We share our experience and the positives learning from receiving an improvement notice. We show how our department is now more resilient.

**Image quality: Old vs new**

Stephen Wolstenhulme ; Kate Langstaff

*Leeds Teaching Hospitals NHS Trust*

**Background**: Ultrasound studies with good image quality (IQ) is a requirement when examining patients with suspected abdominal disease and in the fetal anatomy screening programme (FASP). PURPOSE: To enhance the delegates learning when reviewing twelve images to evaluate the impact of four important ultrasound equipment technology parameters on IQ.

**Methods**: One experienced sonographer obtained comparable images (six renal and six fetal head) from one adult volunteer, using three different ultrasound machines and a trans-abdominal transducer. The following parameters were manipulated : compound imaging, frequency, speckle reduction and harmonic imaging. The presentation will allow you to review and evaluate the images, which will allow the delegates to determine the impact of these important factors on IQ.

**Discussion** : Direct comparison of the images produced will show the profound effect modern ultrasound technology has on IQ. After evaluating these images consider in your own department the impact of these parameters on your levels of diagnostic confidence.

**Conclusion**: 21st century medicine requires high resolution ultrasound image quality (IQ) to aid patient diagnostic pathway. This interactive e-poster highlights the difference between aging and new equipment, using a simple experiment to directly compare images from one healthy volunteer. It demonstrates the importance of leading edge technology when undertaking diagnostic imaging.

*1. NHS (England) Fetal Anomaly Screening Programme - 18+0 - 20+6 week fetal anatomy scan (2016/17) http://bit.ly/28MSLEM (accessed 07 December 2016 2. SoR. 2015. Standards for the provision of an ultrasound service. http://www.sor.org/learning/document-library/standards-provision-ultrasound-service (accessed 07 December 2016)*

**A method to model the influence of beam quality on image noise in a digitally reconstructed radiograph (DRR) based computer simulation for optimisation of digital radiography**

Craig Moore; Tim Wood

*Hull and East Yorkshire Hospitals NHS Trust*

**Background**: Computer simulation of digital x-radiographs has become widespread in recent years. It is vital simulated radiographs contain adequate anatomical and system noise to make optimisation investigations realistic. Recently, our group has produced a computer algorithm capable of simulating x-radiographs but the method used to add (non-anatomical) noise only modelled the incident detector X-ray intensity ('dose') and neglected X-ray beam quality. However, it has been shown recently for digital mammography imaging that beam quality is an important factor when modelling noise in simulated images but there are no such studies for diagnostic imaging of the chest/abdomen/pelvis; this study aims to address that.

**Method**: On a real DR imaging system image noise was measured as a function of dose over a range of clinically relevant beam qualities. Simulated 'dose' and 'beam quality' images were then created per patient per tube voltage under investigation. Simulated 'noise' images were subsequently produced from the simulated 'dose' and 'beam quality' images, using the measured noise/dose/beam quality relationships. The 'noise' images were added over the noiseless 'dose' images to create images with noise correct for dose and beam quality.

**Results**: Signal and noise measurements in simulated chest, abdomen and spine images are within 10% of the corresponding measurements in real images. This compares favourably to our older algorithm where images corrected for dose only were all within 20%.

**Conclusion**: An image simulator that corrects noise for dose and beam quality has been produced and validated for diagnostic imaging. This can be used for optimisation purposes.

**The efficacy of routine radiographer QA testing**

Shahed Khan [1]; Natalie Thring [2]

*[1]Radiation Consultancy Services Ltd.; [2]RCS Ltd*

Ionising Radiations Regulations 32 requires that the employer has in place a quality assurance programme, which includes radiographers performing routine tests on all X-ray producing equipment. The current best practice standard is IPEM Report 91.

Modern X-ray systems come with maintenance contracts either from the manufacturer or third party and these generally include remote diagnostics. This allows for the monitoring and to some degree online maintenance of the equipment, to help limit equipment downtime in the event of reported faults. We review the routine quality assurance tasks conducted at a number of sites by radiographers/operators, focusing on the faults identified during the routine testing and analyse the downtime due to faults not identified during these routine tests, to determine the efficacy of the QA testing. The results indicate that there exists a number of difficulties including time management and local Operator expertise which confound the efficacy of routine QA programmes. The routine testing appears to have no real significance in terms of fault prediction or downtime reduction, leading to the mistaken perception QA can be a 'waste of time' and complacency, which may in turn lead to real safety issues as equipment ages. The supplier remote diagnostic schedules were also examined. It would appear that the full potential of remote diagnostics is not being utilised. An improved solution would involve reducing the number of operator tests to ensure equipment is fit for purpose, more effective use of the available manufacturer remote diagnostics functionality and the use of medical physics support.

*Institute of Physics and Engineering in Medicine (2005) Report 91 Recommended Standards for the Routine Performance Testing of Diagnostic X-Ray Imaging Systems, 4-20, 41-48*

## 7F Proffered papers – clinical Tuesday 14.10-15.30

### Value of invasive angiography following negative CT angiogram in the haemodynamically unstable patient with pelvic trauma

Jen-Jou Wong [1]; Aldo Camenzuli [2]

*[1]Aintree; [2]University Hospital Aintree*

Multidetector CT scanning of trauma patients has rapidly become the norm, and is often the first imaging modality carried out ahead of plain film radiography or FAST scanning [1]. High-energy pelvic trauma in particular, given the close relationship between bony and vascular structures, may have several sites of injury [2] necessitating rapid diagnosis and intervention. Despite the high negative predictive value of CT [3], a negative trauma scan might not conclusively rule out vascular damage in a small number of patients. The effects of immediate resuscitative measures such as the use of pelvic binders and "shock-packs", and the physiological effects of haematoma formation and vasospasm, may mask vascular damage at the time of scanning. The relatively poor prognosis of this subset of trauma patients [4] necessitates more aggressive investigation and intervention to improve their chances of survival. The trend towards centralised, and specialised trauma centres will mean that these patients will be seen more often in these hospitals. As a major trauma centre we present and analyse cases over a 3 year period where invasive angiography has complemented the investigation and treatment of haemodynamically unstable patients with pelvic trauma, with negative or equivocal CT traumogram, underscoring the importance of an interventional radiology service in hospitals that serves as part of the major trauma network. Pelvic vascular anatomy will be reviewed, as will a variety of cases demonstrating the use of invasive angiography in diagnosing and treating pelvic vascular trauma, with an overview of both technical and service delivery considerations.

*[1]. Standards of practice and guidance for trauma radiology in severely injured patients. The Royal College of Radiologists https://www.rcr.ac.uk/sites/default/files/docs/radiology/pdf/BFCR(11)3_trauma.pdf [2]. Woong Y et al. Pelvic Arterial Hemor- rhage in Patients with Pelvic Fractures: Detection with Contrast-enhanced CT. RadioGraphics 2004; 24:1591–1606 [3]. Hamilton J et al. Multidetector CT Evaluation of Active Extravasation in Blunt Abdominal and Pelvic Trauma Patients. RadioGraphics 2008; 28:1603–1616 [4]. Scemama U et al. Pelvic trauma and vascular emergencies. Diagnostic and Interventional Imaging 2015; 96:717-729*

### The current state of MRI in vascular access imaging

Conor MacDonald [1]; Rose Ross [2]; J G Houston [3]

*[1]University of Dundee; [2]NHS Tayside, Vascular Clinic; [3]NHS Tayside, Radiology*

**Introduction** Failure rates in arterio-venous fistulas (AVFs) remain high, and it is important that preoperative predictors of failure are identified. MRI offers strong angiographic capabilities, but has not seen great usage in vascular access (VA) imaging. A review was conducted to determine the state of research in this field, and to identify the advantages and disadvantages of using MRI to image VA.

**Methods** A literature search was performed on PubMed. One reviewer (CM) identified and examined 126 studies that focused on MRI imaging of the VA. Studies on non-imaging factors, phantom imaging, other types of AVFs, computational simulations and animals were excluded. Endpoints such as staging, contrast use, and cohort size were analysed.

**Results** 19 studies were identified between 2002 and 2015. Collectively, the studies analysed 595 patients: 280 with AVFs, 138 with AVGs and 21 with CVCs. 10 without VA, and 123 awaiting VA creation. 15 studies were post-operative and 4 were pre-operative. All studies used MRI: 9 compared MRI with DSA, 2 with US and 1 with CT. 2 studies compared MRI with both US and DSA. 2 compared MRI sequences, and 3 did not compare modality or sequence. 16 studies used contrast enhancement.

**Conclusions** Only 4 of the studies utilised MRI as a pre-operative imaging modality. The pre-operative benefit of MRI as a potential predictor of AVF outcomes may not have been realised. The prevalent use of contrast in these studies would now be considered an unacceptable rick due to the association with renal failure and NSF.

*1. Bode, (2012), Feasibility of Non-contrast-enhanced Magnetic Resonance Angiography for Imaging Upper Extremity Vasculature Prior to Vascular Access Creation, European Journal of Vascular and Endovascular Surgery 43, 88-94 2. Doelman, (2005) Stenosis detection in failing hemodialysis access fistulas and grafts: Comparison of color Doppler ultrasonography, Journal of vascular surgery, 42, 4, 739-46 3. Duijm, (2006), Inflow stenoses in dysfunctional hemodialysis access fistulae and grafts, American Journal of Kidney Diseases, 48, No 1, 98-105 4. Froger, (2005) Stenosis detection with MR angiography and digital subtraction angiography in dysfunctional hemodialysis access fistulas and grafts, Radiology: 234: 1; 284-291 5. Gao, (2012), Three dimensional gadolinium enhanced MR venography to evaluate central venous steno-occlusive disease in hemodialysis patients, Clin. Radio. 67, 560-563 6. Han, (2003), Failing hemodialysis access grafts: Evaluation of complete vascular tree with 3D contrast-enhanced MR angiography with high spatial resolution: Initial results in 10 patients, Radiology; 227:601–605 7. Jin, (2015), Non-contrast-enhanced MR angiography for detecting arteriovenous fistula dysfunction in haemodialysis patients, Clinical Radiology, 70, 852-857 8. Mende, (2007), Time-Resolved, High-Resolution Contrast-Enhanced MR Angiography of Dialysis Shunts Using the CENTRA Keyhole Technique With Parallel Imaging, Journal of magnetic resonance imaging, 25, 832.840 9. Nayak, (2014), High-resolution, whole-body vascular imaging with ferumoxytol, as an alternative to gadolinium agents in a pediatric chronic kidney disease cohort, Pediatric nephrology, 30, 3, 515-21 10. Paksoy, (2004), Three-dimensional contrast-enhanced magnetic resonance angiography (3-D CE-MRA) in the evaluation of hemodialysis access complications, and the condition of central veins in patients who are candidates for hemodialysis access, J NEPHROL; 17: 57-65 11. Pinto, (2005), Time-Resolved Magnetic Resonance Fistulography with TREAT and GRAPPA for Surveillance of Hemodialysis fistula, Proc. Intl. Soc. Mag. Reson. Med. 13, 12. Pinto, (2006) Time-resolved MR angiography with generalized autocalibrating partially parallel acquisition and time-resolved echo-sharing angiographic technique for hemodialysis arteriovenous fistulas, 17, 6, 1003-9 13. Planken, (2008), Contrast-enhanced magnetic resonance angiography findings prior to hemodialysis vascular access creation: a prospective analysis, The Journal of Vascular Access, 9, 269-277 14. Planken, (2008), Magnetic resonance angiographic assessment of upper extremity vessels prior to vascular access surgery: feasibility and accuracy, Eur Radiol, 18, 158–167 15. Planken,(2003), Stenosis detection in forearm hemodialysis arteriovenous fistulae by multiphase contrast-enhanced magnetic resonance angiography: Preliminary experience, JOURNAL OF MAGNETIC RESONANCE IMAGING, 17, 54–64 16. Sigovan, (2012) USPIO-enhanced MR Angiography of Arteriovenous Fistulas in Patients with Renal Failure, Radiology, 265, 2, 584-90 17. Smits, (2002), Hemodialysis access imaging: Comparison of flow-interrupted contrast-enhanced MR angiography and digital subtraction angiography, Radiology, 225, 829–834 18. Tanju, (2005), Direct contrast-enhanced 3D MR venography evaluation of upper extremity deep venous system, Diagn Interv Radiol, 12, 74-79 19. Zhang (2005) Time-resolved 3D MR angiography with parallel imaging for evaluation of hemodialysis fistulas and grafts: Initial experience, AJR, 186, 1436–1442*

**MRI evaluation of epicardial adipose tissue in patients with cardio-metabolic disease: Potential pathophysiological links with inflammation and vascular dysfunction**

Shaween Al-Talabany [1]; Ify Mordi [1]; Graeme Houston [1]; Helen Colhoun [2]; Jonathan Weir-McCall [1]; Shona Matthew [1]; Daniel Levin [1]; Jill Belch [1]; Fiona Dove [1]; Faisel Khan [1]; Chim Lang [1]

*[1]University of Dundee; [2]University of Edinburgh*

**Background**: Epicardial adipose tissue (EAT) is an emerging cardio-metabolic risk factor and has been shown to be correlated with coronary artery disease and left ventricular dysfunction. It has been suggested that EAT can exert local effects on the coronary arteries and the myocardium and could potentially exert harmful effects systemically; however the underlying pathophysiology of this link is not well understood. Arterial stiffness is implicated in both coronary artery disease and in heart failure pathophysiology. We have examined the relationship between EAT and arterial stiffness, measured by pulse wave velocity (PWV) in a cross sectional study of patients with cardio-metabolic disease and controls.

**Methods**: 145 participants (61.4 % male, with mean age of 63.9 ± 8.1 years) were categorised into four groups: (1) type 2 diabetes mellitus (T2DM) with cardiovascular disease (CVD); (2) T2DM without CVD; (3) CVD without T2DM; (4) controls. Measurements were performed on 4 chamber cardiac MR images to define EAT. Arterial stiffness was assessed by carotid-femoral PWV. Blood from participants was analysed with the Olink Proseek Multiplex immunoassay platform.

**Results**: EAT were higher in T2DM with CVD group (15.9±5.5 $cm^2$) and in CVD without T2DM group(15.1±4.3 $cm^2$) in comparison to T2DM without CVD group (13.6±3.5 $cm^2$) ,and controls(11.8±4.1 $cm^2$) (P=0.001).There was a significant correlation between PWV and EAT (R= 0.28, p=0.002).

**Conclusion**: EAT showed an association with arterial stiffness which is pathophysiologically linked to both coronary artery disease and heart failure. EAT appears to be associated with systemic inflammation and increase cardiovascular risk.

*1-Mazurek T et al Human epicardial adipose tissue is a source of inflammatory mediators. Circulation. 2003;108(20):2460-6. 2-Baker AR et al Human epicardial adipose tissue expresses a pathogenic profile of adipocytokines in patients with cardiovascular disease. Cardiovascular diabetology. 2006;5:1.Epub 2006/01/18. 3-Kocaman SA et al The independent relationship of epicardial adipose tissue with carotid intima-media thickness and endothelial functions: the association of pulse wave velocity with the active facilitated arterial conduction concept. Blood Press Monit. 2013;18(2):85-93.*

**Nebulised 18f-fluorodeoxyglucose (18f-fdg) assessment of pulmonary drug deposition: Proof of concept**

Shamsuddeen Ahmad Aliyu [1]; Glenn Woolley [2]; Ged Avery [2]; Simon Hart [3]; Chris Cawthorne [1]; Steve Archibald [1]; Alyn Morice [3]

*[1]University of Hull; [2]Hull and East Yorkshire NHS Hospital Trust; [3]Hull York Medical School*

**Introduction**: Drugs for patients with lung diseases are frequently administered by inhalation, but the delivery to specific areas of the lungs is poorly understood. This phantom study aims assess the feasibility and radiation safety of a system to visualise lung deposition of nebulised 18F-fluorodeoxyglucose. Methods: Using an in-house lung phantom 4.22 MBq 18F-FDG was dispensed into a LCD PERI nebuliser. a 1 minute nebulisation procedure was carried out whilst mimicking normal human tidal

breathing (16 breaths per minute). Four expiratory filters were used to stop radiation contamination. Imaging performed on a Siemens Biograph mCT PET/CT Flow scanner. Attenuation correction CT and 3-D PET images obtained using Continuous Bed Motion (CBM) for 17 mins at 0.5mm/s. Exhalation filters and environmental swabs assessed using a sample counter.

**Results**: After the one minute nebulisation 500 KBq of 18F-FDG was nebulised, 69.0 KBq (14%) was deposited into the phantom. The remainder was captured within the closed system. Deposition in the phantom was predominately central in the proximal one-third. Significant activity was deposited in the artificial trachea, 55% on the inner filter, 0.29% on the middle two and 0.1% on the outer filter. No contamination of the room or personnel detected.

**Conclusions**: Lung distribution and quantification of nebulised 18F-FDG is feasible. This may be an effective way of measuring uptake and distribution of aerosol drugs and determining the efficiency of aerosol drug delivery devices. The next stage is a pilot study comprising healthy volunteers

*1. Dolovich Aerosol Research Laboratory, M. U., St. Joseph's Healthcare, Hamilton, ON, Canada (2012). Positron Emission Tomography (PET) for Assessing Aerosol Deposition of Orally Inhaled Drugs. Canada: Lead Shield. arquenne, C. (2012). "Aerosol Deposition in Health and Disease." J Aerosol Med Pulm Drug Deliv 25(3): 140-147. 2. Dolovich, M. A., et al. (2000). "Consensus statement: aerosols and delivery devices. American Association for Respiratory Care." Respir Care 45(6): 589-596 3. Dolovich, M. B. (2009). "18F-Fluorodeoxyglucose Positron Emission Tomographic Imaging of Pulmonary Functions, Pathology, and Drug Delivery." Proceedings of the American Thoracic Society 6(5): 477-485. 4. Kotzerke, J., et al. (2010). "PET aerosol lung scintigraphy using Galligas." Eur J Nucl Med Mol Imaging 37(1): 175-177*

**Low-dose CT screening for lung cancer: Are we truly achieving a low-dose?**

Carolyn Horst [1]; Nicholas Woznitza [2]; Mamta Ruparel [1]; James Batty [3]; Tara McGinley [2]; Heather Groombridge [3]; Samantha Quaife [4]; Asia Ahmed [3]; Magali Taylor [3]; Angshu Bhowmik [2]; Stephen Burke [2]; May Jan Soo [2]; Penny Shaw [3]; Andy McEwan [4]; Jo Waller [4]; David Baldwin [5]; Neal Navani [1]; Sam Janes [1];

*[1]Lungs for Living, UCL Respiratory; [2]Homerton University Hospital; [3]University College London Hospital; [4]Health Behaviour Research Centre; [5]David Evans Research Centre*

**Background**: Low-dose CT (LDCT) screening is effective within at-risk populations at reducing morbidity and mortality from lung cancer. A spectrum of CT equipment is used across the NHS. Many sites do not have the latest dose reduction technology.
**Methods**: Data were collected as part of the Lung Screen Uptake Trial. LDCT chest was performed at two study sites (S1/S2) using different CT scanners: S1 Toshiba Aquilion 320 (2014) and S2 Toshiba Aquilion 64 (2006). Dose monitoring was performed according to protocol, and optimised if a maximum threshold was reached (2mSv). The mean effective dose overall, per site, and by study period, was analysed using a t-test.

**Results**: 334 baseline LDCT were performed; 232 (S1, 9 months) and 102 (S2, 4 months). Combined mean effective dose remained within the acceptable threshold (1.45mSv; 0.6 -- 11.8) and no significant difference found between study sites (S1 mean 1.43mSv; S2 mean 1.51mSv; p=0.384). Ten of the initial 21 scans performed at S2 exceeded the maximum effective dose (mean 2.22mSv, maximum 3.8mSv). Scanner calibration, and alteration of reconstruction and noise reduction algorithms reduced the mean effective dose to 1.43mSv (p<0.0001) for further scans at S2. No significant difference was found at S1 (initial scans 1.37mSv; subsequent scans 1.49mSv; p=0.29).

**Conclusion**: Initial effective dose data demonstrate that LDCT chest can be performed regardless of equipment age. To ensure compliance with dose requirements, close monitoring, QA and technique optimisation is required. Restrained capital investment for replacement CT equipment is not a barrier to implementation of LDCT screening.

**Ipsilateral dual-site, same-sitting percutaneous lung biopsy: A feasibility study**

Joseph Barnett ; Aniket Tavare ; Ash Saini ; Sam Hare

*Royal Free Foundation Trust*

**Background** Patients with thoracic malignancies often have more than one site of pulmonary, nodal or pleural disease within one hemithorax. In addition, large heterogeneous lesions may comprise distinct, mixed pathological entities. Histological analysis of these lesions can alter tumour staging and treatment options. We investigated the feasibility, safety and benefit of performing image guided percutaneous lung biopsy (PLB) of two lesions in the same hemithorax at a single sitting.

**Methods** Ten consecutive outpatients with two or more potential disease foci within the same hemithorax were analysed over a 15 month period. The mean age of the patients was 66 years (range 46 -- 81 years). Patients underwent CT-guided co-axial 20G core biopsy of both lesions, with separate co-axial punctures for each lesion. Patients were managed as per established local institution ambulatory lung biopsy protocol using small-caliber Heimlich-valve chest drain (HVCD) to treat significant post-PLB pneumothorax in an out-patient setting. Data regarding lesion characteristics, diagnoses and complications were recorded.

**Results** All 10 patients (n=20 biopsies, 100% technical success) received informative histological diagnosis on both lesions. This altered management in all cases. Although a high rate of pneumothorax occurred (60%; 6/10), only two of these patients required treatment with HVCD. No other significant complications occurred in those patients with small asymptomatic pneumothoraces nor those that required HVCD placement.

**Conclusions** Dual-site lung biopsy, performed as a single procedure, is potentially a safe and effective technique for diagnosing patients with multiple thoracic lesions; and can provide useful staging information to guide patient

*1. Ruppert AM, Lerolle U, Carette MF, Lavole A, Khalil A, Bazelly B, et al. Coexisting pulmonary nodules in operable lung cancer: prevalence and probability of malignancy. Lung Cancer Amst. Neth. 2011;74:233—8. 2. Tavare AN, Creer DD, Khan S, Vancheeswaran R, Hare SS. Ambulatory percutaneous lung biopsy with early discharge and Heimlich valve management of iatrogenic pneumothorax: more for less. Thorax. 2015;thoraxjnl—2015—207352*

## 10F Proffered papers - clinical

### Diagnostic paediatric imaging out of hours: A quality improvement project

Fayed Sheikh ; Sara Zafar ; Kathryn Wessely

*Chelsea & Westminster Hospital*

**Background**: Currently, no national guideline exists outlining the provision of out-of-hours paediatric diagnostic imaging services and "access to these services has been described as patchy, especially out of hours" (Paediatric Emergency Services Survey 2011). The PESS reported "a significant proportion of inaccurate reporting is due to misinterpretation of results by non-specialist or trainee radiologists," concluding that access to a consultant radiologist is "an important marker of a quality service." We sought to review whether consultant presence out-of-hours impacts clinical outcome in the management of paediatric patients.

**Methods**: Retrospective audit of all out-of-hours diagnostic paediatric studies performed at a tertiary paediatric-referral hospital, over 6-months. Recorded whether imaging was routinely reviewed by a paediatric consultant radiologist and if so, whether changes to the preliminary report were made and if this altered contemporaneous patient management.

**Results**: A total of 94 studies, including 24 fluoroscopic, 33 computed tomographic, 37 sonographic studies were reviewed. Overall, 83% of all studies were independently performed by radiology trainees. No significant changes to reports were made upon consultant review in 94% of cases and there was no appreciable impact on overall patient management. Of the 24 fluoroscopic studies, intussusception and malrotation were queried in 5 and 19 cases respectively. All intussusceptions were successfully reduced, regardless of consultant presence. The reason for a lack of consultant review in 7/94 cases requires further clarification.

**Conclusions**: The incidence of major discrepancies between the initial out-of-hours report and subsequent consultant review was virtually non-existent in our study, and did not lead to any significant clinical deterioration.

*1. Briggs, R.H. et al. (2010) Provisional reporting of polytrauma CT by on-call radiology registrars. Is it Safe? Clinical Radiology, 65(8): 616-622. 2. Halliday K, Drinkwater K, Howlett D.C. (2016) Evaluation of paediatric radiology services in hospitals in the UK. ClinRad 2016. 3. Kripalani, S. Williams, M. V. and Rask, K. Reducing errors in the interpretation of plain radiographs and computed tomography scans. In: Shojania, K. G., Duncan, B. W., McDonald, K. M. and Wachter, R. M. (2001). Making healthcare safer. A critical analysis of patient safety practices. Agency for Healthcare Research and Quality. 4. Quality and safety programme: Paediatric Emergency Services: A case for Change (February 2013). http://www.londonhp.nhs.uk/wp-content/uploads/2013/03/PES-Case-for-change_FINAL-Feb2013.pdf*

### Quantitative and qualitative values for the different T2W image sequences used for fetal MRI

Rodwan Tumi [1]; Peter Wright [2]; Ashok Raghavan [3]; Elspeth Whitby [1]

*[1]University of Sheffield; [2]Sheffield Teaching Hospitals NHS Foundation Trust; [3]Sheffield Children's Hospital*

**Aim** To assess and compare the visual quality of images produced by 3 different T2 weighted sequences; HASTE, STIR and FISP. To perform quantitative analysis by calculating contrast ratios between body areas and contrast to noise ratios for each sequence and to compare these between the sequences.

**Methods** 97 patients scanned on a 1.5T Siemens Avanto MRI system were included. Visual quality of these images was assessed jointly by 2 experienced radiologists and graded 0-3 (0 - non diagnostic and 3 - excellent). Image quality was compared between sequences. Regions of interest were drawn on three anatomical structures in the brain: grey matter, white matter and cerebrospinal fluid, and in the body in three organs: right lung, left lung and liver. Background noise was also measured. These values were used to calculate contrast ratio and contrast to noise ratios and results compared for the 3 sequences.

**Results** STIR and HASTE sequences showed superiority over FISP in providing better image visual quality. STIR and HASTE sequences had higher contrast ratios in brain images than FISP. For body images, contrast ratios by STIR were superior to HASTE, which was superior to FISP. HASTE sequence contrast to noise ratios were higher than STIR which were higher than FISP sequence.

**Conclusion** STIR and HASTE sequences provide similar image quality and tissue contrast in depicting the foetal brain, whereas the STIR sequence is the superior sequence in imaging the body. The FISP sequence has the lowest visual quality and tissue contrast.

**Development of an instrument to assess trauma radiograph interpretation performance**

Michael Neep [1]; Thomas Steffens [1]; Victoria Riley [2]; Patrick Eastgate [3]; Steven McPhail [1]

*[1]Metro South Health, Australia; [2]Worcestershire Royal Hospital; [3]Metro North Health, Australia*

**Background** The assessment of technical skills during training and practice can be considered to be a form of quality assurance. The purpose of this investigation was to develop a valid and reliable instrument to assess trauma radiograph interpretation performance suitable for use among health professionals. Method Stage 1 examined 14159 consecutive adult appendicular and axial examinations from an Australian hospital emergency department over a 12 month period to quantify a typical anatomical region case-mix of trauma radiographs. A sample of radiographic cases representative of affected anatomical regions was then developed into the Image Interpretation Test (IIT). Stage 2 involved prospective investigations of the IIT's reliability (inter-rater, intra-rater, internal consistency) and validity (content and concurrent) among 41 radiographers.

**Results** The final IIT included 60 radiographic examinations. The median (interquartile range) clinical experience of participants was 5 (2-10) years. Case scores were internally consistent1 (Cronbach's alpha=0.90). Favourable inter-rater reliability2 (kappa>0.70 for 58/60 cases, Intra-class Correlation Coefficient3 (ICC)>0.99 for total score) and intra-rater reliability (kappa>0.90 for 60/60 cases, ICC>0.99 for total score) was observed. There was a positive association between radiographers' confidence in image interpretation and IIT score (coefficient=1.52, r-squared=0.60, p<0.001).

**Conclusion** The IIT developed during this investigation included a selection of radiographic cases consistent with anatomical regions represented in an adult trauma case-mix. Results from this study provide foundational evidence to support the reliability and validity of the IIT. The investigators conclude that it is possible to assess image interpretation performance of trauma radiographs with this selection of radiographic cases.

*1. Cronbach LJ. Coefficient alpha and the internal structure of tests. psychometrika. 1951 Sep 1;16(3):297-334. 2. Gwet KL. Handbook of inter-rater reliability: The definitive guide to measuring the extent of agreement among raters. Advanced Analytics, LLC; 2014 Sep 7. 3. Müller R, Büttner P. A critical discussion of intraclass correlation coefficients. Statistics in medicine. 1994 Dec 15;13(23-24):2465-76.*

**3D CT based orthopaedic reconstructive software**

David Liston

*Sectra Ltd*

**Background** With the increasing relevance of the use of CT data in orthopaedic trauma patients the reliance on flat 2 dimensional X-ray data is becoming less and less.

**Purpose** Advancement in the use of digital data for clinical diagnosis and planning has seen the development of increasingly more sophisticated platforms to allow physicians and clinicians better understanding of symptoms. 3D reconstructive software for the complex trauma patient better enables a viewing surgeon to understand the fracture patterns and manipulate them back into their correct alignment pre-operatively. This not only decreases operative time but can significantly reduce the workflow of data centric clinicians such as MSK radiologist. Over time the process has now evolved into fully manipulative fragments as well as output to 3D print fractures/ specific anatomical zones to give better understanding of each individual patient.

The relevance in teaching environments of such platforms should also be highlighted, and how 3D reconstructive tools are used to better educate trainees on surgical approaches, treatment pathways as well as implant choice.

**Summary** This presentation will highlight the usages in clinical environments as a tool to make rapid diagnostic decisions as well as visualise difficult orthopaedic procedures pre-operatively, and how utilising 3D CT based planning can reduce workload on other departments.

**High index of suspicion aided with muskuloskeletal ultrasound can resolve complex midfoot and hindfoot problems, which can be otherwise sometimes labelled as 'non-specific footpain': Review of literature with pictorial review of differential diagnosis**

Saayija Kumarachandran [1]; Ajay Chourasia [2]; Mahdi Saleh [1]; Muhammad Ali [1]; Aanchal Mehta [3]; Avantika Narasimhan [4]; Ajay Sahu [1]

*[1]London North West Healthcare NHS Trust; [2]East Surrey Hospital; [3]Poznan University of Medical Sciences; [4]Dubai Medical College*

**Introduction**: The correct diagnosis of foot and ankle problems remains an enigma for clinicians due to complex anatomy and multiple clinical conditions. Conventional radiographs are only helpful in late features of the midfoot arthritis. Ultrasound is very sensitive in diagnosis of early Midfoot arthritis well before X-ray changes and can be managed by guided injections easily, if needed. MRI is better in demonstrating bone marrow edema and biomechanical causes but a clinical radiologist has the advantage of clinically assessing the patient during ultrasound, aided with scanning.

**Methods**: We have come across many causes of midfoot problems in our department, which can be diagnosed by Ultrasound with accuracy. Midfoot arthritis, navicular stress disease, chronic metatarsalgia, extensor tendinitis, tibialis posterior

insufficiency, plantar fasciitis, stress fracture, peroneal tendon problems, cavus or planovalgus deformity and tarsal coalition etc. Interestingly some of these patients were referred as forefoot problems e.g Mortons neuroma clinically, however it was eventually diagnosed that there pain was being referred from midfoot arthritis.

**Result**: We will demonstrate cases of midfoot arthritis from our institution, where radiographs could not demonstrate it and were reported normal despite sonographic abnormalities detected later.

**Conclusion**: Ultrasound is an excellent modality to target symptomatic sites for assessment of changes (dorsal osteophyte formation, effusion, hyperemia and synovitis), which helps in making early diagnosis and instituting treatment in form of guided injections to the the affected joint. Ultrasound by a MSK Radiologist can resolve these problems in the most cost effective and timely fashion.

*(1) Imaging of Arthritis and Metabolic Bone Disease. Gandikota. Girish MBBS, FRCS(ed), FRCR and Jon A. Jacobson MD Chapter 7, 89-103, 2009 First edition. (2) Musculoskeletal ultrasonography in healthy subjects and ultrasound criteria for early arthritis (the ESPOIR cohort). Millot F et al. J. Rheumatol- Published April 1, 2011. Volume 38, Issue 4; Pages 613-20 (3) Imaging. R. Hodgson and P.J. O'Connor. Medicine, 2010-03-01, Volume 38, Issue 3, Pages 142-145.*

**Do radiologists and radiographers need to know about osteoporosis?**

Amit Gupta ; Sandra Wood ; Ne-Siang Chew ; Muthusamy Chandramohan ; Clare Groves

*Bradford Teaching Hospitals NHS Foundation Trust*

**Background** Osteoporotic fractures represent a potentially avoidable burden to both the patient and healthcare service. The estimated lifetime risk of fracture at the hip, lumbar spine or distal forearm is 30-40% in developed countries. With over 200,000 fractures occurring every year, the current financial cost to the NHS amounts to over £1.75 billion annually with the figure only set to rise in the future as the population ages As vertebral fractures increase the risk of subsequent fragility fractures by four to five fold, their recognition by the radiology team is crucial for the implementation of secondary prevention strategies. Detecting and treating vertebral fractures early can prevent further vertebral fractures, decrease patient morbidity and prevent future hip fractures. Prompt radiological intervention presents an opportunity to reduce the financial burden of osteoporosis to the NHS.

**Purpose**: The aim of this review is provide clinicians, radiologists and radiographers an overview of osteoporotic fractures, highlight the importance of detecting such fractures and describe the methods of how we at our institution have improved our detection rates of such fractures -- not just a local problem but a national one.

**Summary**: Brief background of osteoporotic fractures and key statistics, pictorial review of different osteoporotic fractures, classification of vertebral fractures, the use of DEXA scanning to identify such patients and describe the methods we have introduced to improve our detection rates.

**Gout imaging with dual energy CT: Imaging protocol, post-processing techniques and its limitations**

Wei Ling Chuang ; Bak Siew Wong

*Singapore General Hospital*

**Background**: Gouty arthritis is a common crystalline and inflammatory arthropathy and is characterized by hyperuricemia (serum urate level >6.8mg/dl), with deposition of monosodium urate (MSU) crystals in tissues, leading to inflammation and tissue damage.

Definitive diagnosis of gout requires positive finding of MS crystals from fine needle aspiration of the synovial joint fluid. It can be technically challenging and is not identified in up to 25% of acute gout cases, whether due to insufficient amount of fluid aspirated, the anatomical location or recurrence of acute inflammation.

**Impact**: Dual-energy CT imaging enables high-molecular-weight compounds to be separated from low-molecular-weight compounds, allowing the differentiation and characterisation of calcium and uric acid, allowing DECT to be a non-invasive option in the diagnosis of gout.

**Content**: The current scan techniques being used in our institution include a 128-slice Siemens Flash CT scanner installed in 2013. Unenhanced scans acquired as per department protocol with the coverage of the entire foot.

Post-processing includes axial soft, axial bone, coronal bone, and sagittal bone images of the foot. In addition, material color-coded images using specific attenuation characteristics are generated to aid the diagnosis of gout. It is important to identify post-processing artifacts such as nail bed or calluses to avoid false-positive results. Tendons can be clearly depicted on the color-coded images, aiding in the localisation of disease.

**Conclusion**: DECT provide a fast and non-invasive option for the diagnosis of gout. Good imaging technique and knowledge of post-processing artifacts are crucial to provide an accurate diagnosis.

*1. Girish, G., Glazebrook, K.N., Jacobson, J.A. (2013) Advanced Imaging in Gout. AJR. 201, 515-525. 2.Mallinson, P.I., Coupal, T., Reisinger, C., et al. (2014) Artifacts in dual-energy CT gout protocol: A review of 50 suspected cases with an artifact identification guide, American Journal of Roentgenology. 203, W103-W109. 3. Desai, M.A., Peterson, J.J., Garner, H.W., Kransdorf, M.J. (2011) Clinical Utility of Dual-Energy CT for Evaluation of Tophaceous Gout. RadioGraphics.*

*31(5), 1365-1375. 4. Grajo, J.R., Patino, M., Prochowski, A., Sahani, D.V. (2016) Dual energy CT in practice: Basic principles and applications. Applied Radiology. 45(7), 6-12. 5. Johnson, T.R.C. (2012) Dual-Energy CT: General Principles. AJR. 199, S3-S8.*

## 12G Proffered papers Wednesday 14.10-15.30

### The use of eye tracking technology to assess radiographer interpretation of X-ray images

Laura McLaughlin [1]; Sonyia McFadden [1]; Ciara Hughes [1]; Jonathan McConnell [2]; Raymond Bond [1]

*[1]Ulster University; [2]NHS Greater Glasgow and Clyde*

**Background**: Studies have used eye tracking technology to assess radiographer ability to identify pulmonary lung nodules within chest images. This digital technology has provided an insight into cognitive processes during image interpretation. Within this study we use eye tracking technology to assess image interpretation skills on a variety of pathologies to determine differences in approach and search strategies.

**Method**: Eye tracking data was collected during participant interpretation of musculoskeletal and chest radiographic images while thinking aloud. A total of 312 image interpretations were collected from 21 students and 18 reporting radiographers.

**Results**: Reporting radiographers were more accurate (p≤0.001), confident (p≤0.001) and took a mean of 2.4s longer to decide on image features compared to students. Reporting radiographers had a greater mean fixation duration (p=0.01), mean fixation count (p=0.04) and mean visit count (p=0.04) within the areas of pathology compared to students. Students had a higher fixation frequency than reporting radiographers (p=0.03) for the area of pathologies. Eye tracking patterns, presented within heat maps, and recordings of participants thought processes were a good reflection of group expertise and search strategies.

**Conclusion**: The accuracy and confidence of each group could be reflected in the variability of their heat maps. A number of computed eye gaze metrics were statistically significant in discriminating between students and practitioners, that an algorithm could be used to automatically and non-intrusively classify radiographer performance. Heat maps, containing high fixation areas representing common areas of pathology presentation, may be a useful aid for undergraduate teaching of pathology recognition.

*1. Bond, R., Zhu, T., Finlay, D., Drew, B., Kligfield, P., Guldenring, D., Breen, C., Gallagher, A., Daly, M. and Clifford, G. (2014) Assessing computerized eye tracking technology for gaining insight into expert interpretation of the 12-lead electrocardiogram: an objective quantitative approach. Journal of Electrocardiology, 47(6), 895-906. 2. Donovan, T., Manning, D.J. and Crawford, T. (2008) Performance changes in lung nodule detection following perceptual feedback of eye movements. Medical Imaging, 691703-691709. 3. Manning, D., Ethell, S., Donovan, T. and Crawford, T. (2006a) How do radiologists do it? The influence of experience and training on searching for chest nodules. Radiography, 12(2), 134-142. 4. Matsumoto, H., Terao, Y., Yugeta, A., Fukuda, H., Emoto, M., Furubayashi, T., Okano, T., Hanajima, R. and Ugawa, Y. (2011) Where do neurologists look when viewing brain CT images? an eye-tracking study involving stroke cases. Plos One, 6(12). 5. Piper, K., Paterson, A. and Godfrey, R. (2005) Accuracy of radiographers' reports in the interpretation of radiographic examinations of the skeletal system: a review of 6796 cases. Radiography, 11(1), 27-34.*

### Formulating and implementing a robust feasibility governance pathway for clinical research within the imaging department

Rachel Sutton ; Ruth Cope ; David Wells

*University Hospitals of North Midlands NHS Trust*

The research team has been in place within Imaging since 2013. In the beginning there were many challenges to the role, these included: no list of trials, no pathway to assess feasibility, no definite Radiology Lead for each trial, difficulties in identifying trial patients, no funding pathway and no ability to audit. An authorisation proforma was devised in order to implement the feasibility pathway. The proformas contain all the governance checks required to assess capacity and capability for research trials involving Imaging and are held on a secure server which is accessible to members of the Imaging department. They act as a quick reference guide for trials and can be useful as an audit trail. The feasibility pathway has allowed our department to understand its research activity and therefore future capacity for trials. Evidencing trial activity has led to an increase in CRN funding which has in turn allowed us to support more trials. The feasibility pathway aims to identify barriers early so that issues can be resolved quickly. When capacity has been a challenge we have devised innovative solutions. When there hasn't been any funding for imaging we have worked together alongside research teams to establish agreement over costs. We believe it has also speeded up the trial set up process which is beneficial to both patients and sponsors. It has raised the profile of research within Imaging and the Trust so that we stand out as a research led department not just a support service.

### The views of radiology service managers concerning professionalism and the ability of newly qualified graduate radiographers to cope with working in contemporary clinical contexts

Charles Sloane ; Paul Miller

*University of Cumbria*

**Background** The findings reported in this poster emerge from a broader project which mapped the views of radiology service managers in the UK concerning the 'fitness for purpose' of diagnostic radiography graduates.

**Method** In line with the conventional methods of Straussian Grounded Theory, N=20 Radiology Department leads in the United Kingdom, working within NHS Trusts (N=19) and independent provision (N=1), were interviewed. All interviews were semi-structured, conducted and recorded by telephone and transcribed verbatim.

**Results** A major theme emerging from the data concerned the ability of graduates to cope and with demands of working in the modern NHS. Conflicts related to motivation, role expectations and the graduate's ability to maintain their professional responsibilities were highlighted as issues which impacted upon their roles. Concerns were also raised into the ability of graduates to communicate effectively and to be cognisant of the potential consequences of poor communication upon efficient working and complaints.

**Conclusion** There was widespread dissatisfaction with the capability of graduates to fulfil key functions within their wider role beyond the technical aspects of clinical imaging. Issues related to the capabilities and expectations of the current generation of students applying for radiography programmes could stem from wider socioeconomic changes in society and the marketisation of education. This has implications for education providers in relation the design of curricula and programme delivery. It is argued that different approaches are now required which align professional and service requirements with the values of a new generation of students.

*1) NHS England Analytical Services. (2014) NHS Imaging and Radiodiagnostic Activity 2013/14 release. Available at : https://www.england.nhs.uk/statistics/statistical-work-areas/diagnostics-waiting-times-and-activity/imaging-and-radiodiagnostics-annual-data/ Accessed 5.4.16 3) Professional Standards Authority. (2015) Rethinking Regulation. Available at http://www.professionalstandards.org.uk/docs/default-source/psa-library/rethinking-regulation.pdf?sfvrsn=2 Accessed 2nd February 2016 2) Strauss, A., & Corbin, J. M. (1998). Basics of qualitative research: Techniques and procedures for developing grounded theory (2nd ed.). London: Sage.*

**Evaluation of interprofessional learning workshop involving radiographers, vascular surgeons and theatre staff**

Brooke Reeve

*Royal Free Hospital London*

**Aim** To create quarterly inter-professional learning workshops, helping to undertake complex vascular procedures in theatre.

**Content** To describe the workshop set up, pictures and future development plans. Provided an opportunity for Radiographers and the Vascular theatre team, to understand each other's roles within a theatre setting. Gave an insight into what is expected from each team and how procedures will be carried out. Allowed Radiographers to learn the new theatre equipment in a 'controlled' setting, and become competent in the equipment with an Apps specialist on site. Provided Radiographers with a booklet on equipment and how to obtain 'Gold Standard Images' on the new theatre equipment. Relevance All Radiography Bands had the opportunity to attend the workshop. This inter-professional workshop was found to be relevant to their CPD, allowing an understanding of what's expected before attending a case.

**Outcomes** Both Vascular and Radiography teams found the workshop to be detailed and a high learning experience of a vascular theatre case. Both professionals experienced inter-professional working, understood each other's roles and what challenges arise during a case.

**Discussion** Radiographers rated the workshop and learning booklet to be high quality. Staff provided feedback that would help structure the next workshop. Both professionals where able to discuss throughout the session, how each team could help aid one another. During the workshop there was an opportunity to take on the other role giving insight on each other's role during a case.

**Pulmonary artery hypertension - making the diagnosis**

Rose Panton ; Adam Wallis ; Paula McParland

*Portsmouth Hospitals NHS Trust*

**Background**: Pulmonary artery hypertension (PAH) is characterised by mean pulmonary pressures of >25mmHg and a progressive re-modelling of the distal pulmonary arteries. The result is elevated pulmonary vascular resistance and subsequently, right ventricular failure. In normality pulmonary pressures at rest are typically <14mmHg, rising to 30mmHg during exercise with increased vascular resistance. Sub-types of PAH (including CTEPH) and their distinguishing imaging features will be demonstrated.

Relevance of the topic to diagnostic imaging: Timely and accurate diagnostic imaging has a crucial role in identifying and monitoring patients with PAH. Chronic thrombo-embolic pulmonary hypertension (CTEPH) is an important cause of severe pulmonary hypertension and is associated with significant morbidity and mortality.

**Purpose**: (1). To increase recognition of this important condition using diagnostic imaging. Specifically to: (a) highlight the characteristic radiological features and associated sequelae of PAH on CT imaging (b) highlight the imaging features specific to PAH sub-types (c) highlight typical ECHO findings seen in PAH (2). To describe the typical radiological features of CTEPH and highlight its importance as a cause of PAH.

Application to practice: It is hoped that by increasing radiological recognition of this condition it will guide informed clinical practice and optimise patient management.

Summary of content: The presentation will outline the typical radiological findings of pulmonary artery hypertension to inform accurate clinical diagnosis and early recognition of the disease.

*1. Castaner, E. et al. (2006) Congenital and Acquired Pulmonary Artery Anomalies in the Adult: Radiologic Overview, Radiographics **26**(2), 349-371. 2. Frazier, A.A. et al. (2007) From the Archives of the AFIP: pulmonary veno-occlusive Disease and pulmonary capillary hemangiomatosis, Radiographics **27**(3), 867-882. 3. Grosse, C. and Grosse, A. (2010) CT Findings in Diseases Associated with Pulmonary Hypertension: A Current Review, Radiographics **30**(7), 1753-1777. 4. Jiménez, D. et al. (2014) Prognostic significance of multi-detector CT in normotensive patients with pulmonary embolism: results of the protect study, Thorax **69**(2), 109-115. 5. Kang, D. et al. (2011) CT Signs of Right Ventricular Dysfunction: Prognostic Role in Acute Pulmonary Embolism, JACC: Cardiovascular Imaging **4**(8), 841-849. 6. Peña, E. et al. (2012) Pulmonary Hypertension: How the Radiologist Can Help, Radiographics **32**, 9-32. 7. Trujillo-Santos, J. et al. (2013) Computed tomography-assessed right ventricular dysfunction and risk stratification of patients with acute non-massive pulmonary embolism: systematic review and meta-analysis, Journal of Thrombosis and Haemostasis **11**(10), 1823-1832.*

**CT sinus and facial bones reporting by radiographers**

Paul Lockwood

*Canterbury Christ Church University*

**Background** The aim of this study was to compare the observer performance of a cohort of radiographer's in reporting Computed Tomography (CT) sinus and facial bones investigations against a reference standard and alternative comparator of summary data from peer reviewed literature.

**Purpose**: The aim of this presentation is to enable conference participants to review results from a cohort of radiographers (n=6) results of an examination bank (n=25 cases using radiologists as reference standards) after completion of part-time training programme. A literature search was performed to identify an additional alternative comparison reference standard from studies reporting observer performance data in CT sinus and facial bones investigations of both trauma and sinus pathology (target conditions). The intended learning outcomes are: 1. Describe the process of assessing radiographer's ability using a range, and variety of statistical methods and reference standards. 2. Begin to evaluate the level of reporting radiographer competence in CT Sinus and facial bone reporting. 3. To start to reflect afterwards of the various advanced practice roles available for radiographers to support service delivery

**Conclusion**. The data analyses used to measure observer performance and determine differences between the cohort and the reference standards, used statistical assessment models including accuracy, sensitivity, specificity, Kappa (k), summary receiver operating characteristic curves with estimated area under the curve (AUC).

**Constructing the "ideal" first-post sonographer: Mapping the views of ultrasound department leads in the UK**

Lorelei Waring ; Paul Miller ; Charles Sloane ; Gareth Bolton

*University of Cumbria*

**Background** The findings reported in this presentation emerge from a broader project investigating the future of Ultrasound education in the UK. Specifically addressed herein is the way in which the employers of prospective first-post sonographers assembled the attributes and aptitudes that would constitute an "ideal" person for such a role.

**Method** In line with the conventional methods of Straussian Grounded Theory, N=20 Ultrasound Department leads in the North West of England, working within NHS Trusts (N=17) and independent provision (N=3), were interviewed. All interviews were semi-structured, conducted and recorded by telephone and transcribed verbatim.

**Results** Participants cited "acquired" capacities such as advanced communication skills, good time management and the ability to work autonomously as essential in a first post-sonographer. They also argued that certain "inherent" personality traits should be sought out as part of a selection process; these attributes included patience, amicability, empathy, caring and a tendency towards perfectionism. Although academic aptitude was deemed important, the ability to be non-judgmental was deemed more so.

**Conclusion** In discussing the ideal attributes of a workplace sonographer, it became clear that the participants had a clear sense of which were desirable and undesirable. However, and in a more novel vein, it was equally clear that they also held strong and relatively consistent views on which kinds of personal attribute were static (i.e. immanent qualities of a prospective employee) and which were malleable (i.e. could be altered/improved with on-the-job training). This, it is contended, has significant import for educators and trainees alike

o001 **Feedback from students on the formative assessment process as well as their mentors' responsibilities: Presenting a novel evaluation tool**

Sindy Singh [1]; Clare Knee [1]; Camarie Welgemoed [1]; Susan Murray [2]

[1]*Imperial College Healthcare NHS Trust;* [2]*University of Hertfordshire*

**Background** The Society and College of Radiographers showed attrition rates of 36.5% for therapeutic students between 2010 and 20111. Reasons for attrition vary but evidence suggests that unsatisfactory placement learning and support contribute to poor placement experience which can result in student withdrawal. Mentors are fundamental in providing learning opportunities and student support, however, opportunity to receive feedback on their performance from students is limited. To address this gap, a novel evaluation tool has been developed for use with students from the University of Hertfordshire (UH) so they can provide feedback on the formative assessment process and their mentors.

**Purpose** The formative assessment feedback evaluation tool was created as part of a prospective evaluative pilot study to determine mentor compliance with the assessment process and facilitation of positive student learning experiences. Second year students were invited to use the tool which resulted in 15 forms being collected over a 6 week placement. Data analysis informed amendments to the tool after which time use of this tool was made mandatory for all students. A repeat analysis of the amended tool has been conducted. Since then, use of the tool has been implemented by other departments affiliated with UH.

**Summary** Information from this novel evaluation tool has the potential to identify mentor training needs and examples of good practice. This can then be shared initially with all the other departments affiliated with UH and hopefully nationally. It also highlights any trends in the formative assessment process which may need to be addressed.

*1. Colyer H. (2013) Improving retention of the radiotherapy workforce - the role of practice placements in student attrition from pre-registration programmes in England: executive summary and recommendations. Society and College of Radiographers.*

o002 **The educational role of automated planning metrics feedback for radiotherapy student practical planning support: qualitative findings**

Mark Warren; Pete Bridge; Marie Pagett

*University of Liverpool*

**Background:** Student feedback is important in higher education; ensuring learning has taken place in both formative and summative assessments. In radiotherapy treatment planning education it is suggested that automated feedback derived from planning metrics software may develop performance and clinical-decision-making skills. This study reports student feedback related to use of automated feedback in their radiotherapy planning education.

**Method**: All 26 students on an undergraduate Year 2 radiotherapy planning module were invited to complete an anonymous questionnaire relating to the value of the automated feedback and plan evaluation tool. Thematic analysis of open responses was performed independently by two researchers via coding, collation of keywords and identification of conceptual themes. Results 16 students completed the questionnaire and 10 themes were identified from analysis of the 49 free text comments. Themes related to the planning process, goal setting, plan evaluation, assignment support, learning, speed and ease of use.

**Conclusion:** The data suggests that automated feedback is valuable to radiotherapy students with little radiotherapy treatment planning experience. Although these students find the automated feedback to be easy to interpret and act upon, other students clearly preferred to rely on tutor support. The findings suggest that automated feedback has a useful supportive role as part of a range of mechanisms within an educational environment.

o003 **The role of the research and development radiographer in implementing new technology and techniques within the radiotherapy department**

Karen Crowther

*Belfast City Hospital*

**Introduction:** Radiotherapy is one of the most potent and cost-effective curative treatments for cancer and the potential benefits from improvements in tumour control and reduction in toxicity are considerable.[1] Technical developments in radiotherapy can make a major contribution to this strategy. It is imperative that technical developments are introduced in a safe and robust manner. [2-5]The introduction must be carefully planned with thorough risk assessment, review of staffing levels and skills required, and documentation must be updated prior to implementation.[6]

**Methodology:** A multi-disciplinary group was formed who acts as an expert advisor and provides guidance and direction to the Radiotherapy Multi-professional Team and Senior Medical Staff Committee in identifying, prioritizing and implementing new and advanced radiotherapy technology and techniques. This group promotes a collaborative multi-disciplinary approach and the Research and Development Radiographer takes a lead role coordinating the group, ensuring projects are kept to the defined timelines while ensuring the implementation pathway is followed (Figure 1).

**Results:** All proposals for implementation of new technology are now formally presented to this group which ensures the proposal contributes to the Radiotherapy Department Research and Development Strategic plan. New techniques successfully implemented using this pathway are: Lung Stereotactic Ablative Radiotherapy (SABR); Prostate SABR; Deep inspirational breath hold; Prostate fiducial marker implantation clinic; and ExacTrac Imaging.
**Conclusion:** This group and the lead role the Research and Development Radiographer plays has enabled our centre to make great progress in recent years ensuring we provide a patient-centred, modern, safe and equitable, and research-driven radiotherapy service.

*1) National Cancer Research Institute (NCRI). CTRad: national leadership in radiotherapy research. Achievements and Vision, 2014 2) The Royal College of Radiologists, Society and College of Radiographers, Institute of Physics and Engineering in Medicine. On target: ensuring geometric accuracy in radiotherapy. London: The Royal College of Radiologists, 2008. 3) Cancer Research UK and NHS England. Vision for Radiotherapy 2014–2024. 2014. 4) Independent Cancer Taskforce. Achieving world class cancer outcomes: A strategy for England 2015-2020. 5) Department of Health, Social Services and Public Safety. Service Framework for Cancer Prevention. 6) Donaldson, S.R. Towards safer radiotherapy. British Institute of Radiology, Institute of Physics and Engineering in Medicine, National Patient Safety Agency, Society and College of Radiographers, The Royal College of Radiologists, London; 2007.*

o004 **CASPIR Trial: Interim analysis of prostatic calculi as an alternative to fiducial markers for IGRT**

Angela O'Neil

*Queens University of Belfast*

**Purpose**: To compare fiducial markers (FMs) with Prostatic Calculi (PC) as an aid to prostate IGRT. Preliminary results are reported.
**Method**: We designed a clinical trial investigating the feasibility of using PC as natural FMs. Patients planned for prostate radical EBRT +/- brachytherapy are eligible. Prior to CT planning, 3 gold fiducial markers are inserted trans-perineally under TRUS guidance. PC within the PTV are contoured. EBRT is aligned to FMs using daily CBCT. CBCTs are analysed in Eclipse (version 13.6). Random and systematic set-up errors are determined based on FMs, PC (where present), prostate gland (PG) and bony landmarks (BL). CTV-PTV margins are derived for each data set.
**Results**: To date 25 participants have been recruited. 12 participants have PC contoured, 6 of whom have completed radiotherapy. PTV margins required based on each reference structure are summarised in Table 1.
**Conclusion:** The maximum difference between the CTV-PTV(PC) margin and CTV-PTV(FM) margin is 1.3mm in the X or L/R dimension. This is less than the maximum difference between CTV-PTV(FM) and CTV-PTV (BL) for the same dimension (1.7mm). Preliminary results demonstrate some evidence to support the use of PC as an alternative to FMs for prostate IGRT. Recruitment continues with a target of 30 patients with PC

o005 **Harmonisation of molecular radiotherapy dosimetry between multiple centres for the SEL-I-METRY trial**

Rebecca Gregory [1]; Iain Murray [1]; Jonathan Gear [1]; Sarah Chittenden [1]; Andrew Fenwick [2]; Jill Wevrett [3]; James Scuffham [4]; Martha Stuffins [5]; Sofia Michopoulou [5]; Brian Murby [6]; Jill Tipping [6]; Steve Jeans [6]; Glenn Flux [1]; Jonathan Wadsley [7]

*[1]Royal Marsden NHS Foundation Trust and The Institute of Cancer Research; [2]National Physical Laboratory; [3]The Royal Surrey County Hospital and National Physical Laboratory; [4]The Royal Surrey County Hospital and The University of Surrey; [5]University Hospital Southampton NHS Foundation Trust; [6]The Christie NHS Foundation Trust; [7]Sheffield Teaching Hospitals NHS Trust*

The SEL-I-METRY trial is the first of its kind to implement molecular radiotherapy (MRT) dosimetry based on quantitative SPECT/CT imaging in a multicentre setting, to build the evidence base for radiation absorbed dose thresholds for successful radioiodine therapy of advanced thyroid cancer enhanced using Selumetinib. This MAP kinase inhibitor may be able to increase the uptake of radioiodine in patients previously refractory to radioiodine, providing a new treatment option [1]. In this trial an iodine-123 scan will be performed before and after 4 weeks of Selumetinib treatment. Patients that demonstrate enhanced radioiodine uptake (>30%) will receive radioiodine therapy alongside dosimetry measurements. Three to 4 iodine-123 SPECT/CT scans will be acquired to determine the dose that will be delivered at therapy. The patient will receive the standard 5.5 GBq iodine-131 therapy and undergo a further 3-4 SPECT/CT scans, to validate the predicted therapeutic dose. Whole body counting and dosimetry will be used to indicate the likelihood of toxicity. Sites participating in this trial will follow standardised procedures. Therefore doses measured at each centre will be comparable, to establish the dose thresholds for an optimised treatment regime. The SPECT/CT systems at each site have been set-up and calibrated for quantitative iodine-123 and iodine-131 SPECT/CT imaging using standardised protocols. The calibration factors and system capabilities varied between sites supporting the requirement for individual calibration of all systems. In this way the first network of centres able to perform MRT dosimetry measurements in a standardised way is being established in the UK.

*1. Ho, A.L., et al. (2013) Selumetinib-enhanced radioiodine uptake in advanced thyroid cancer. N. Engl. J. Med. **368**(7), 623-32.*

o006 **Can we influence the response rate to a research questionnaire?**

Nicola Rivington

*Queen Alexandra Hospital, Portsmouth*

**Background** The oncology team were asking patients to complete a questionnaire for research. With their agreement they were given it to complete at home and then asked to post to the chief investigator in a pre paid envelope. Accrual would be awarded to the department for completed questionnaires received by the Chief Investigator. This study examined the relationship, between the amount of time the researcher spent explaining both the study and the questionnaire to the patient and the response rate.

**Method** Three different members of staff approached the first breast cohort. Two clinicians in the outpatients clinic asked patients if they wished to help with a questionnaire survey. Extra time spent by the clinician was no more than two minutes. The third staff member gave them a detailed explanation of the study in a separate clinic room. Time spent was approximately 15 minutes plus time spent waiting for clinic rooms. The same method of detailed and brief explanation was used for the second prostate cohort. For this group, all communication was from the same staff member which would negate personality factors.

**Results** There was no significant difference in the number of questionnaires that were completed and returned between the two methods of approach.

**Conclusion** Proving there is no significant correlation between return rate and time spent by the researcher with the patient has large resource implications. For any Future similar studies the department will use the most time efficient approach knowing that it will not be detrimental to study uptake.

o007 **Radiotherapy patient experiences and perceptions of enrolling in clinical trials: a qualitative interview study to inform patient-centric best practice for enrolment**

Kim Meeking [1]; Lyndsey Kilgore [1]; Susannah Chapman [1]; Elaine Cooper [1]; Nicola Jarrett [2]

[1]*University Hospital Southampton;* [2]*University of Southampton*

**Background**: Less than 1% of cancer patients are recruited to radiotherapy clinical trials [1]. In a measure to improve this, national recruitment targets have been set for the first time [2]. There is a need to identify and address existing barriers to recruitment in order to increase participation [3]. Previous research has explored barriers to trial recruitment but research relating specifically to radiotherapy trials is scarce. This relevant and timely study seeks to understand the factors influencing recruitment to radiotherapy trials from the patients' perspective.

**Method**: This is a qualitative study using semi-structured interviews with approximately 20 patients who have received radiotherapy. Perspectives will be sought from a variety of radiotherapy patients; patients previously approached regarding a radiotherapy clinical trial, and patients naive to the experience of clinical trial participation. The interviews will be recorded, transcribed, and thematic analysis will be used to explore the data, and draw out relevant themes.

Results / Conclusion: To follow (results are expected in March 2017)

*1. National Institute for Health Research Clinical Research Network. (2016) High Level Objectives Year End Performance Report - 2015/16. [Online] Available at http://www.nihr.ac.uk/about-us/how-we-are-managed/managing-centres/crn/our-performance.htm [Accessed 15th August 2016] 2. Bateman, A., Walters, J., Nicholls, A. (2016) CRN: Wessex Cancer Research Team Newsletter [Newsletter] Autumn 2016 ed. NHS National Institute for Health Research. 3. Cancer Research UK, (2014) Vision for Radiotherapy 2014-2024. [Online] Available at https://www.cancerresearchuk.org/sites/default/files/policy_feb2014_radiotherapy_vision2014-2024_final.pdf [Accessed 15th August 2016]*

o009 **All of a twitter: the radiotherapy conversation in the digital age**

Kim Meeking

*University Hospital Southampton*

**Background**: Twitter is an online social networking platform with 15 million users in the UK [1]. Patients, healthcare professionals and healthcare organisations are increasingly turning to sites like Twitter to share information, to build networks, and to find support [2]. Previous research has shown that cancer patients tweet about all aspects of their pathway [3], but the needs expressed by patients or the purpose of the exchanged information has not yet been studied. The aim of this research is to determine the extent and purpose of radiotherapy-related messages posted on Twitter. Furthermore, to explore how social media research can contribute to improving the care and support of radiotherapy patients.

**Method**: This is a cross-sectional observational study using content analysis. 2000-3000 tweets relating to radiotherapy will be collected over one composite month. The dataset will be analysed with quantitative and qualitative methods to explore what is being said, by whom, and why.

**Results/Conclusion to follow** (results expected early April 2017)

*1. Statista: The Statistics Portal (2016) Twitter: Number of monthly active users 2010-2016. Statista Inc. Available from: http://www.statista.com/statistics/282087/number-of- monthly-active-twitter-users/ [Accessed 15 June 2016] 2. Ventola C (2014) Social media and health care professionals: Benefits, risks and best practices. Pharmacy and Therapeutics, 39(7): 491-499 3. Tsuya A, Sugawara Y, Tanaka A and Narimatsu H (2014) Do cancer patients tweet? Examining the Twitter use of cancer patients in Japan. Journal of Medical Internet Research 16(5): e137*

o010 **Developing a national guidance document for consultant radiographers**

Neill Roberts; Stella Campbell

*SCOR Consultant Radiographer Sub Group*

**Introduction**: Since the implementation of the Consultant Allied Health Professional Role in 2000, the development of the Consultant Radiographer post has taken a varied and inconsistent route. There is limited literature available regarding role development and appropriate job structure therefore the SOR Consultant Radiographer group felt it was now time for a more consistent approach with supporting documentation and guidance. According to the Department for Health (DoH), non-medical Consultant posts consist of four core domains of practice

1. Expert clinical practice.
2. Professional leadership and consultancy.
3. Education, training and development.
4. Practice and service development, research and evaluation.

**Aims/Objectives**:

* To provide a national guidance document for those new and established in Consultant Radiographer posts for imaging and radiotherapy, for use by clinical staff, service leads and academic staff alike.
* To contribute towards greater transparency in: the function, training, terms and conditions and governance of these posts.
* To promote interdisciplinary working and the Consultant Radiographer role more widely. **Discussion/Outcome**: A working party was formed from Consultant Radiographers representing a variety of disciplines and geographical locations. This group has written an 'all encompassing' document to meet the aims above, it explores all four core domains, explains the rationale for robust job descriptions and job plans, clarifies how to facilitate role development, with recommendations or requirements for trainees and touches on terms and conditions. Radiographers of all disciplines, commissioners, managers, multidisciplinary teams that interact with CRs, aspiring CRs and other healthcare professionals are the intended audience for this publication.

o011 **The impact of a departmentally developed PROMS baseline questionnaire for prostate cancer patients due to under go radical radiotherapy**

Gayan Chetiyawardana

*Mount Vernon Hospital – The Hillingdon Hospitals NHS Foudantion Trust*

**Aim**: Baseline function is important to differentiate between treatment related toxicity and disease symptoms [1]. An audit and discussion with the Society of Radiographer's (SOR) Prostate, Radiotherapy Information, and Support and Review Special Interest Groups (SIG) found that there was no national consensus of a flawless single validated toxicity tool, for assessing Genito-urinary, gastrointestinal, sexual function and androgen deprivation therapy toxicity [2]. Many departments, including our own, utilised modified toxicity tools or combinations of different questionnaires [2]. The opportunity was identified for a potential national consensus to develop a single fit for purpose toxicity tool and this was developed using feedback from multiple stakeholders including patients, urological specialist oncologists, the British Association of Urological Nurses (BAUN) and the British Society for Sexual Medicine (BSSM).

**Method**: A PROMS toxicity questionnaire was developed using modification and amalgamation from the commonly used validated toxicity questionnaires identified in the audit of the SOR SIGs. It's was decided to test the questionnaire in the baseline only setting first to test efficacy. The questionnaires were filled out during a pre-prostate radiotherapy group consultation in both guided and non-guided settings. Amount of support required in filling out the questionnaire, time taken and patient satisfaction were all assessed as primary end points through questionnaires carried out mid way through their radiotherapy treatment.

**Results**: Data still being collected at present.

**Conclusions**: Will be dependent on analysis of final data.

*1. Pearse M, Choo R, Danjoux C, Gardner S, Morton G, Szumacher E, Loblaw A, Cheung P (2008) Prospective Assessment of Gastrointestinal and Genitourinary Toxicity of Salvage Radiotherapy for Patients With Prostate-Specific Antigen Relapse or Local Recurrence After Radical Prostatectomy. International Journal of Radiation Oncology Biology Physics. Vol 72 (3) p792-798 2.*

o012 **An institutional audit to assess online image guidance for lower limb sarcomas**

Chaide Taylor [1]; Mark Warren [2]; Jacqui Parker [3]; Julie Stratford [3]

[1]*The University of Liverpool;* [2]*University of Liverpool;* [3]*The Christie NHS Foundation Trust*

**Background:** With the initiation of the IMRIS trial in the UK, increased confidence in set up margins is vital for radiotherapy for sarcoma of the lower limb. However, there are conflicting reports of the adequacy of small magnitude set up margins1 to adequately compensate for the overall set-up uncertainty. As a

Result, daily on-line imaging is usually recommended. This study aimed to investigate a less intense institutional strategy of on-line imaging, which allows for the offline correction of systematic error after the first three fractions and on a weekly basis thereafter, provided that discrepancies were below a 3mm action level.

**Methods**: A retrospective analysis of 30 patients was performed. Patient set up and correctional data derived from cone beam CT analysis was retrieved. The population systematic and random error was derived and planning margins calculated. The timing, frequency and magnitude of correctional episodes were evaluated.
**Results**: The required Planning Target Volume margin for the study population was 0.55cm, 0.41cm and 0.50cm in the lateral, caudocranial and anteroposterial directions. 20% of patients had no offline correctional episode over the duration of treatment, and 47% had one. The maximum number of offline correctional episodes per course of radiotherapy was 4, which occurred for 2 patients. 34% of episodes occurred within the first 5 fractions.
**Conclusion**: The required PTV margin for this population compares well with other published daily, online correctional strategies. A less intense online imaging strategy can therefore be used in conjunction with online image guidance to achieve small planning margins.
*1. Dickie C, Parent A, Chung P, Catton C, Craig T, Griffin A, et al (2010). Measuring Interfractional and Intrafractional motion with cone beam computed tomography and an optical localization system for lower extremity soft tissue sarcoma patients treated with preoperative intensity-modulated radiation therapy. Int J Radiat Oncol, Biol Phys; 78 (5): 1437-1444*

o013 **Hearing voices**

Lorraine Whyte, *Beatson West of Scotland Cancer Centre*

**Introduction**: The cancer story is changing...There is a new story for advanced cancer. Many people with incurable advanced cancer can live good quality lives with the right support...if a patient needs palliative Radiotherapy, we can be fairly certain that Radiotherapy is not all the patient needs (1). We as health care professionals need to be better educated and must acquire the necessary skills to provide us with the tools to support the "whole" patient. This qualitative research was carried out in order to improve our knowledge base and help us understand the experiences of our palliative in-patients here at the Beatson West of Scotland Cancer Centre.
**Methods and Materials**: Here at the Beatson we have a patient Wellbeing Centre where in-patients can take advantage of a number of contemporary, non-clinical spaces, quiet areas and a vast range of wellbeing and complimentary therapies. A survey was carried out to assess the positive effect the Wellbeing Centre had on the patient experience and a short film has been produced to showcase the voice of the patient, no-one else, just the patient.
**Results**: We have underestimated or forgotten that patient wellbeing, compassionate care and a holistic approach to healthcare are just so important and beneficial to patients. Significant learning has arisen from listening to the patients! This has directly influenced our often dismissive approach to complementary therapies and the holistic approach to patient care.
**Conclusion and Discussion**: There has been no standard approach to the way Holistic Needs Assessment are carried
*1) Mackillop WJ (1996) The principles of palliative radiotherapy: a radiation oncologist's perspective. Can J Oncol. Feb;6 Suppl 1:5-11. 2) 2) National Cancer Survivorship Initiative (2013). National Cancer Action Team, Holistic Needs Assessment for people with cancer; A practical guide for healthcare professionals.*

o014 **Compassion in healthcare: A concept analysis**

Amy Taylor [1]; Karen Collins [2]; Denyse Hodgson [2]; Melanie Gee [2]
[1]*Sheffield Teaching Hospitals NHS Trust;* [2]*Sheffield Hallam University*

**Background** The necessity to develop and subsequently utilise caring and compassionate behaviour within the healthcare workforce is central to radiographers' professional policy [1] and practice and is congruent with the core values of the NHS Constitution [2]. Cases of malpractice, poor care and neglect steered the Government to place compassion at the heart of its NHS strategy, and policies calling for improved compassionate care ensued [3-6]. However the policies provide limited definition and explanation of compassion, leaving the policies open to misinterpretation. Exploration and a contextual understanding was sought to refine the ambiguous, vague and often over-used term, compassion in healthcare.
**Method** Walker and Avant's Eight-step model [7] was used as the framework for the concept analysis. Data collection utilised a number of resources including online databases: Medline, CINAHL complete, Scopus, PubMed, PsycINFO, Science Direct, Cochrane and DARE; dictionaries, social media, internet sources, books and doctoral theses.
**Results** The concept analysis distinguishes the defining characteristics of compassion within a healthcare context, allowing for associated meanings and behaviours to be outlined aiding understanding of compassion. Compassion in healthcare requires five defining attributes to be present: Recognition, Connection, Altruistic desire, Humanistic response and Action.
**Conclusion** The findings identify the complexity of the term and subjective nature in which it is displayed and in turn perceived. The concept analysis forms the basis of further research aiming to develop a healthcare explicit definition of compassion within cancer care and radiography practices. Lucidity will enhance understanding, active engagement and implementation into practice.
*1. Society and College of Radiographers. Code of Professional Conduct. 5th July 2013 2. The NHS Constitution for England. 26th March 2013. 3. Department of Health. Delivering high quality, effective, compassionate care: developing the right people with the right skills and the right values. England, Williams Lea for the Department of Health. 2013. 4. Department of Health. Education Outcomes Framework. England. 28 March 2013 5. NHS England. Putting Patients First: the NHS England business plan for 2014/15 – 2016/17 6. Department of Health. Compassion in Practice; Nursing, Midwifery and Care staff, Our Vision and Strategy. December 2012 7. Walker L & Avant K. Strategies for theory construction in nursing. Pearson Pretence Hall. Pearson Education. 2005*

o015 **Mortality and survival differences between patients undergoing single and multi-fraction palliative radiotherapy - is there scope for optimisation of resource utilisation?**

James Price; Kirsty Clarke; Thomas Wolfe; Ewan Shawcroft; Santhanam Sundar

*Nottingham University Hospitals NHS Trust*

**Background** Palliative radiotherapy (RT) is becoming more technically complex and costly. The NHS is facing an unprecedented financial crisis and it is critical that our available resources are used in a cost-effective manner. We assessed for any survival benefit from multi-fraction palliative RT compared to single-fraction RT.
**Method** Patients undergoing either single- or multi-fraction palliative RT for all types of indications in all tumour sites over a 3 month at our institution were included in our analysis.
**Results** Table 1 details the median patient age (similar between the two groups), median total RT dose and median number of fractions. Dose per fraction ranged from 1.8Gy to 10Gy. Median overall survival was not different between the two groups.
On survival analysis by Cox regression, tumour site and histology were predictive of overall survival; but total radiation dose and dose per fraction were not. The hazard ratios for dose, number of fractions and dose per fraction were 0.956, 1.004, and 1.072 respectively.
**Conclusion** The lack of survival advantage for multi-fraction palliative RT suggests that prognosis is influenced by the biology of disease rather than radiation treatment modality. The appropriate use of highly technical radiotherapy needs accurate prognostication but the prediction of survival of cancer patients by radiation oncologists tends to be inaccurate[1]. Hence, lab-based prediction tools are needed to predict survival of patients undergoing palliative RT so that RT fractionation and the emerging complex palliative RT is used appropriately and cost-effectively in the palliative care of patients.

*1. Chow et al. Int J Radiat Oncol Biol Phys. 2005 Mar 1;61(3):870-3*

o016 **Curative radiotherapy in patients aged over 80, a single centre experience**

Anthea Cree; Ananya Choudhury; Richard Cowan

*The Christie NHS Foundation Trust, Manchester*

**Background** Half of all cancers are diagnosed in patients aged over 70 and the number of people in the UK over 85 years has increased to 1.5 million(1). In our centre, 10% of patients undergoing radiotherapy last year were over the age of 80. The aim of the study was to assess the tolerability of radiotherapy in this group.
**Method** All patients (82) over 80 years, treated with adjuvant or radical radiotherapy in January 2016, were identified, with a comparison group of 82 consecutive patients aged between 70-74 years. Details including demographics, tumour site, toxicity (CTCAE v4) and survival were recorded.
**Results** The median age of patient in over 80 group was 85 years (oldest 93).
In both groups radiotherapy was well tolerated with 81 (98%) of patients completing treatment.
With a median follow up of 313 days, there were 10 (12%) deaths in the 70-74 group and 12 (15%) in the over 80 group. 6 (7%) patients were admitted during treatment in over 80 group with only 1 (1%) in 70-74 group. Most patients who died had lung cancer. Cause of death was hard to establish although progressive disease or intercurrent illness was present in at least half of cases. In the over 80 group, early mortality was higher suggesting a possible relationship to radiotherapy.
**Conclusion** Direct comparison between the groups was not possible due to but radiotherapy appears to be reasonably well tolerated in the selected very elderly. Comprehensive geriatric assessment may improve patient selection(2).

*1. Office for national statistics. Population Estimates for UK, England and Wales, Scotland and Northern Ireland: mid-20154. 2. Review of current best practice and priorities for research in radiation oncology for elderly patients with cancer: the International Society of Oncology (SIOG) task force I. H. Kunkler, R. Audisio, Y. Belkacemi, M. Betz, E. Gore, S. Hoffe, Y. Kirova, P. Koper, J.-L. Lagrange, A. Markouizou, R. Pfeffer, S. Villa On behalf of the SIOG Radiotherapy Task Force Ann Oncol (2014) 25 (11): 2134-2146*

o017 **Better, quicker, safer - streamlined VMAT palliative radiotherapy at Newcastle's Northern Centre for Cancer Care**

John Byrne; Shahid Iqbal; Nick West; Neil Richmond; Audrey Ogilvie; Karen Pilling

*Northern Centre for Cancer Care, Newcastle Upon Tyne*

Current palliative treatment at NCCC, like most departments, uses simple parallel opposed pairs or single beams and a simple factor based calculation that estimates dose to a single point and ignores the presence of density heterogeneities. As a consequence, tumours, particularly in the thoracic region, often do not receive the prescribed dose and superficial tissues can receive significantly more. The process usually involves repeat attendance by the oncologist before the plan is complete. With modern planning tools and VMAT delivery there is now potential to quickly conform the prescribed dose distribution, reduce the plan preparation time and enable a quicker treatment delivery. In NCCC's pilot palliative pathway process, planners define the simple target volume and use Raystation to automatically create a VMAT plan that meets palliative-protocol goals. Automatic plan-QA scripts check that the steps meet the process requirements. The plan and prescription are approved in a single visit by the oncologist. Automating the planning process saves approximately 10 minutes per patient and involves only a single attendance in planning for the oncologist. On-treatment patient position is quickly verified with kV CBCT 3D-3D matching before patient treatment. Dose coverage is optimised, the dose distribution is accurately calculated, the need for manual MU check

calculations and manual data transcription is removed and staff time is used more efficiently. This approach will enable better correlation between prescribed dose and outcomes and will facilitate dose escalation or further hypofractionation for palliative patients.

o018 **Effect of minimum MLC leaf gap on plan quality and delivery accuracy in VMAT planning**

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The minimum MLC leaf gap (MLG) in VMAT planning affects both the quality of the plan, and the accuracy of the predicted dose distribution[1]. The purpose of this study was to investigate the influence of MLG on a sample of treatment sites selected to provide a representative cross section of VMAT objectives. A mixture of 6MV and 10MV plans were chosen. All plans were planned in Monaco v3.3 (Elekta). Plans were created with MLG 0.5cm, 1cm and 2cm. Plan quality was assessed using Dose Volume Histogram (DVH) statistics, conformity index, number of segments and total Monitor Units (MUs). Accuracy of delivery was compared using a global gamma comparison (3%,3mm and 3%,2mm). It was found that, as expected, improved target coverage with better conformity is predicted as MLG is decreased; while MUs and number of segments increases. Gamma pass rate for simple treatment sites are generally excellent when planned with MLG 1cm and little benefit is seen above this, while reducing MLG was found to reduce gamma pass rate. For complex sites, it was not always possible to produce a clinically acceptable plan using a 2cm MLG. Good gamma pass rates were observed for plans produced with an MLG of 1cm, though there is more scope for plan improvement (by reducing MLG) than for simpler sites. As expected, the influence of the MLG appears to be more important for more complex treatment sites, however a setting of 1cm gives a good balance for the range of sites studied.

*1. Nithiyanantham, K et al (2014) Influence of segment width on plan quality for volumetric modulated arc based stereotactic bodyradiotherapy Reports of practical oncology and radiotherapy **19** 287-295*

o019 **Simulation of interplay effects in lung VMAT using dose deformation tools**

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Intra fraction motion induced by respiratory breathing can degrade intensity modulated treatments due to dose blurring, interplay and setup. To date, studies of tumour motion have mainly been limited to dosimetric verification with a variety of phantom measurements[1] and a couple of partial arc SBRT lung simulations[2,3].

Patients were scanned using a 4DCT respiratory gated system, binning data over 10 phases. To simulate respiratory breathing, sinusoidal motion was chosen and sampled over 10 equi-spaced points. Lung VMAT plans were created in Pinnacle$^3$ 9.8 with the VMAT delivery split up into individual control points; monitor units were assigned to each of the 10 phases of the motion dependent on the amplitude, breathing rate and arc time. ITV amplitudes up to 1.3cm were considered. The starting breathing phase on the sine wave (for each fraction) was randomly generated.

The dose calculated on the average CT image was recalculated on each of the individual phases in Pinnacle$^3$ and exported to Mirada 1.6 (Mirada Medical, Oxford, UK). The individual phase doses were then individually deformed on to the midvent CT and weighted dependent on the assigned MU.

In conclusion the effect of breathing across all phases appears to wash out dose differences due the extremes of motion; ITV and CTV dose statistics for plans simulated with different amplitudes and breathing phases are within 1% of the original dose calculated on the midvent scan. The midvent dose statistics are within 4% of any given phase and 1% of the average.

*1. Jiang, S.B. et al. (2003) An experimental investigation on intra-fractional organ motion effects in lung IMRT treatments. Phys. Med. Biol. **48**(12) 1773-1784. 2. Zou, W. et al. (2014) Dynamic simulation of motion effects in IMAT lung SBRT. Rad. Onc. **9**225. 3. Li, X. et al. (2013) Dosimetric effect of respiratory motion on volumetric-modulated arc therapy-based lung SBRT treatment delivered by TrueBeam machine with flattening filter-free beam. J Appl. Clin. Med. Phys. **14**(6) 4370.*

o020 **Development of a simple single arc Elekta VMAT class solution for prostate treatments with hip prostheses using the Pinnacle TPS**

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**Background** When treating patients with hip replacements it is common to use complex IMRT or multiple arc VMAT plans that avoid treating through the prosthesis, because of plan robustness and calculation accuracy issues[1-4]. In this study, our standard single arc prostate Elekta/Pinnacle VMAT class solution has been modified to reduce dose delivered through the prosthesis, simulating the use of avoidance sectors.

**Method** Twelve prostate patients with hip prostheses were selected. A sparing volume was produced using the intersection of an expanded prosthesis contour and a "rind" beneath the body surface. This volume was included in the optimisation parameters with a maximum dose constraint. Clinical assessment of plan suitability was completed by an oncologist. Robustness

to differences in prosthesis position was assessed by overriding the prosthesis to water-equivalent density and recalculating. Dose verification was performed by delivering plans to the OIS Delta4 phantom and to a PTW 2D array in the Octavius phantom.
**Results** All twelve VMAT plans were comparable to the original IMRT plans and acceptable in terms of target volume coverage and organ-at-risk doses (see figure 1(a)). All plans had a pass rate of >98% using 3%/3mm global gamma analysis in both verification phantoms and showed good robustness (see figure 1(b)).
**Conclusion** A single arc VMAT class solution has been developed that successfully delivers clinically acceptable prostate treatments. This simplifies the planning and verification procedure and allows prostate treatments to be standardised. This is achieved using a simple sparing volume and could easily be extended to alternate treatment sites.
*1. Carolan, M. et al. (2000) Effect of hip prostheses on radiotherapy dose. Australasian Radiology, 44, pp. 290—295. 2. Peters, S. et al. (2014) A Treatment Planning Study Comparing Elekta VMAT and Fixed Field IMRT Using the Varian Treatment Planning System Eclipse. Radiation Oncology, 9, 153. 3. Rana, S. and Pokharel, S. (2014) A dosimetric study of volumetric modulated arc therapy planning techniques for the treatment of low risk prostate cancer in patients with bilateral hip prostheses. South Asian Journal of Cancer, 3(1), pp. 18—21. 4. Reft, C. et al. (2003) .Dosimetric considerations for patients with HIP prostheses undergoing pelvic irradiation. Report of the AAPM Radiation Therapy Committee Task Group 63. Medical Physics, 30(6), pp. 1162—1182.*

o021 **Analysis of the dosimetric effect of seed-based prostate localisation on pelvic lymph nodes when treating high-risk prostate cancer with VMAT**

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*Beatson West of Scotland Cancer Centre*

**Background** Prostate movement is unrelated to pelvic lymph nodes (PLN) location. Therefore, for High-Risk Prostate Cancer radiotherapy, set-up corrections based on image-guided localisation of the prostate might not guarantee that the other nodal PTV receives the intended dose.
**Method** To evaluate the impact that couch shifts applied for prostate motion correction have on the dose delivered to the PLN, and to determine their ideal PTV margins: Retrospective analysis of 21 treatments using the interfraction prostate-based couch shifts as new isocentre coordinates in a verification plan. Then each fraction dose was recalculated and the dose coverage of the PLN CTV was assessed with DVHs. To reduce the geometric miss new PLN PTV margins were proposed using the Van Herk formula. Finally, treatment plans using current and proposed margins were compared based on the dose to OARs and PTVs.
**Results** The verification plans reported a mean PLN CTV D99% of 91.7% and this reduced between 4.8% and 9.0% ($p<0.001$) compared to the mean of the original plans. 51.3% of the verification plans did not meet the criteria, these showed a prostate vector displacement larger than 0.62 cm. The recommended margins: AP 0.91, SI 0.57, and RL 0.26 cm, reported no significant difference in the dose to OARs and PTVs compared to the current treatment plans margins.
**Conclusions** When daily position correction is made considering only the prostate there is potential dose degradation to the PLN. The proposed margins expect to improve its dose coverage, without significantly affecting the associated OARs.
*1. Adamczyk M, Piotrowski T, Adamiak E, Malicki J. Dosimetric consequences of prostate-based couch shifts on the precision of dose delivery during simultaneous {IMRT} irradiation of the prostate, seminal vesicles, and pelvic lymph nodes. Physica Medica. 2014;30(2):228-233. 2. Schallenkamp JM, Herman MG, Kruse JJ, Pisansky TM. Prostate position relative to pelvic bony anatomy based on intraprostatic gold markers and electronic portal imaging. International Journal of Radiation Oncology*Biology*Physics. 2005;63(3):800-811.*

o022 **A clinical evaluation of Varian smart segmentation software for the contouring of Organs at Risk (OAR) in radiotherapy treatment planning**

Ryan Hulley [1]; Ghirmay Kidane [1]; Liz Crees [1]; Margaret Bidmead [2]

[1]*Barking Havering and Redbridge University Trust;* [2]*The Royal Marsden Hospital*

**Background**: Varian Smart Segmentation® knowledge based contouring (SSKBC) software (version 13.6MR1) combines two auto-contouring tools, image intensity based (smart detection) and deformable registration based (propagation). Several studies have investigated the accuracy of generated contours however the aim of this study was to compare the structure generated by each algorithm to a reference to identify which algorithm optimally contours each OAR.
**Method**: In this retrospective study of 30 patient plans, the manually contoured OARs were used as a reference to compare the accuracy of the auto contours generated by each algorithm. Treatment regions included were head, thorax and pelvis. Each clinical plan was re-contoured using both algorithms. A quantitative appraisal of the automatically contoured structures with reference to the manually contoured structures was completed using the dice similarity coefficient (DSC) and centre of mass (CoM) shift.
**Results**: The mean DSC achieved by the smart detection and propagation algorithms were 0.79 (range: 0.41-0.98) and 0.77 (range: 0.3-0.96) respectively. The greatest shift in CoM was on average along the superior-inferior axis and were 0.44cm (range: 0cm- 3.2cm) for the smart detection and 0.58cm (range: 0cm-3.9cm) for the propagation algorithms. The smart detection algorithm created superior contours compared to the propagation algorithm for the brain and mandible, whilst the propagation algorithm created the superior contours for the eye structure. There was no significant difference between the two algorithms for the bladder, spinal canal and femurs.
**Conclusion**: This study concluded that for optimal contouring there should be organ-specific departmental guidance on which algorithm to use.

o023 **Using a TPS scripting interface to audit scanning practice**

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*Worcestershire Oncology Centre*

**Background** The Python scripting interface available in the RayStation treatment planning system enables efficient retrieval of data, making it possible to audit large volumes of patient data. In this work, data retrieved from RayStation has been used to assess acquisition and reconstruction fields of view (AFOV/RFOV) used for radiotherapy planning scans.
**Method** Data was retrieved for prostate and head & neck cases, covering a period of approximately 22 months. Scan data was used to deduce which AFOV was used (five discrete options). Minimum required AFOV and optimal pixel size (representing optimal RFOV) were calculated from maximum patient radius. The distributions of reconstructed and optimal pixel sizes were compared, as were discrepancies between AFOV used vs. required.
**Results** Reconstructed pixel sizes were >120% of optimal (i.e. too large an RFOV selected) in 50% of head & neck and 70% of prostate cases (n = 400, 109), with peaks at the AFOV limits (default RFOV sizes). A larger than required AFOV was used in 41% of head & neck and 31% of prostate cases.
**Conclusion** The peaks in reconstructed pixel size at AFOV limits suggest that the RFOV is often not optimised for the individual patient. Scans should also be optimised by using the smallest possible AFOV. Data retrieved via the RayStation scripting interface provides a valuable audit tool and assists in using departmental data to drive changes to practice. A future audit will assess the impact of refresher training in scan reconstruction.

o024 **Novel Minimal Point Volumetric Outlining and Editing Tools for Radiotherapy Treatment Planning**

Pete Bridge [1]; Andrew Fielding [1]; Pam Rowntree [1]; Andrew Pullar [2]

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**Purpose** This novel application (1) uses emerging visualisation and modelling techniques to aid rapid manual segmentation of target structures. The tool uses a minimal point approach (2) across orthogonal planes to generate a mesh which is then edited across multiple slices using innovative 3D sculpting tools. This study aimed to compare bladder outlining times and volumes for the new tool with conventional manual outlining.
**Methods and materials** Participants were students undertaking their first planning module in a pre-registration University radiotherapy course; they first received bladder outlining training and at-elbow support from a tutor with each tool. Users were also provided with printed "gold standard" contours then when each user felt ready, they performed a timed outlining of the same patient. Users provided feedback on their preferred method and all contours were compared with a gold standard using DICE Similarity Coefficients (DSC) (3).
**Results** Comparison of times from the resulting 10 datasets showed a significant time saving with the new tool with a mean time of 11.9 minutes compared to 19.2 minutes (p = 0.03). The users expressed a preference for the new tool (8 users) and the mean DSC for both contour sets was identical.
**Conclusions** A minimal point 3D volumetric manual outlining tool demonstrated significant time saving for bladder segmentation compared to axial-based outlining within a group of novice outliners. Generated volumes were equivalent to gold standard with both outlining tools.

*1. Bridge P, Fielding A, Pullar A, Rowntree P. (2016). Development and initial evaluation of a novel 3D volumetric outlining system. J Radiother Pract 15(1), 38-44 2. McBain CA, Moore CJ, Green MML, et al. (2008). Early clinical evaluation of a novel three-dimensional structure delineation software tool (SCULPTER) for radiotherapy treatment planning. Brit J Radiol, 81(968), 643-52 3. Zou K, Warfield S, Bharatha A, et al. (2004). Statistical validation of image segmentation quality based on a spatial overlap index: scientific reports. Acad Radiol. 11,178-189*

o025 **Using in-house software for auditing and troubleshooting breathing traces for the real time positional management system**

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**Background**: RPM is used for providing respiratory breathing information for the reconstruction of 4DCT scans, or for the treatment of gated radiotherapy. The acquisition of these traces is not without complication and can lead to undetected errors if used incorrectly. A means of providing more insight and Quality Assurance (QA) of RPM traces was required.
**Method**: A tool (The RPM analyser) has been developed in Matlab V2012b to query the clinical RPM database for a selected patient and then analyse all of the acquired sessions. Two main objectives were to be addressed using the software; to provide meaningful interpretation of breathing trace information for 4DCT scans when artefacts were present in reconstructed images and to be used as a QA tool for RPM use across all sessions. The tool was used for a Deep Inspiration Breath Hold (DIBH) pilot study of 10 patients.
**Results**: The software works as an effective means for auditing practice shown during the implementation of DIBH. We have highlighted minor baseline shift issues on 6 of 157 sessions that were investigated and fed back to the staff involved. It also identified a procedural issue whereby incorrect reference traces were chosen for treatment on 5 occasions of 157.

**Conclusion**: The RPM analyser provides an effective means of auditing the use of the RPM within the local department, reducing time and increasing the likelihood of identifying clinically significant deviations in practice.

o026 **How useful is Elekta XVI large field of view?**

Talitha Smith [1]; Gareth Webster [2]

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**Background** Small or medium field-of-view (S/MFOV) cone-beam CT with Elekta XVI are routinely used for on-treatment imaging. Large FOV (LFOV) may be required to properly assess change (e.g. weight change) in larger pelvis patients, however little data is available regarding LFOV image quality, dosimetry, and usage.
**Method** Three phantoms (maximum diameter 30cm) were imaged using four LFOV protocols and a pelvis MFOV protocol for reference. High contrast spatial resolution (HCSR), low contrast visibility (LCV) and uniformity were compared; surface representation fidelity was assessed relative to CT scans.
Experiences of using LFOV were solicited via the medical physics mailbase. An audit of prostate patients in our centre was performed to estimate how frequently LFOV is required.
**Results** A 'rod' artefact was seen at isocentre and reported in 2/6 mailbase responses; LFOV uniformity was consequently poor (magnitude 80-480% vs. 20% MFOV). LCV and HCSR were similar for all protocols.
LFOV was used for soft-tissue matching in one centre and for contour only in one centre. Two respondents raised concerns about LFOV contour fidelity; phantom measurement error was ≤3mm except for the highest dose LFOV protocol (maximum error 11mm; additional artefacts seen at phantom edges).
Retrospective audit showed some patient volume outside MFOV in 50% of prostate cases.
**Conclusion** For a fixed-size phantom, LFOV and MFOV scans have similar HCSR, LCV & phantom contour uncertainty. However, the rod artefact decreases LFOV uniformity and may impair image matching around isocentre; clinical images are needed to assess this. Further work with larger phantoms may also be useful.

o027 **Assessment of Varian's auto beam hold feature: a phantom study**

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**Purpose**: Assess the ability of Varian's Auto Beam Hold feature to identify fiducial markers in kV triggered images during volumetric modulated arc therapy (VMAT) treatment.
**Methods**: The CIRS dynamic thorax phantom was used throughout this study. Three gold fiducial markers (3mmx1mm) were implanted into a wax cylinder. This was inserted into the phantom. A VMAT plan was then delivered. Triggered kV images were acquired every 90 degrees of gantry rotation with the expectation that the software should locate each fiducial on the kV images; if the fiducial location is within a defined search region, treatment continues. Otherwise, treatment is paused. The phantom was initially aligned correctly. The VMAT plan was delivered multiple times, changing the diameter of the search region incrementally from 2.5cm to 0.5cm. The insert was then moved 1cm in the superior direction; again, the size of the search region was varied. This was repeated with the insert shifted 1cm in all other translational directions.
**Results**: When the phantom was correctly aligned, fiducials were identified, and treatment was delivered for all search region diameters. With the fiducials shifted, the software correctly identified the mismatch in the majority of instances, pausing the treatment correctly. However, when the image was acquired at an angle parallel to the shift, the software did not detect the error, so continued to treat.
**Conclusions**: Initial phantom studies suggest that intrafraction triggered kV images can be used to detect a change in fiducial location. However, the limitations of the approach much be taken into consideration.

o028 **Auto-contouring comparison between Mirada and SPICE for brain SRS patients**

Robert Chuter; Gillian Whitfield; Philip Whitehurst

*The Christie NHS Foundation Trust, Manchester*

**Purpose**: To compare the auto-contoured structures created from Mirada RTx v1.6 (Mirada Medical, Oxford, UK) and Smart Probabilistic Image Contouring Engine (SPICE) (Philips Radiation Oncology, Andover, MA) for brain patients.
**Method:** An atlas was created using Mirada from 13 SRS Brain VMAT patients with clinician reviewed contours. This atlas was used to auto-contour 5 additional patients (on CT: 0.5mm axial resolution and 1mm slice thickness) using Mirada. These patients were also auto-contoured using SPICE within Pinnacle 9.10. The auto-contours from both were then compared to the clinician drawn contours using DICE and Distance to Agreement (DTA) metrics. The contours were additionally blindly assessed by clinicians for suitability.
**Results**: The contours for the brainstem, optic chiasm, eyes and optic nerves were analysed. There was no significant difference between Mirada and SPICE for all of the contours apart from the optic chiasm which showed significant discrepancies with both methods but Mirada was closer to the clinicians' contours. The DICE for brainstem was 0.84 and 0.81 for SPICE and Mirada

respectively in comparison to the clinicians' contours. The average DTA for the eyes and optic nerves was 0.82mm and 1.3mm for SPICE, and 0.81mm and 1.4mm for Mirada.
**Conclusion**: The auto-contours from SPICE and Mirada are comparable over the 5 patients that we have currently analysed. Initial analysis indicates that the eyes, optic nerves and brainstem auto-contours can be used to aid the contouring workflow but further work will be done to expand the sample of patients that the auto-contours are tested on.

o029 **Implementing and evaluating an Aria Island**

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**Background**: Treatment equipment at our hospital comprises 2 Tomotherapy units, 5 ageing Siemens units and 2 Varian True beam STx units The department is linked by Mosaiq oncology information system as the result of an upgrade to the previously installed LANTIS Siemens product. The remaining 5 Siemens linacs will reach end of life by 2018 and will require a planned programme of replacement. Thus the department at NCCC is currently undergoing a major equipment replacement programme.
**Method**: The future needs of the department were thoroughly evaluated. The legacy of ageing mismatched equipment has partly hindered the use of Mosaiq. As a result we are heavily paperbased. Any solution would have to include an ambitious paperlight project. Through multiple site visits, we evaluated a number of replacement equipment and software options.
**Results**: The decision was made to install an Aria "island" for evaluation purposes on the TrueBeams whilst leaving the rest of the department utilising Mosaiq. As a result we were able to start the implementation using a paperlight workflow from the beginning, in a controlled environment.
**Conclusion**: Having evaluated an Aria Island, we have been able to implement paperlight working, before a potential gradual roll out to the rest of the department. As part of the evaluation we be assessed the positive and negative aspects of the implementation in comparison with Mosaiq. We have also looked at issues associated with running a department with 2 R&V systems and how we have overcome this, by utilizing the best aspect of both

o030 **Performance differences between early- and late-model ArcCHECK devices**

Stephen Moloney [1]; Will Holmes-Smith [2]

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**Background** An investigation was undertaken at two UK radiotherapy departments to quantify differences in patient -- specific quality assurance results when using ArcCHECK devices of different ages. Devices manufactured after November 2014 have modified construction in order to comply with EU regulations.
**Method** At both departments, measurements were performed for a range of clinical VMAT plans with both old- (pre Nov. 2014) and new-style ArcCHECK devices. Results of gamma analyses for each plan were compared between the old- and new-style devices.
**Results** A clear pattern emerged; in the vast majority of cases, better gamma passing rates were obtained with the new-style devices. The greatest differences were exhibited for more complex head / neck and dual - arc plans, where gamma passing rates (3% local / 3 mm) were up to 15% higher with a new-style device.
**Conclusion** An application note from the manufacturer was released, acknowledging small differences in gamma passing rates between the two versions of ArcCHECK. However, the tests performed at the two departments show that the differences in gamma passing rates between the two versions are significant, and greater than indicated by the manufacturer.
Users of the ArcCHECK and other comparable devices are encouraged not to rely on manufacturer specifications, but to carry out full and detailed assessment of any new device before it is brought into clinical use. This investigation shows that the same advice applies even when commencing use of a second device that is nominally the same as an existing device.
*1]Directive 2011/65/EU of the European parliament and of the council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast) [electronic version]. O J. 2011; L 174/88 - L 174/110 2]Low D A, Harms W B, Mutic S, Purdy J A. A technique for the quantitative evaluation of dose distributions. Med Phys. 1998; 25(5): 656 – 661. 3]Shi, J. Application Note #01-15: Differences Between Original and New ArcCHECK and Clinical Impact [electronic version]. Sun Nuclear Corporation, 2015.*

o031 **An assessment of interfractional vaginal motion and the effect on clinical target volume to planning target volume margins for endometrial cancer using weekly cone beam computed tomography scans**

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*Imperial College Healthcare NHS Trust, London*

**Background**; Acute and chronic side effects, especially gastrointestinal, can be reduced when patients with gynaecologic malignancies are treated with intensity modulated radiotherapy (IMRT) rather than conventional four-field arrangements. Due to the increased conformity of IMRT over conventional field arrangements it is essential to understand the magnitude of internal-organ motion. This ensures the safe application of IMRT through calculation of appropriate margins. The purpose of this study is to quantify vaginal movement for post-operative endometrial cancer patients and assess if our current departmental margins are adequate. **Method**; A total of 20 patients, each with at least 5 weekly cone beam computed tomography (CBCT)

scans acquired throughout their treatment, have been retrospectively reviewed. CTV vagina was delineated on each individual CBCT by at least 2 experienced clinicians and deviation from the planning CTV was measured in the anterior posterior, superior inferior and right left directions. Using these deviations from planning CTV a van herk calculation was performed in each direction to calculate the margin necessary to account for target motion.
**Results**; The results from this study will allow us to assess our departmental margins for endometrium cancer. Full results from this study are awaited.
**Conclusion**; Derivation of margins applicable to our department has allowed us to confidently deliver IMRT for this patient cohort.
*1. Ahamad, A., D'Souza, W., Salehpour, M. et al. Intensity-modulated radiation therapy after hysterectomy: Comparison with conventional treatment and sensitivity of the normal-tissue-sparing effect to margin size. Int J Radiat Oncol Biol Phys. 2005; 62: 1117–1124 2. Jhingran A, Salehpour M, Sam M, Levy L, Eifel PJ. Vaginal motion and bladder and rectal volumes during pelvic intensity-modulated radiation therapy after hysterectomy. Int J Radiat Oncol Biol Phys. 2012 Jan 1;82(1):256-62. 3. Jürgenliemk-Schulz IM, Toet-Bosma MZ, de Kort GA, Schreuder HW, Roesink JM, Tersteeg RJ, van der Heide UA. Internal motion of the vagina after hysterectomy for gynaecological cancer. Radiother Oncol. 2011 Feb;98(2):244-8.*

o032 **An audit evaluating repeat cbct due to variation in bladder and bowel preparation during prostate IMRT**

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**Background/Purpose**: kV-CBCT is routinely used to verify prostate radiotherapy and changes in bladder and rectal volume affecting the position of the target are seen. This leads to variations in PTV coverage which may contribute to treatment toxicity and biochemical failure. It is important to reduce rectal distension and minimize prostate movement and ensure this is reproduced during treatment.
Method: During a one month period all CBCTs for patients receiving prostate IMRT on one linear accelerator were examined. The departmental prostate radiotherapy Bladder/Bowel preparation and CBCT protocol were followed. Details of re-prep following CBCT analysis were recorded with explanation for this action
**Results**: 137 scan sets were acquired. 89.78% treatments were delivered after analysis of initial CBCT. 14 cases (10.22%) after CBCT acquisition patients were taken off the treatment couch; 3 due to urinary urgency; 11 with variation in rectal distension and/or bladder filling seen on CBCT (Figure 1).
Summary of results are in Figure 2.
The mean delay on the unit was 15 minutes (mins) (range 0-20); or 210 min per month/21 treatment slots; time from image acquisition to decision=3.21mins (mean) (range 1-6mins). Scheduled appointment to CBCT acquisition mean= 7.6mins (range 1-18mins)
**Conclusion**: This small sample highlighted important issues with this patient population. Patient compliance with preparation and consistent re-prep instructions are important. The increasing demand for IGRT will continue to have an impact on Linac workflow. CBCT planning studies are necessary to discover what benefit to the delivered dose re-preparation has and evaluate if the time taken is justified

o033 **The impact of intra-fractional bladder filling on adaptive bladder radiotherapy**

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**Aims**: To assess the effect of intra-fractional bladder filling on adaptive bladder radiotherapy and investigate whether current departmental adaptive bladder treatment-planning margins and plan selection options are appropriate.
**Method**: A retrospective audit was carried out on 38 pairs of pre-treatment and post-treatment cone-beam computed tomography scans (CBCTs) from 20 adaptive bladder radiotherapy patients. The bladder was contoured on pre and post-treatment CBCTs to quantitatively analyse the differences in bladder volume and bladder wall expansion over the treatment fraction. Treatment time was established from acquisition of pre-treatment CBCT and post-treatment CBCT. Non-parametric Spearman's Rank correlation test was conducted to investigate if there was a relationship between intra-fractional bladder filling and treatment time.
**Results**: A variety of intra-fractional bladder filling and bladder wall expansions were observed. Mean intra-fractional filling volume was 10.2cm3(standard deviation(SD)=7.1cm3;range=0.3-26.9cm3). Average treatment time was 8.9 minutes(SD=1.8mins;range=6.5-13.6mins). Intra-fractional bladder filling resulted in expansion of the bladder predominately in the superior and anterior directions with mean translations 2.5mm(SD=1.9mm;range=0-6mm) and 1.5mm(SD=1.4mm;range=0-5mm) respectively. An increase intra-fractional bladder filling was associated with an increase overall treatment time (rs=0.323, p=0.048). All plan selection options chosen adequately covered the bladder target volume.
**Conclusions**: Despite the effect of intra-fractional bladder filling, current use of the adaptive bladder treatment-planning margins and decision-making for all plan selections sufficed. All treatments were delivered within an appropriate time-frame for the hospital department. Due to limited expansion of the bladder wall laterally, consider reducing the lateral margin requirement if a more conformal plan could be selected whilst minimising dose to normal tissue.

o034 **Implementation of RTT led 'plan of the day' adaptive radiotherapy in cervical cancer**

Angela Baker; Thomas Hague; Yat Man Tsang; Peter Hoskin

*Mount Vernon Cancer Centre – East and North Herts NHS Trust*

**Purpose**: Plan of the day (PoD) ART for cervical cancer patients can potentially reduce toxicity and the risk of geometrical miss but may be resource intensive. In order to implement accurate PoD for these patients this study aimed to assess the accuracy of adaptive online plan selection and linac resource impact.

**Methods:** An initial patient cohort had planning CTs acquired with an empty and full bladder and an intermediate MRI. CTVs were outlined on each of the datasets to include uterus and proximal vagina, from which an ITV and PTV were defined with further nodal volumes as required. VMAT plans were created depending on the amount of uterine movement, with a further plan using the previous standard technique as a backup.

Online daily CBCT was performed for all patients with additional kV planar images used for nodal positioning in one patient and for pelvic tilt in another. Plan selection following online registration using a combination of bony anatomy and soft tissue was performed by 2 members of the project team (observers) who had attended an anatomical training session and had a range of experience with female pelvic CBCT analysis. A 3mm margin between the visible target anatomy and the PTV contour was allowed for intrafraction motion. This was assessed through the addition of weekly post-treatment CBCTs. In-room time (patient enter to exit) was recorded at each session and patients were booked into the departmental 20 minutes time slot for ART.

A consensus standard PoD was agreed offline by an experienced clinician and RTT. Offline analysis was performed to measure concordance with the consensus standard PoD and the online decision.

**Results**: A total of 100 online PoD evaluations plus 600 offline evaluations, by 6 observers, were used for the analysis. The median concordance between the consensus standard PoD and the online plan selection was 98%. Where poor concordance was observed between online plan selection and the consensus standard PoD, a safe larger volume option was chosen online. Post-treatment CBCT's showed target anatomy was covered in all but 1 case. In-room timing ranged from 10 – 30mins with a median time of 19mins. The median score of the 4 observers offline compared to the consensus standard was 86%. The range between individuals was 76%- 96% and between patients was 78 – 96%.

**Conclusion**: High online concordance of 98% with the consensus standard PoD demonstrates that the initial training equipped the team with appropriate knowledge to perform accurate plan selection. A combination of 2 observers online achieve closer results to the consensus standard rather than individually. The joint decision making can be performed within the standard departmental ART time slot of 20 minutes. The CBCT data, consensus standard PoD and anatomy training can be used as part of the assessment programme for future RTT observers. Greater confidence in choosing smaller volume plans needs to be built to achieve the full potential of ART.

o035 **A critical review of ovarian preservation techniques for female pelvic radiotherapy.**

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**Introduction**: Recent advances in treatment have increased long-term survival of young, female cancer patients; unfortunately these treatments bring a significant risk of ovarian failure and infertility. This literature review evaluates techniques for ovarian preservation in pre-menopausal women receiving pelvic radiotherapy. Methods include conventional (surgical transposition) intensity modulated radiotherapy and other emerging techniques aiming to minimise ovarian dose.

**Methods**: A critical review of the evidence pertaining to pelvic radiotherapy and ovarian sparing was performed. Evidence was subjected to critical appraisal using the CASP tool and thematic analysis of the findings identified key issues.

**Results**: Surgical transposition appears to be a successful method of preserving ovarian function (1-2) depending on the position of the ovaries outside of the radiation field (1), the age of the patient and the total dose received by the ovaries. There is limited modern evidence concerning its usage in relation to emerging techniques and technology. The use of IMRT is certainly widespread in the treatment of female pelvic cancers, however, there is limited evidence (3-4) supporting its use for reduction of ovarian dose. Several other studies (5-6) have attempted to demonstrate new techniques to preserve ovarian function but no functional outcome measures have reinforced their results.

**Conclusions**: Ovarian transposition has a proven track record for preservation of ovarian function but the potential value of IMRT as a viable alternative to date remains unexplored. New work should be encouraged to determine the potential value of IMRT as a non-surgical alternative.

*1. Chambers S, Chambers J, Kier R, Peschel R. Sequelae of lateral ovarian transposition in irradiated cervical cancer patients. Int J Radiat Oncol Biol Phys 1991; 20(6): 1305-1308 2. Morice P, Juncker L, Rey A, El-Hassan J, Haie-Meder C, Castaigne, D. Ovarian transposition for patients with cervical carcinoma treated by radiosurgical combination. Fertil Steril 2000; 74(4): 743-748 3. D'Souza D, Rumble R, Fyles A et al. Intensity-modulated Radiotherapy in the Treatment of Gynaecological Cancers. Clin Oncol 2012; 24(7): 499-507 4. Fiorino C, Valdagni R, Rancati T, Sanguineti G. Dose-volume effects for normal tissues in external radiotherapy: Pelvis. Radiother Oncol 2009; 93(2): 153-167 5. Oktay K, Bedoschi G Oocyte Cryopreservation for Fertility Preservation in Postpubertal Female Children at Risk for Premature Ovarian Failure due to Accelerated Follicle Loss in Turner Syndrome or Cancer Treatments. J Pediatr Adol Gynec 2014; 27(6): 342-346 6. Lee C, Bilton S, Famigliettie R et al. Treatment planning with protons for pediatric retinoblastoma, medulloblastoma, and pelvic sarcoma: How do protons compare with other conformal techniques? Int J Radiat Oncol Biol Phys 2005; 63(2): 362-372*

o036 **Choice of CT reconstruction algorithm and the affect on radiotherapy treatment plan dose calculation; what level of Hounsfield unit (HU) change is acceptable?**

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**Background**: The selection of different reconstruction algorithms can change Hounsfield units in CT scans. This work determined the level of HU change which can be tolerated if planning dose change is to be kept within 1%.
**Method**: Five planning CT scans (2 head and neck, 1 prostate and 2 lung) were acquired on a Toshiba Aquilion LB scanner. Each was reconstructed using four CT reconstruction algorithms. HU values for bone, soft tissue and air were measured on all scans. Treatment plans (IMRT or VMAT) were produced using a Pinnacle system (version 9.6) with either the Collapsed Cone Convolution or Adaptive Convolve algorithms. For each patient, a single treatment plan was applied to the four different reconstructions. The dose levels at defined points within the plans were noted. The levels of HU change and planning dose change were compared.
**Results**: 15 plans were compared against 5 baseline plans with default reconstruction algorithm. HU difference was: -51 to + 35 for soft tissue, -58 to +33 for air, -34 to +142 for bone. Dose change was -2.2% to +1.0%. Where HU change was within +/-20 for soft tissue and +/-50 for bone and air, planning dose change was within 1%.
**Conclusion**: Changes in HU of +/- 20 for soft tissue and +/- 50 for bone and air are likely to cause <1% change in calculated dose in radiotherapy treatment plans.

o037 **Evaluation of non-uniform backscatter correction of aS1000 EPID for in vivo dosimetric verification**

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[1]*Cardiff University;* [2]*Velindre Cancer Centre*

**Background:** EPID-based patient dose verification had been widely discussed and yet to be the key topic of interest to avoid dosimetric errors**[1]**and protocols for in vivo verification is practically demanded**[3]**. In this presentation, we emphasized on the commissioning and implementation of the commercially available Dosimetry Check (DC)**[2, 5]** system to address the significant of non-uniform backscatter effect from the VARIAN aS1000 EPID support arm**[4, 7]**.
**Method:** A backscatter correction matrix was developed by combination of dosimetric information from a set of segmented fields sampling on different positions around the active area of the imager. The matrix was then used to correct raw EPID images and create corrected images in DICOM format while export them to Dosimetry Check (DC) to read and analyse. The same planned fields were generated in Oncentra MasterPlan, OMP subsequently to obtain several comparative dosimetric assessment between TPS and DC.
**Results:** By using the correction; **(i)**overall agreement between fields generated in OMP and those recorded in DC improved from more than 3% to better than 1%, **(ii)** agreement between OMP and DC for IMRT dose profiles with a sample Head & Neck case was improved by approximately 3%, **(iii)**pass rates of 3%/3mm gamma criterion**[6]** verified by DC were improved from around 80% to around 90%.
**Conclusion:** The correction method implemented herein for the DC system has proved to be an effective way to reduce verification inaccuracy caused by backscatter from the Varian EPID arm as well as enhancing the previously established portal verification method for IMRT.

***1.*** *Towards Safer Radiotherapy. 2008, Royal College of Radiology: London.* ***2.*** *Dosimetry Check Software. 2011-2016 2016; Available from: http://www.osl.uk.com/DC.* ***3.*** *Donaldson, S.L., On the state of public health: Annual report of the Chief Medical Officer 2006 2007, London Department of Health.* ***4.*** *Joseph, A.M. and V.S. Jeffrey, 2005, Verification of the optimal backscatter for an aSi electronic portal imaging device. Physics in Medicine and Biology. 50(10): p. 2341.* ***5.*** *Renner, W.D., K. Norton, and T. Holmes, 2005, A method for deconvolution of integrated electronic portal images to obtain incident fluence for dose reconstruction. J Appl Clin Med Phys. 6(4): p. 22-39.* ***6.*** *Spezi, E. and D.G. Lewis, 2006, Gamma histograms for radiotherapy plan evaluation. Radiotherapy and Oncology. 79(2): p. 224-230.* ***7.*** *Van Esch, A., et al., 2013, Optimized Varian aSi portal dosimetry: development of datasets for collective use. 2013. Vol. 14. 2013.*

o038 **Implementation of transit in-vivo dosimetry for treatment verification in a new radiotherapy service**

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**Background**: A transit in-vivo dosimetry system was implemented using the Electronic Portal Imaging Device (EPID) to verify safe treatment delivery in a new radiotherapy service.
**Method**: The commercial product SNC PerFraction was selected because of its fully automated workflow and collapsed-cone dose reconstruction. The treatment beam is captured after it has passed through the patient and the integrated image back-projected to determine the dose distribution delivered to the patient. This provides spatial dosimetric information which cannot be obtained with more traditional methods. Treatments were performed using Varian TrueBeam linacs with aS1200 EPIDs. A completely independent calculation is performed using a generic linac model that is fine-tuned using local calibration data and CT-electron density curves. 3D analysis protocols were established for VMAT, IMRT and 3D conformal treatments that closely reflected planning criteria for the targets and OARs. Transit dosimetry was undertaken for all fractions (n=43) of the first cohort

of prostate patients. Dose was calculated on the planning CT dataset, allowing comparison of DVHs for each fraction against the planned DVH.
**Results**: The average point-dose difference from the planned reference dose was 0.9±0.8%, with an average gamma pass-rate of 99.94±0.06% at 3%/3mm. DVH comparisons and protocol goals indicated close agreement with planned clinical goals. EPID measurements had negligible impact on treatment workflow or delivery times.
**Conclusion**: Transit dosimetry gives confidence of safe delivery of radiotherapy. Visualisation of treated dose distributions stimulates clinical engagement. Full automation encourages routine adoption, facilitating an adaptive workflow with recalculation on daily CBCT images.

o039 **In-vivo EPID transit dosimetry using an in-house and a commercial system for radical and palliative radiotherapy**

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*Edinburgh Cancer Centre*

**Background** In-vivo transit dosimetry (IVD) can be a useful tool for error detection in radiotherapy [1]. A commercial system (Dosimetry Check (DC), MathResolutions) has been in use at the clinic since 2011 to perform IVD for radical treatments. However, DC cannot be used on plans without a volumetric dose calculation (usually palliative), for which a simple in-house system has been developed.
**Method** A simple transit dosimetry system has been implemented to calculate the delivered dose at the prescription point using a measurement from an integrated EPID image. The calculation uses a table of transmitted intensity per unit midplane dose for a range of water separations and field sizes, similar to the approach described by Piermattei et al [2]. Work is ongoing to use scripting to integrate the IVD within the Oncology Information System.
**Results** Initial phantom testing showed that the in-house system to have a measurement accuracy of -0.4%±2.5%, with DC giving -2.3%±4.1% (1SD, comparison with TPS). From April to December 2016, 802 clinical fields were measured with the in-house system, with a mean measured dose versus the prescription of -1.4%±5.2% (1SD). The current mean difference for DC vs TPS is -1.9%±4.5% (1SD, >3500 plans). Results categorised by site are also available for both systems.
**Conclusion** These results show that the in-house method has the accuracy required to detect gross errors and anatomical changes in palliative patients where 3D plans are not available. It can complement the use of commercial systems and allow transit IVD for all plans.
*[1] Bojechko et al., A quantification of the effectiveness of EPID dosimetry and software-based plan verification systems in detecting incidents in radiotherapy, Medical Physics 42, 5363 (2015); [2] Piermattei et al., Application of a practical method for the isocenter point in vivo dosimetry by a transit signal, Phys. Med. Biol. 52, 16, 5101, (2007).*

o040 **Impact of 18F-Choline PET scan acquisition time on delineation of GTV in Prostate cancer**

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**Background:** Dose painting radiotherapy requires accurate outlining of primary tumour volumes in the prostate. MRI is considered the best imaging method for delineating the GTV. The role of Choline PET is uncertain and image acquisition differs between published studies. One study found that 18F-Choline PET/CT with late image acquisition has superior accuracy to MR imaging alone. We investigate whether increasing 18F-Choline PET scan acquisition time from 60 (PET-60) to 90 (PET-90) minutes improves GTV target volume delineation.
**Methods:** Analysis was performed on 9 18F-Choline PET scans. Three clinicians (C1, C2 and C3) independently contoured GTVs on MRI and PET scans acquired at 60 and 90 minutes (PET-60 and PET-90). The treating clinicians (C1) MRI contour was used as the reference GTV. Scans were registered using rigid co-registration. Analysis was performed on PET-60 and PET-90 scans. Dice Similarity Coefficient (DSC), Specificity (Sp) and Sensitivity (S) were calculated for C1, C2 and C3.
**Results:** Table 1 shows the mean and range DSC, S and Sp scores on MRI, PET-60 and PET-90. A 2 sampled T-test ($P < 0.01$) showed, no significant difference in the Sp, S and DSC between GTVs on PET-60 and PET-90. Figure 1 shows that variability in GTV delineation is significant between observers in a singular case as well as across imaging modalities.
**Conclusion:** Compared to MRI delineated GTVs, 18F-Choline PET GTVs are different. However in these cases, increasing the PET acquisition time did not improve GTV TVD performance in comparison to MRI delineated GTV.

o041 **Low acute toxicity is predictive of low 2 year late toxicity, but not the reverse, in patients receiving helical image-guided IMRT for prostate cancer**

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**Purpose/objective** Many patients undergoing radical radiotherapy (RT) for prostate cancer develop some acute toxicity, and others also suffer these long term side. This study determined whether there is a link between significant acute rectal toxicities (gr. 2+) and late rectal toxicities at two years post RT in patients received helical IG-IMRT for prostate cancer.
**Materials and methods** This was a sub-study of the VoxTox programme and focused on those treated for prostate cancer & prescription dose 74Gy/37# (76) or 60Gy/20# (31). Patients were reviewed acutely a two weekly during RT upto 4 weeks post-treatment and for late toxicities at month 24. 3 key rectal toxicity endpoints using CTCAE v4.03 were considered: rectal frequency, urgency and bleeding, plus the maximum of any reported rectal toxicity within the VoxTox assessment. Only one maximum reported toxicity rate for each endpoint was recorded acutely and compared to the grade of toxicity at month 24.
**Results** For all endpoints it was found that a low grade acute toxicity (gr 0 or 1) was a predictor of low grade late toxicity (figure 1). But conversely experiencing a higher grade of acute toxicity (gr 2+) was not a predictor of high grade late toxicity. This was statistically indicated for the maximum of reported rectal toxicity within the VoxTox assessment with a sensitivity of 78% but a specificity of 29.5%.
**Conclusion** While these finding were not expected, they do provide an interesting link that requires further investigation that will be completed within future studies currently in development.

## o042 Radiation protection post permanent iodine-125 seed prostate brachytherapy

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**Background:** Permanent implant Iodine-125 seed brachytherapy is a widely accepted treatment for early stage localised prostate cancer (NICE, 2005). Iodine-125 produces very low energy X-rays and these are not very penetrating. The activity content of each seed used at this hospital is between 14MBq (0.38mCi) and 16MBq (0.43mCi) so the total implant activity will be approximately 0.8 - 1.6GBq. There is no radiation hazard except when in contact with the patient area immediately surrounding the implant site (between navel and groin) or if a seed is passed out in the urine.
**Purpose:** This poster is primarily intended for use as Educational Media, to provide Aide Memoire guidance to the oncology ward nursing staff in their provision of postoperative care for Iodine-125 seed brachytherapy patients. As it will be displayed in a public area, therefore viewable by patients and their visiting relatives, the content will be presented in a format that is also suitable for non-staff.
**Summary:** The main themes of the poster will aim to alert individuals to essential radiation protection measures necessary to ensure compliance with EA permit terms for safe clinical use of Iodine-125 seeds, whilst drawing attention to the statutory legislation that must be observed during the hospital stay. The poster will refer to the documentation to facilitate the safe custody of the seeds during the post-operative period, and the patient discharge. As well as providing the patient with basic radiation safety to protect young children and pregnant women in the initial period post-implant.
*Nice. (2005) Low dose rate brachytherapy for localised prostate cancer: Interventional Procedure Guidance 132. National Institute for Health & Clinical Excellence. London*

## o043 Proton computed tomography for proton therapy range calculations

Sam Manger [1]; Spyros Manolopoulos [2]; Jon Duffy [1]; Stuart Green [3]; Ben Phoenix [4]; Tony Price [4]; Chris Waltham [5]; Michela Esposito [5]; Nigel Allinson [5]; Gavin Poludniowski [6]; Phil Evans [7]; Jaime Nieto-Camero [8]; Julyan Symons[8]

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Proton computed tomography promises to reduce uncertainties associated with proton therapy treatment planning introduced during the conversion of X-ray Hounsfield Units to proton stopping powers. The PRaVDA collaboration has developed the world's first fully solid-state instrument for proton CT [1], which is expected to produce accurate stopping power maps with an uncertainty of 1%, less than the uncertainty associated with the conversion of HU->SP, which is calculated to be 1.6-5.0%, depending on the tissue type [2][3].
A phantom has been developed to be imaged using both X-ray CT and proton CT imaging modalities that also allows the range of a proton beam to be measured, such that an observable proton range difference should be seen between Monte Carlo simulations based on both X-ray CT and proton CT images. This can be compared with a delivered proton dose in order to quantify the benefit of proton CT in proton therapy treatment planning.
The phantom was imaged on the proton therapy beamline at iThemba Labs, South Africa in November 2016, and a dose was delivered to the phantom. A precision cut piece of film was used to measure proton range in polyethylene with two heterogeneities inserted into the phantom. Monte Carlo simulation was used to inform the design of the phantom and further analysis will follow. The phantom will provide an absolute measure of range uncertainty introduced by the conversion of X-ray Hounsfield units to proton stopping power.
*1. Poludniowski, G., Allinson, N. M., & Evans, P. M. (2015). Proton radiography and tomography with application to proton therapy. The British Journal of Radiology, 88(1053) 2. Yang, M., Virshup, G., Clayton, J., Zhu, X. R., Mohan, R., & Dong, L. (2010). Theoretical variance analysis of single- and dual-energy computed tomography methods for calculating proton stopping power ratios of biological tissues. Physics in Medicine and Biology, 55(5), 1343–1362.. Paganetti, H. (2012). Range uncertainties in proton therapy and the role of Monte Carlo simulations. Physics in Medicine and Biology, 57(11), R99-117*

o044 **Assessment of patient stability resulting from six degrees of freedom repositioning in lung SABR treatments**

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The work assesses whether the accuracy of patient positioning for lung SABR radiotherapy treatments is improved by applying image-guided corrections in six degrees of freedom (6DoF) compared to corrections in three translational degrees of freedom (3DoF). There is limited data in the literature on the accuracy of 6DoF corrections for lung patients and specifically for patients immobilised in custom vacuum cushions. This analysis included 89 patients: 21 receiving 3DoF corrections and 68 receiving 6DoF corrections. On their first treatment fraction, all patients received a kV CBCT before treatment to correct setup and mid-way through the treatment to monitor positioning. The mid-treatment CBCT provides information on residual errors, which are any changes in patient positioning following the application of movements to correct setup. Residual errors for 3DoF and 6DoF methods were compared. Errors for 6DoF corrections were also analysed to assess for any correlations with applied setup corrections. The residual errors for 6DoF treatments were not significantly different from those for 3DoF treatments. A significant correlation between applied pitch and residual longitudinal error (1.0mm/1°) and applied roll and residual lateral error was found (0.7mm/1°). This work complements the literature by assessing 6DoF corrections for a large cohort of lung SABR patients. Lung patients immobilised using a customised vacuum cushion have no significant decrease in treatment accuracy when using 6DoF corrections, however a correlation was found between applied pitch and residual longitudinal error and applied roll and residual lateral error. Use of 6DoF corrections for lung SABR is under review.

*1. Cao, M., et al. 2012. Radiation Oncology 84 520-526 2. Guckenberger, M., et al. 2007. Strahlentherapie und Onkologie 6 307-311 3. Linthout, N., et al. 2007. Radiotherapy and Oncology 83 168-174*

o045 **Initial clinical experience of using SABR on oligometastases from primary gastrointestinal cancer**

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**Background**: The standard treatment for oligometastases originated from primary gastrointestinal (GI) cancer is systemic therapy. By contrast, current evidence suggests that Stereotactic Ablative Body Radiotherapy (SABR) is a new treatment modality for local extra-cranial metastases, which has shown favourable clinical results. This study aims to demonstrate the efficiency of SABR treatment of GI oligometastases in terms of acute toxicity and local control.

**Methods**: A retrospective review of SABR patients with GI primary was carried out to assess each patient's post treatment toxicity (PROMS) and local control (LC). Patient's demographic data including age, histopathology of primary disease and anatomical location of sites treated were reviewed.

**Results**: Between September 2015 and November 2016, 22 consecutive patients with oligometastases from primary GI cancer were treated with SABR. The median follow-up is 6 months and the median of patient's age is 67.8 years old. Histopathology of Primary: Colon (n=6), Rectum (n=13), and Anus (n=3). The metastases sites include lung (n=1), liver (n=3) node (n=10) pelvic mass (n=6) and bone (n=2). Overall, acute toxicity occurred in 18% (4/22) of patients 6 months post SABR; No grade ≥3 toxicities were recorded. The local control at 6 months is 86% (19/22). Significant differences were found in local control rates between the patients with different histopathology of primary ($p<0.05$).

**Conclusion**: In conclusion, the use of SABR has shown great potential and benefit. Our cohorts of patients with GI oligometastases have shown acceptable acute toxicities and promising local control rates.

o046 **Prostate SABR - dosimetric impact of on treatment organ motion on OARs**

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*Beatson West of Scotland Cancer Centre*

**Background** It is essential when implementing a highly conformal technique with steep dose gradients such as Prostate SABR, to consider the effect of geometric uncertainties on the delivered dosimetric plan. With this highly conformal technique it is necessary to ensure toxicities are within the acceptable range.[1] This study evaluates CBCT images for Prostate patients who had treatment within a local safety, feasibility and efficacy study. There is little published evidence on the true dose received by organs at risk. Currently the dosimetric impact of organ motion on OAR constraints is not well understood.

**Method**: 11 patients treated using Prostate SABR linac based technique, 35Gy/5#. Prostate tracked pre delivery matching to fiducial markers on CBCT. Bladder and rectum delineated retrospectively on 55 pre CBCT images. CBCT registered to planning CT. CBCT contours overlayed for dosimetric analysis. Recalculation to evaluate the DVH's for each structure using the 'original plan' as the comparator to evaluate the impact of inter fraction motion of internal organs. Planning constraints evaluated to ensure these are being met despite OAR motion.

**Results** Rectum constraint V18<35 % was the only the constraint achieved on treatment by all patients. In 3 patients 10 % of the rectum received >28Gy. In 4 patients 5 % of the rectum received >32Gy and in 5 patients 1 % of the rectum received >35Gy(Fig. 1) . In 2 patients 1 % of the Bladder received >35Gy(Fig. 2).

**Conclusion** Due to organ motion, Rectal and Bladder constraints were not met for some patients. Applying strict dose constraints at the planning stage ensures dose received by OARs are kept to a minimum on treatment.

*1. Tree, A.C et. al. (2013) Biological dose escalation and hypofractionation: What is there to be gained and how will it best be done? Clinical oncology, 25 (8), 483-498.*

o047 **Establishing a new Peptide Receptor Radionuclide Therapy service and outcomes from the first patient cohort**

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Peptide Receptor Radionuclide Therapy (PRRT) is a promising Molecular Radiotherapy technique for the treatment of inoperable, symptomatic neuroendocrine tumours (NETs). PRRT exploits the over-expression of somatostatin receptors in NETs by utilising peptides chelated to beta-emitting radionuclides to selectively target tumour cells and deliver a cytotoxic radiation dose. The radiopeptides are administered intravenously over four cycles, typically at eight week intervals. We present our experience of establishing a new service to deliver PRRT at our institution, including regulatory requirements, financial planning, clinical protocol development, training and implementation. To date, we have completed treatment of 6 patients. For each patient, haematological, renal and hepatic function was monitored every two weeks. Gamma camera imaging was completed 24 hours post-injection and used to quantify the uptake in tumour sites over the course of therapy. Radiological response was assessed using follow-up CT and SPECT or PET scans. Patients were also assessed clinically after each cycle. All patients showed stable or decreased tumour uptake over four cycles, indicating reduced volume of disease, with the best responder showing a 43% decrease. All patients demonstrated radiological and/or symptomatic responses. The treatment was well tolerated with minimal toxicity observed in our cohort. Some treatment cycles were delayed due to thrombocytopenia, raising the question of the possible role of transfusion in PRRT patient management. PRRT is a complex procedure requiring close integration of the multi-disciplinary team. Clinical trials of PRRT are ongoing, and its efficacy is currently being assessed by NICE before commissioning guidelines are published in July 2017.

o048 **Assessing plan quality and delivery verification of stereotactic ablative body radiotherapy to spinal metastases across different provider landscapes**

Maeve Smyth; Matthew Williams; Andrew Bryant; Tony Millin

*Velindre NHS Trust, Cardiff*

**Background**: The aim was to provide an evidence base for introduction of Stereotactic Ablative Body Radiotherapy (SABR) to treat spinal metastases. Both plan quality and delivery across two manufacturers, Varian TrueBeam STx and Elekta Agility, was assessed. In particular the Varian HD120 MLC including 2.5mm leaves in the centre, and the Elekta Agility with 5mm leaves, could be compared.

**Method**: Clinically commissioned models for both the TrueBeam and Agility within Oncentra MasterPlan were utilised to plan four test case spinal volumes. All plans were optimised using a standard VMAT solution, developed in house. Plan quality assessment was performed using metrics outlined in the UK SABR consortium guidelines [1]. Plans were then verified using IBA CC01 ionisation chamber measurements, in the centres of both the target volume and the spinal cord, and using Ashland Gafchromic film.

**Results**: Both machine models produced clinically acceptable plans which have been reviewed externally (Commissioning through Evaluation (CtE), Radiotherapy Trials QA (RTTQA)). The delivery of each plan was successfully verified using film, where the resolution of the dose calculation grid was found to have a notable effect on gamma analysis. Measurements using the CC01 chamber were acceptable, with discrepancies in the spinal cord region. This is possibly due to the large dose gradient across the chamber in this region of the plan.

**Conclusion**: Creating an evidence base to implement new protocols is an essential component of developing a clinical service. This work has highlighted that clinically acceptable plans can be produced and delivered using either provider.

*1. SABR UK Consortium (2016) Stereotactic Ablative Body Radiation Therapy (SABR): A Resource, Version 5.1.*

o049 **Developing an in-house, automated and efficient verification process for stereotactic radiosurgery (SRS) brain treatments**

Jonathan Sutton; Anna Bangiri; Jonathan Littler; Katya Gnutzmann

*Nottingham University Hospitals NHS Trust*

**Introduction** SRS is a hypofractionated radiotherapy technique commonly used to treat brain metastases. Prescribed doses of around 20 Gy are typical, often delivered in a single fraction. The high doses and small field sizes heighten the need for accurate delivery. We present a method for verification using a point dose measurement, combined with coronal and sagittal 2D film distributions analysed using gamma analysis.

**Method** For every patient, each PTV is verified separately with an A26 ionisation chamber [6] (tolerance ± 10%) and EBT-XD Gafchromic film [5] measurements in an anthropomorphic phantom, STEEV [1]. Film data is compared with data from the planning system using a 2D global gamma analysis (5% / 2 mm) [2], [3] written in MATLAB 2013 [4]. A pass rate of 95% is

required.
**Results** Delivering the QA beams is a time consuming process which takes approximately 1 hour per PTV. The analysis workflow is highly automated and can be performed in less than 10 minutes per PTV. After 12 patients with a total of 19 PTVs, the mean gamma pass rate (5% / 2 mm) was 98.9% (range: 92.0% to 100%, SD: 1.5%). For the absolute dose measurements, the mean difference from expected was +1.2% (range: -6.5% to +9.5%, SD: 3.8%).
**Discussion** The efficiency of our patient specific QA process for SRS brain treatments has been greatly increased through the introduction of an in-house automated analysis technique. Work is ongoing to further reduce QA time by implementing independent dose calculation software combined with linac log file analysis.
*1. CIRS, Norfolk, United States. 2. Ju, T., Simpson, T., Deasy, J. O. and Low, D. A. (2008) Geometric interpretation of the γ dose distribution comparison technique: Interpolation-free calculation. Med. Phys. **35**(3), 879-887. 3. Low, D. A., Harms, W. B., Mutic, S. and Purdy, J. A. (1998) A technique for the quantitative evaluation of dose distributions. Med. Phys. **25**(5), 656-661. 4. MathWorks, Natick, United States. 5. MediTron, Frauenfeld, Switzerland 6. Standard Imaging, Middleton, United States.*

o052 **Soft tissue image matching for oesophageal cancer: To use or not to use, that is the question?**

Zankhana Jani; Justine Mooney; Mark Elsworthy; Lucinda Melcher; Tim Hosking

*North Middlesex University Hospital*

**Background** Oesophageal radiotherapy has evolved significantly over the past 5 years with the use of VMAT, dose escalation and 4DCT. Volumetric imaging is commonly used for treatment verification but the limited soft tissue contrast means visualising the oesophageal tumour can be challenging. Consequently bony anatomy is used in combination with the soft tissue to verify treatment position. The aim of this study is to evaluate differences in terms of set up errors between the bony and soft tissue match and correlate these differences in relation to tumour position to ascertain the optimal imaging protocol in terms of frequency and matching methods.
**Method** A retrospective study was conducted of 10 patients with a variety of tumour positions. The magnitude of set up errors wasere compared using both a bony match and a soft tissue match. Intra-fractional variations in surrounding tissues as well as any tumour deformations were noted. The correlation between tumour position and set up error was determined.
**Results** Initial results showed that the use of bony anatomy is still the preferred matching option for proximal tumours as difference between the soft tissue and bony match was minimal ($P<0.1$) regardless of any deformation of tumour and surrounding tissues. However for distal tumours the variation between bony anatomy and soft tissue was significantly larger ($P>0.0001$) suggesting a daily soft tissue match would be a superior method of verification. Deformations of anatomy were also more prevalent and the variations in shape and volume of the stomach had substantial impact on set up reproducibility.
**Conclusion** Suggests different matching strategies would be beneficial for oesophageal tumours based on position.

o054 **Image guided adaptive radiotherapy for bladder cancer using 'plan of the day' and the impacts on staff training**

Benjamin Meigh

*Queen Alexandra Portsmouth Hospitals*

Curative radiotherapy (RT) to the bladder is complex due to the geometric uncertainty of inter and intra-fraction organ motion. Bladder size variations from planning studies provide evidence that adaptive strategies are needed to improve target coverage and dose escalate. Non-adaptive conventional techniques (including IMRT) allow the use of large isotropic margins, resulting in unnecessary normal tissue irradiation. Plan of the day (PoD) is an adaptive solution utilising the use of multiple approved CTV-PTV margins, selected daily, based on the acquisition of online volumetric imaging. The RAIDER trial aims to assess the practicalities of dose escalation using multiple plan selection and confirming the severity of toxicities are acceptable for Bladder cancer. Planning studies have outlined the advantages and limitations of the 'Plan of the day' technique which are outlined in table 1. Recent studies have shown the importance of staff training. Online and offline verification and plan selection had concordance rates of more than 90% when in-house or ethics-approved training regimes were undertaken and 70-75% when they were not. This highlights whether experience or competence should be used to form the basis of confident decision-making actions relating to plan selection. Researchers surveyed sixty-five radiographers who had volumetric imaging training and found that senior therapists were less confident with volumetric imaging than junior therapists ($P = .016$). The evidence shows that the confidence and knowledge needed to make the clinical decisions for adaptive RT are gained through structured learning, which could be a mixture of different grades throughout the workforce.

o055 **CTE implementation: Challenges, solutions and progression**

Alison Blower; Andrew Jepson; Helen Kerr; Hazel Newcombe; Jonathan Poole; Catherine Wilson

*South Tees Hospitals NHS Foundation Trust*

The CtE program has now been running for over a year. During this time we have treated over 45 oligometastatic cases with SABR. These treatment sites have presented new challenges and opportunities for improvement to this service. The SABR treatment team at JCUH have expanded their knowledge base and worked well together in all aspects of the patient pathway. Sites treated include Adrenal, Lung, multiple Lung lesions, Nodes, Liver and Bone. Summary: We have gained significant

experience over the last year, and grown with confidence in every new case. Some cases have been more challenging than others which we have had to adapt working practices. Communication and guidance from the consultants and the physics team have helped to overcome these challenges.

p056 **Imaging stress fractures**

Safi Rahman [1]; Hasan Nizami [2]; Jenn Shiunn Wong [1]; Priya Suresh [1]; Alun Davies [1]; Abdul Gafoor [1]

*[1]Penra Plymouth Hospitals NHS Trust; [2]Plymouth Hospitals NHS Trust*

**Background**: Stress fractures result from abnormal stress on normal bone or normal stress on abnormal bone. The incidence of stress injuries is increasing in recreational/competitive athletes*1. Through a pictorial review we aim to present common sites and imaging modalities used to evaluate stress fractures. Primary investigation includes a plain radiograph, this may be normal*2 initially and radiologists should not be comforted by a negative primary study. If clinical suspicion persists follow-up imaging is advised.

**Purpose**: The poster will aid radiology trainees / general radiologists in identifying radiological features of and sites of stress fractures such as the os calcis, femoral neck, tibia, metatarsals & sacrum amongst others; including bisphosphonate induced fractures. Imaging modalities used include plain film, CT, MRI and nuclear imaging. We aim to demonstrate salient features from each. The poster will provide an aid memoir for stress fracture imaging.

**Summary**: The poster will help better manage stress fractures through early recognition and diagnosis by identifying their common sites and importance of follow-up imaging where there is strong clinical suspicion. A negative plain radiograph does not necessarily exclude a stress fracture & early subsequent imaging should be considered to save significant time off training / work & have a positive impact on health/social care*3.

*1. Michele Gaeta, MD, Fabio Minutoli, MD, Emanuele Scribano, MD, Giorgio Ascenti, MD, Sergio Vinci, MD, Daniele Bruschetta, MD, Ludovico Magaudda, MD, and Alfredo Blandino, MD Radiology 2005 235:2, 553-561 :CT and MR Imaging Findings in Athletes with Early Tibial Stress Injuries: Comparison with Bone Scintigraphy Findings and Emphasis on Cortical Abnormalities 2.John M Martinez, MD Staff Physician, Kaiser Permanente:http://emedicine.medscape.com/article/1270244-overview. 3.O. Nachtrab, V.N. Cassar-PullicinocorrespondencePress enter key for correspondence informationemailPress enter key to Email the author, R. Lalam, B. Tins, P.N.M. Tyrrell, J. Singh Department of Radiology, The Robert Jones and Agnes Hunt Orthopaedic Hospital, Gobowen, Oswestry Shropshire SY10 7AG, UK. European Journal of Radiology.Role of MRI in hip fractures, including stress fractures, occult fractures, avulsion fractures*

p057 **FRAX that fracture**

Sandra Wood

*Bradford Teaching Hospitals NHS Foundation Trust*

**Background** Osteoporotic fractures represent a potentially avoidable burden to both the patient and healthcare service. The estimated lifetime risk of fracture at the hip, lumbar spine or distal forearm is 30-40% in developed countries. With over 200,000 fractures occurring every year, the current financial cost to the NHS amounts to over £1.75 billion annually with the figure only set to rise in the future as the population ages As vertebral fractures increase the risk of subsequent fragility fractures by four to five fold, their recognition by the radiology team is crucial for the implementation of secondary prevention strategies. Detecting and treating vertebral fractures early can prevent further vertebral fractures, decrease patient morbidity and prevent future hip fractures. Prompt radiological intervention presents an opportunity to reduce the financial burden of osteoporosis to the NHS.

**Purpose**: The aim of this review is provide clinicians, radiologists and radiographers an overview of osteoporotic fractures, highlight the importance of detecting such fractures and describe the methods of how we at our institution have improved our detection rates of such fractures -- not just a local problem but a national one.

**Summary** Brief background of osteoporotic fractures and key statistics, pictorial review of different osteoporotic fractures, classification of vertebral fractures, the use of DEXA scanning and FRAX scoring to identify such patients and describe the methods we have introduced to improve our detection rates.

*Giannotti et al (2013) Early Diagnosis of Vertebral Fractures IOP (2016) Facts and Statistics IOP (2016) Invest in your bones: Move it or loose it NHS choice: (2016) Osteoperosis NICE (2012) Osteoperosis: Assessing the risk of fragility fracture CG146 University of Sheffield (2011) FRAX - Fracture Risk Assessmenttool*

p058 **Common fracture mimics in plain film radiography: A pictorial review**

Gillian Wilkinson

*NHS Forth Valley*

**Background** There are numerous normal anatomical features which may imitate acute skeletal trauma, many of which have characteristic radiological qualities. It is essential that theses features are recognised at image acquisition and interpretation to ensure that the patient receives the correct imaging, treatment and management. Careful correlation of radiological findings with clinical features such as soft tissue signs is often useful to aid in clinical decision making and eliminate or confirm significant injury.

**Purpose** Describe the key features and radiological presentation of a series of musculoskeletal normal variants that simulate commonly seen fractures. Raise awareness of these common appearances and the differentiation between fracture imitation and acute bony injury.

**Content** Radiographic images of common fracture mimics. Definitions and explanations of each presentation. Normal variants discussed include; Mach effect, unfused apophysis and epiphysis, secondary ossification centres, previous fractures, accessory ossicles, nutrient channels, soft tissues, sesamoid bones and bony excrescence.

*Keats, T.E. and Anderson, M.W. (2007) Atlas of Normal Roentgen Variants That May Simulate Disease, 8th Edition, . Philadelphia: Mosby Elsevier. Learningradiology.com. (2015) 21 Imaging Findings Simulating Fractures.[online]. Available from http://learningradiology.com/archives2013/COW%20586-Fx%20or%20Not/fxornotcorrect.html [Accessed 10/11/2016]. Williams, H. (2008) 'Normal Anatomical Variants and Other Mimics of Skeletal Trauma' in Johnson, K.J. and Bache, E. (ed.) Imaging in Paediatric Skeletal Trauma,91-118, Berlin: Springer.*

p059 **Evolving technique in orthopaedic radiography - understanding variation and drivers for change**

Lisa Field; Bev Snaith; Emily Lewis; Martine Harris

*The Mid Yorkshire NHS Trust*

**Background**: Scant research exists to support positioning techniques in orthopaedic radiography, with textbooks reflecting the practices of the pioneers of the profession. Anecdotal evidence suggests variation in current practice. To establish consistent evidence based approaches to radiographic practice any variations should be understood in terms of benefit to the patient or impact on radiation dose.

**Objectives**: To establish any variation in orthopaedic radiography across the UK and to explore the drivers behind these changes, using 4 common examinations (foot, knee, pelvis and L-spine). Design: This mixed methods CoRIPS funded study involved a national electronic survey of adult X-ray departments, followed by in-depth telephone interviews with a purposive sample of radiographer key informants identified from the survey. Qualitative data was analysed using the framework method. Results: A survey response rate of 39.7% (n=69/174) was achieved.

**Findings** identified differences in the routine projections undertaken and the approach to positioning. Variations included the use of weight bearing techniques, use of angles, direction of primary beam, and degree of flexion of relevant joint. Analysis of qualitative interviews is ongoing, emerging themes suggest that changes are driven by conscious and subconscious factors. Demands from local referrers and adaptations made due to technological advances being examples of the former, with the latter occurring as practice creep over time.

**Conclusions**: This study has demonstrated a lack of standardisation of projections undertaken and techniques adopted across the UK. The results suggest that the evidence base is neither established nor embedded and appears not to be the prime consideration

*1. Carver E, Carver B. (2006) Medical imaging, techniques, reflection & evaluation. China: Churchill Livingstone. 2. Clarke KC. (1939) Positioning in radiography. London: Heinemann. 3. McQuillan-Martensen K. (1996) Radiographic Technique. Philadelphia: Elsevier. 4. Whitley AS, Sloane C, Hoadley G, Moore AD, & Alsop CW. (2005) Clarke's positioning in radiography. 12th edition. London: Hodder Arnold.*

p060 **The experience of radiology at a major trauma centre: An audit to evaluate limb fracture detection on scanograms of whole body trauma CTs**

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*Mersey Deanery, Liverpool*

**Introduction**: At our regional Major Trauma centre, radiologists are present at the time of trauma scan to provide a preliminary report. Latest NICE guidelines state that scanograms as well as clinical findings should be used to direct CT-imaging for limb trauma in adults.

**Aim**: Calculate the true peripheral fracture (TPF) detection rate of initial whole body (PAN-CT) trauma scanogram in our institute. We will audit this against current NICE guidelines and our local set target of 75%. Methods: All patients with PAN-CT scans over a 4 month period were included (100 patients). A senior radiology registrar assessed scout images for peripheral fractures, excluding axial skeleton fractures. Comparison was made against plain radiograph report.

**Results**: Main indication for PAN-CT was road traffic collisions. 45 patients had subsequent plain films within 20minutes to 2days after CT. 20 patients had a TPF. 2 of those fractures were demonstrated on the scout. 18 out of the 20 TPF had plain radiographs. Only 5.5% of scanograms were matched to a positive fracture radiograph. 50% of scanograms didn't match the positive upper limb fracture demonstrated on radiograph and 44.4% weren't possible to assess.

**Conclusion**: The use of scanograms for upper limb fractures is non-diagnostic. Limitations were lack of scout extension to include lower limbs and suboptimal scanograms. Clinical history and examination of patients should remain the primary assessment.

p061 **Qualitative assessment of the one stop MSK ultrasound clinic**

Mohamed Bushara; Hasan Nizami; Alun Davies; Abdul Gafoor; Priya Suresh

*Plymouth Hospitals NHS Trust*

**Background**: The 'one stop' MSK ultrasound clinic has been established in a large tertiary hospital and has been running for over 3 years, the clinic runs concurrently with trauma and orthopaedics, rheumatology and physiotherapy in tandem. The aim of the

service is to improve patient's experience by reducing their waiting time, number of visits and accelerate the clinical decision making process by providing diagnostic/therapeutic ultrasound most of the time at the same visit. After receiving positive feedback from our initial survey, we had taken on board suggestions made and re-surveyed to complete the cycle.

**Method**: Patient satisfaction survey was completed by 100 consecutive patients using the service, their views on the service, feedback and suggestions for service improvement were recorded. Electronic survey was sent to all clinicians' making referrals to the clinic and their views on the current running service, how the clinic can be best tailored to their clinical needs and recommendations for better patient experience were recorded.

**Results and discussion:** The overall response has once again been positive. We aim to present the changes made in response to our previous survey and valuable points highlighted for service improvement. We will share our, now almost 3 and a half year, experiennce of setting up and running this unique 1 stop service, normally offered to cancer patients' which can act as model for other trusts nationwide to consider.

p062 **Auto-reporting audit**

Mohammed Nabi; Rajat Chowdhury

*Oxford University Hospitals NHS Trust*

**Background**: Auto-Reporting is a process designed for radiological examinations that are not formally reported by radiologists. The referring clinical team must review these examinations and their interpretation recorded in the patients' records.

**Aim**: To determine the clinical teams' compliance in the use of the local Auto-Reporting Policy with regards to reviewing the imaging studies that are recorded as Auto-Reported and recording their findings in the patients' records.

**Methods**: We conducted a retrospective review of the patients seen in fracture clinic in October 2016, using the Blue Spiers System to identify fracture clinic lists and analysing letters generated by the Trauma consultants. CRIS was used to identify reports, which were generated as Auto-Reported. We also reviewed the images on PACS to compare the radiologists' opinion with the clinical team record. Our findings were correlated with the local Auto-Reporting Policy.

**Results**: A total of 62 cases were analysed, 22 of which had their radiographs recorded as Auto-Reported. 21 of these cases had their clinical team image interpretation findings recorded in the fracture clinic letters. The radiologist's interpretations of these 21 imaging studies were not significantly different from what was recorded by the clinical teams.

**Conclusion**: 100% satisfaction with the interpretation of the clinical teams. Although 96% of the radiographs marked as Auto-Reported were reviewed and recorded in the patients' records, our target should be 100%. Recommendations: To distribute the results of this audit to the Trauma and Orthopedics clinicians and re-audit after 6 months.

*1. Auto-Reporting Policy – Imaging Service Version 2.0 – May 2015, Oxford University Hospitals NHS Trust. 2. Standards and recommendations for the reporting and interpretation of imaging investigations by non-radiologist medically qualified practitioners and tele radiologists, The Royal College of Radiologists.*

p063 **Quantification of IBEX technology for BMD measurement and improved scatter correction on standard DR systems**

Paul Scott [1]; Ben Lopez [2]; Adam Ratcliffe [1]; Joshua Cowling [1]

*[1]IBEX Innovations; [2]Durham University*

**Background**: IBEX has demonstrated a technology which adds information to X-ray imaging [1]. It functions by interpreting the pattern of a structured filter attached to the detector. IBEX technology can return both a familiar diagnostic image and information relating to beam energy. This allows measures such as BMD to be acquired from any X-ray scan on DR systems. We demonstrate the quantification of the IBEX technology for BMD measurement on phantoms and show a comparison to a DEXA system. Furthermore, we use this information to accurately predict and remove the effect of scatter to demonstrate our potential for improved gridless imaging.

**Method**: The quality of IBEX diagnostic images has been assessed using quantitative (MTF) and subjective assessments. A comparison between the IBEX technology and DEXA systems has been performed to demonstrate the extra information returned by an IBEX imaging system. Finally quantitative phantoms are assessed for scatter correction accuracy. Results: MTF and other image quality metrics will be presented. Correlation is observed between IBEX and DEXA system measurements for a set of quantitative phantoms with a residual standard error on IBEX measurements of 0.043 g/cm$^2$. Scatter correction has been performed on quantitative phantoms and demonstrated to agree with a simulated case with less than 5% total error.

**Conclusion**: IBEX technology presents a viable, useful and novel addition to standard X-ray imaging, providing both standard and scatter corrected imaging procedures alongside new material information which can be used to enhance diagnostic outputs.

*Cowling, J et al. (2016), Novel X-ray detector technology for quantitative material information in digital radiography, ECR 2016 Book of Abstracts, Insights into Imaging, **7**(1), 466, DOI:10.1007/s13244-016-0473-x*

p064 **When is an effusion not an effusion?**

Lucy Taggart

*NHS Greater Glasgow and Clyde*

**Background** Our reporting radiography team notice a trend in the misdiagnosis of effusions, fat pad elevations, lipohaemarthrosis and "normal" soft tissues on our sticky note reporting scheme we run within accident and emergency (A&E) and minor injuries sites. These sites are staffed by nurse practitioners and doctors with varying experience. However effusions appear to be a common miss no matter what expertise.

**Purpose** We developed a poster showing the common pitfalls of soft tissues signs and the common pathologies they are linked to. This has enabled A&E staff to more effectively assess soft tissue signs on plain film radiographs and direct patients into a more accurate treatment plan in a more timely fashion. The poster has limited information available as not all soft tissue signs could be highlighted, however as a basic indicator of what to look out for has been a vital educational tool in our Accident and Emergency departments. By missing a soft tissue sign indicative of patient pathology we are essential mistreating and misdiagnosing patient. Despite our fast turn around of hot reporting there can sometimes be a significant delay of patient treatment, the poster has allowed soft tissue "red flags" that will require medical intervention to be identified quicker and more effectively.

**Summary**: The poster has been created as a quick reference guide to allow the quick radiographic appearances of

- Upper limb effusions
- Lower limb effusions
- Lipohaemarthrosis
- Pseudosubluxation
- Fat pad signs

p065 **Computer-aided detection in musculoskeletal projection radiography: A systematic review**

Mike Gundry; Karen Knapp; Jude Meakin; Robert Meertens

*University of Exeter Medical School*

**Background**: Computer-aided detection (CAD) is utilised successfully in imaging modalities such as computed tomography (CT) colonography and CT lung screening, these CAD systems have increased sensitivity scores[1,2], reducing human error in reporting. Yet there is little information regarding CAD deployed within musculoskeletal (MSK) projection radiography;- As such a systematic review was undertaken to investigate clinical MSK application of CAD software utilising a diagnostic test design.

**Method**: A systematic review was conducted based on the Cochrane DTA review methodology searching specific inclusion/exclusion criteria. Electronic databases including Medline, EMBASE, HMIC, AMED, PubMed were searched using a pre specified search strategy. Additionally backwards and forwards citation searches were used to include any papers mentioned within the papers scoped and these were themselves reviewed. Two reviewers independently screened results for title and abstract data, and then full papers (with a third reviewer as arbitrator). The final papers had their data extracted and a bias check performed utilising a blinded double assessment with the QUADAS-2 quality check tool.

**Results**: In total, 6256 papers were originally discovered from the searches, which after duplicate removal and the first round of screening, was truncated to 149 papers. These were then screened for full text analysis resulting in 16 papers for data extraction.

**Conclusion**: Results demonstrate that CAD has the potential to help diagnostic accuracy within MSK imaging, but is still in its infancy. This is reflected in the majority of the research papers outlining proposed software, but with limited or no clinical testing or participant follow up

*1. Beigelman-Aubry C, Raffy P, et al. Computer-Aided Detection of Solid Lung Nodules on Follow-Up MDCT Screening: Evaluation of Detection, Tracking, and Reading Time. American Journal of Roentgenology. 2007;189(4):948-55. 2. Petrick N, Haider M, et al. CT colonography with computer-aided detection as a second reader: observer performance study. Radiology. 2008;246(1):148-56*

p066 **Forgotten signs in rheumatology**

Leon Sergot; Nicholas Ridley; Hyeladzira Thahal; Elizabeth Price; Roopa Tekkatte

*Great Western Hospital, Swindon*

**Background:** Soft tissue swelling, juxta-articular osteoporosis, joint space narrowing, and marginal erosions are all well-known radiographic signs of Rheumatoid Arthritis that are commonly identified. Classical signs of seronegative arthropathy are also well described. However, there are a number of other recognised, but often overlooked plain film signs of rheumatological disease. Recognition of these can aid diagnosis and monitor disease progression.

**Purpose:** A pictorial review of often forgotten signs of rheumatological disease on plain film, including Rheumatoid Arthritis, Psoriatic Arthritis, Calcium pyrophosphate dihydrate deposition (CPPD), and Diffuse idiopathic skeletal hyperostosis (DISH). This pictorial review will aid recognition by radiologists and rheumatologists who are not familiar with these rare signs.

**Summary:** The poster will be organised into disease categorised groups with displays of unusual and rarer plain film signs for each rheumatological condition. The cases include: Rheumatoid arthritis: Terminal phalangeal sclerosis, inferior distal clavicular erosions, posterosuperior calcaneal erosion, rib erosions, non-cervical spinal disease. Psoriasis: Acro-osteolysis affecting terminal phalanges of hands and toes. CPPD: Unusual sites. DISH: Periosteal new bone formation and enthesopathy in the pelvis.

p067 **Ankle-foot orthosis lifespan estimation: Does radiographic evidence support the computer simulation prediction of orthotic deformation and breakdown propagation patterns?**

Amanda Rutherford [1]; Jonathan McConnell [1]; Graham Johnstone [1]; Gillian Wilkinson [1]; Andrew Sheilds [2]; Ester Smith [2]; Craig Girvan [2]; Steven Combes [2]; Shahbaz Hameed [2]; Dominic Conlin[2]

[1]*NHS Greater Glasgow and Clyde;* [2]*Glasgow Caledonian University*

**Background/Objectives**: The time period for use of Ankle Foot Orthosis (AFO) and the number of patients now using them has increased - this has been a driving force in developing new orthotics with greater longevity. An AFO is a leg splint for patients who have below knee paralysis - its purpose is to readjust patients gait back to a more comfortable walking style, allowing for increased mobility. The purpose of this study is to compare radiographs and computed simulations of deformations/stress points of several AFOs from patients presenting with differing initial gait problems to establish the durability and estimated lifespan of the orthosis.

**Method** Baseline imaging will be obtained before fitting the orthosis to the patient. Follow up interval imaging of each orthosis over a period of time will generate radiographic evidence of wear and timeframe influences and compared with computer simulated predictions to establish the validity of computer modelling and consequent personalised construction of the AFO for each patient.

**Outcomes**: Work in progress.

**Discussion**: This study has potential for further multidisciplinary research in prosthetic/orthotics between healthcare professionals and engineering with the aid of diagnostic imaging.

p068 **The occurrence of bone marrow oedema in asymptomatic adolescent footballers - an observational study**

Lucy Ashton [1]; Jon Fulford [1]; Susan McAnulla [1]; Karen Knapp [1]; Christine Heales [2]; David Silver [3]; Craig Williams[4]

[1]*University of Exeter Medical School;* [2]*Plymouth Hospitals NHS Trust;* [3]*Royal Devon and Exeter NHS Foundation Trust;* [4]*University of Exeter*

**Background** Studies have demonstrated the presence of bone marrow oedema in asymptomatic athletes who engage in a variety of sporting activities[1,2,3,4]. Many studies have focused on sportsmen and women who are skeletally mature. The aim of this observational study was to examine whether a similar pattern of oedema was evident in adolescent elite football players.

**Method** 14 footballers (16 to 18 years) attached to a sports academy underwent T1 and STIR MRI scans of both knees and ankles. Scans were examined for evidence of bone marrow oedema. Participants were asked to report either acute or chronic pain affecting the lower legs. Training and injury records for participants were provided by the academy coaching staff for that current academic year.

**Results** Results of the scans demonstrated the presence of bone oedema in 47% of ankle MRI sequences (15/32) and 22% of knee sequences (7/32). The most common sites for oedema were either the medial or lateral malleoli (11/15) or the medial femoral condyle (5/7). No participants reported any significant injuries during their career and all were actively training at the time of scanning.

**Conclusion** MRI findings in this cohort reflect those shown in previous studies of skeletally mature athletic asymptomatic populations. The clinical significance of oedema is uncertain in the absence of acute trauma and may reflect biomechanical stresses associated with high intensity training (minimum 10 hr per week). Presence of oedema in the adolescent asymptomatic athlete provides a diagnostic challenge when translated to the acute injury setting.

*1. Kornaat, P. R., et al. (2008). "Bone marrow edema-like signal in the athlete." European Journal of Radiology 67(1): 49-53. 2. BRUNNER, M. C., et al. (1989). "MRI of the Athletic Knee: Findings in Asymptomatic Professional Basketball and Collegiate Football Players." Investigative Radiology 24(1): 72-75. 3. Kornaat, P. R. and S. K. Van de Velde (2014). "Bone Marrow Edema Lesions in the Professional Runner." Am J Sports Med 42(5): 1242-1246. 4. Soder, R. B., et al. (2012). "MRI of the knee in asymptomatic adolescent swimmers: a controlled study." British Journal of Sports Medicine 46(4): 268-272.*

p069 **Knee X-rays - are we adhering to iRefer?**

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*Princess Alexandra Healthcare Trust, Essex*

**Background** Knee pain is a common complaint in primary care. The majority of knee complaints can be attributed to osteoarthritis (OA)1. Knee X-rays often can be limited in what they add to a clinical diagnosis. Evidence based guidelines have thus been created by The Royal College of Radiologists called iRefer. The existence of these guidelines are not well known amongst clinicians. Method Patients across two primary care centres were identified between 1st-31st August 2016. Those who had a knee X-ray were selected and a manual screening of their notes was undertaken to retrieve (1) presenting complaint, (2) referral reason, (3) X-ray outcome and (4) any further imaging/follow up. Data was compared against knee X-ray iRefer guidelines.

**Results** 50 patients fit the selection criteria across both primary care centres. Of those, 40 patients presented with pain as their primary symptom, 2 with locking, 4 with knee trauma, and 4 with non-specific complaints. Only 12/50 patients met the iRefer criteria. 3 of these had features of OA, 1 with a metallic foreign body and 8 being normal. 38/50 patients didn't meet the criteria; 15 had normal X-rays, 20 had evidence of OA, 1 had a small effusion, 1 with shrapnel and 1 with chondrocalcinosis.

**Conclusion** iRefer guidelines are not well known in primary care despite a large volume of requests. The majority of requests did not meet iRefer guidelines. In order to increase awareness of iRefer, the audit was presented and a simplified format of the guidelines was sent to all GPs.

*1. Porcheret, M., Jordan, K. and Croft, P. (2006). Treatment of knee pain in older adults in primary care: development of an evidence-based model of care. Rheumatology, 46(4), pp.638-648. 2. Irefer.org.uk. 2016 [cited 6 December 2016]. Available from: http://www.irefer.org.uk/*

p070 **Spicks and specks: clues to pathology around the knee. All you kneed to know**

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**Background**: Tiny fragments of bone, calcification or enthesopathy around the knee can be important clues to more significant pathology. Most of these are well described but are easily overlooked. The classic example is the Segond fracture that is a strong marker for internal derangement.

**Purpose**: We aim to present a large number of examples of these 'spick and specks' around the knee so that radiographers who red dot films, reporting radiographers and radiologists and ED doctors have an educational resource to review. The principle learning outcomes are that health professionals reviewing knee radiographs are able to spot, describe and understand the significance and importance of these abnormalities.

**Summary**: The following abnormalities amongst others will be covered; Normal variants, post trauma (e.g. cruciate avulsion, Pellegrini Stieda, Segond, Osgood Schlatter's disease, quads rupture) and other pathology e.g. seronegative arthopathy, CPPD, Guinea worm and synovial chondromatosis.

p071 **Re-audit of MRI in the diagnosis of meniscal tears**

Dhaara Bhatt; Fatima Alves-Pereira; Andoni Toms

*Norfolk and Norwich University Hospital*

**Background** MRI has reported sensitivities of between 88% - 95% for meniscal tears and is routinely used to assess meniscal integrity [1]. Previous audits in our department had recorded similar diagnostic accuracy for isolated meniscal tears. A re-audit was performed to measure the accuracy of MRI for meniscal tears but expanded to include patients with anterior cruciate ligament (ACL) tears.

**Methods** Patients were identified from our electronic surgical database. 50 consecutive cases recording the presence of a meniscal tear on arthroscopy between October 2015 and March 2016 were identified. The time interval between the arthroscopy and MRI was recorded. MRI reports were assessed by two radiology trainees and discrepancies between the MRI report and surgical findings were independently reviewed by 3 senior musculoskeletal radiologists.

**Results** 40 of 50 patients (sensitivity 80%) were correctly diagnosed with a meniscal tear on MRI. Of the remaining 10 patients, there was a persistent discrepancy between MRI and arthroscopy in 3 patients, 8 patients had an acute ACL injury, and 4 of the discrepancies were meniscocapsular separations of the posterior horn of the medial meniscus.

**Conclusion** The discrepancy rate between MRI and arthroscopy appears to be higher in the setting of an acute ACL injury. In half of these cases a meniscocapsular tear seen at arthroscopy was not identified at MRI.

*1. Phelan N, Rowland P, Galvin R, O'Byrne J.M. A systematic review and meta-analysis of the diagnostic accuracy of MRI for suspected ACL and meniscal tears of the knee. Knee Surg Sports Traumatol Arthrosc. 2016 May; 24(5):1525-39.*

p072 **Radiologist's guide to patella tendon disease**

Gulraiz Ahmad [1]; Waqar Bhatti [2]

[1]*Stockport NHS Foundation Trust;* [2]*University Hospital South Manchester*

Patellar tendinopathy is a common condition seen in athletes. It is thought to be due to repeated loading of the knee extensor mechanism characterised by anterior knee pain and most frequently seen in sports that involve jumping such as basketball. (1) (2) Traditionally the conservative management of patella tendinopathy has involved combinations of rest with eccentric exercises such as decline squats. (3) Surgical procedures are also used although varied success rates have been reported. (4) More recently minimally invasive techniques such as dry needling, autologous blood injection and platelet rich plasma therapy have been employed. These techniques utilise ultrasound to determine the site for injection. (5) We employ elastography during the routine assessment of tendon disease which assesses tendon rigidity on a colour scale. The colour of the scale is suited to the operator's preference; either a henna red or a royal blue colour is representative for normal tendon rigidity. The diseased patella tendon becomes less rigid and organised compared to normal tendon and the colours depicted represent softening within the affected tendon. Alteration in the tendon ultrastructure seen with tendinopathy may manifest as tendon thickening, increased Doppler activity, interstitial fissures or low echo clefts. These affected regions are targeted during injection therapy. (1)

*(1) Warden SJ, Brukner P. Patellar Tendinopathy. Clin Sports Med 22 (2003) 743 – 759 (2) Khan KM, Cook JL, Kannus P, et al. Time to abandon the ''tendinitis'' myth. BMJ 2002;324:626-7 (3) Ferretti A, Puddu G, Mariani P, et al. The natural history of jumper's knee: patellar or quadriceps tendinitis. Int Orthop1985;8:239–42. (4) Khan KM, Cook JL What is the most appropriate treatment for patellar tendinopathy. Br J Sports Med 2001;35:291-294 doi:10.1136/bjsm.35.5.291 (5) Mathijs van Ark, Johannes Zwerver, Inge van den Akker-Scheek. Injection treatments for patellar tendinopathy. Br J Sports Med 2011;45:1068-1076 doi:10.1136/bjsm.2010.078824*

p073 **Atypical Femoral Fractures (AFF's): Discussion and radiological review**

Mike Mackenzie

*Fairfield Hospital, Pennine*

To review the definition and pathophysiology of atypical femoral fractures Incipient or complete atypical fractures Compare insufficiency fractures (loosers zones) Recent epidemiologic evidence shows that the absolute incidence of atypical femoral fractures is small compared to the incidence of typical hip fractures. Long-term bisphosphonate use may be an important risk factor for atypical fractures For patients with postmenopausal osteoporosis durations (longer than 5 years) there is minimal additional 'antifracture' benefit demonstrated for treatment.

*Aasis, U. et al (2013) Atypical Femoral Fractures: What Do We Know About Them? J Bone Joint Surg Am. 16(95): e8 Donnelly, E. et al (2012) Atypical Femoral Fractures: Epidemiology, Etiology, and Patient Management Curr Opin Support Palliat Care. 6(3): 348--354. McKenna, M.J. et al (2014) Clinician approach to diagnosis of stress fractures including bisphosphonate- fractures associated n DOI: http://dx.doi.org/10.1093/qjmed/ hct192 99-105 Neviaser, A.S. et al (2008) Low-energy femoral shaft fractures associated with alendronate use. J Orthop Trauma. 22(34): 6-50. Pankaj T & Thorn JM (2012) Atypical femoral fractures related to bisphosphonate therapy. MSK Imaging. 22(3): 178-181 Shane, E. et al (2010) Atypical subtrochanteric and diaphyseal femoral fractures: report of a task force of the American Society for bone and mineral research. J Bone Miner Res.10;25(22):67-94.*

p074 **Femoroacetabular impingement - what the radiologist needs to know**

Samir Khwaja; Saqib Butt; Scott Mcdonald

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Femoroacetabular impingement (FAI) is increasingly recognised as a cause of hip pain and dysfunction especially in young active patients (1). FAI is caused by repetitive abutment of a morphologically abnormal proximal femur and/or acetabulum during hip motion, especially during flexion and internal rotation. The resulting stress on the acetabular labrum and articular cartilage can cause labral damage and cartilage degeneration, resulting in early-onset osteoarthritis.

Pincer impingement generally involves the acetabular side of the joint where there is excessive coverage of the acetabulum, which maybe focal or diffuse. Cam impingement involves various forms of femoral head asphericity. Most patients have a combination of both forms of impingement (2). Imaging has a key role in detecting both the morphological features and pathological changes associated with FAI.

Our case-based multi-modality review will enable the radiologist to:

1. Understand the anatomy of the hip joint and how this affects function.
2. Identify, characterise and describe the radiologic findings associated with FAI.
3. Outline the key radiographic measurements and signs.
4. Highlight the role of MRI and CT in detecting the morphological features and pathological changes associated with FAI.
5. Communicate abnormalities more effectively with clinical colleagues.

p075 **Intra and inter-operator precision measurements of hip migration using projection radiography and dual energy X-ray absorptiometry**

Ella Hancock; Harriet Elder; Saffron Martin; James Spreadbury; Chris Morris; Karen Knapp

*University of Exeter*

**Background**: Children with cerebral palsy (CP) are at an increased risk of hip dysplasia. To monitor hip dysplasia, regular bilateral hip radiographs are undertaken at 6 to 24 month intervals and the migration percentage calculated. The aim of this study was to explore whether dual energy X-ray absorptiometry (DXA) measurements can provide reproducible hip migration measurements as a potential low dose alternative to projection radiography (PR).

**Method**: A Kyoto Kagaku PBU-50 phantom was imaged once in the recommended position for hip migration imaging using both Siemens Multix Fusion DR and GE Lunar Prodigy for PR and DXA respectively. Images were downloaded and the hip migration percentage calculated using GNU image manipulation (GIMP). Intra- and inter-operator precision errors were calculated using the coefficient of variation (CV%), root mean square standard deviation (RMSSD) and RMSCV% from 30 repeated measurements completed by four researchers for both modalities.

**Results**: The CV% ranged from 8.4% to 21.6% and 10.05% to 22.4% and the RMSCV% (RMSSD) was 17.05% (1.76) and 14.80% (2.23) for PR and DXA respectively. The mean migration percentage was 10.3% for PR and 15.2% for DXA, although these differences need to be treated with caution due to re-positioning between PR and DXA in addition to suboptimal anatomy of the phantom.

**Conclusion**: These results demonstrate that DXA shows potential as a low dose alternative to PR for hip migration measurements. This study was restricted to an adult phantom and further research is required in-vivo to explore these results in a more clinically relevant population.

p076 **Review of the deltoid ligament**

David Shatti; Leon Sergot; Martin Williams

*North Bristol NHS Trust*

**Background**: The deltoid ligament is a complex structure with variable superficial and deep layer components involved in the stabilisation of the ankle joint. It provides strong resistance to valgus, pronation and rotation forces on the talus. The ligament is prone to injury with eversion and pronation mechanisms of force and fractures of the lateral ankle destabilize the structure.

**Methods**: To understand the pathological mechanisms this structure is subjected to, we provide a review of the deltoid ligament complex anatomy. Radiological appearance is reviewed using multi-modality imaging: plain film radiography, ultrasonography and magnetic resonance imaging. With appreciation of the structure we visit the pathological processes involved including trauma, impingement and tibialis posterior dysfunction and their radiological features. The aim of this review is to raise awareness of the patterns of injury and pathology for the general radiologist.

**Results**: Both ultrasonography and magnetic resonance imaging provide detailed anatomical evaluation and are complementary modalities for identifying the substructure anatomy and pathological processes it undergoes.

**Conclusion**: The deltoid ligament is a primary stabiliser of the ankle joint; understanding this detailed anatomy helps to guide early treatment options and prevent long-term morbidity when abnormalities occur.

p077 **Fluoroscopically guided glenohumeral joint injection - a single centre experience**

Jenn Shiunn Wong; Hasan Nizami; Mark Portet; Ghauri Sherafghan; Alun Davies; Abdul Gafoor

*Derriford Hospital, Plymouth*

**Aim**: Referral for fluoroscopy guided glenohumeral injection is increasing. We aim to present our local experience of GHJ steroid injections over a year looking specifically at pain diaries - their return rate, percentage reduction in pain score and breakdown of responders and non-responders looking at age, gender and severity of radiographic signs. A literature search (1,2,3) revealed no official standard of expected pain improvement. Whilst there are publications commenting on mean pain score, to our knowledge there is no publication that provides the breakdown percentage of responders vs non-responders.

**Method**: Retrospective analysis of patients' visual analogue pain scores and their clinical referrals were searched on CRIS over a year. Patients included were those referred for osteoarthritis or adhesive capsulitis. Acromioclavicular joint injections were excluded. Plain radiographs were reviewed for assessment of severity of degenerative changes.

**Results**: We analysed 218 events. A total of 101 pain diaries were scanned onto RIS. Out of theses, 60 GHJs (59.4%) were reported to have 'good' response (50% and above improvement from baseline pain score), 8 GHJs (7.9%) had 'some' response

(between 25% and 50% improvement), and 33 GHJs (32.7%) 'poor' response (25% and less improvement). Roughly 55% of patients had their pain diaries scanned onto RIS, and this requires improvement.

**Conclusion**: Our review will help set a standard, improve patient consent and guide patients' expectations in terms of how likely they will experience an improvement. We have also proposed changes to the local pain diary collection method and will be auditing returns.

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p079 **Crowned Dens Syndrome: A case report illustrating its non-specific presentation**

Mohammed Nabi; Rowena Johnson

*Oxford University Hospitals NHS Trust*

**Background**: Crowned Dens Syndrome is a rare cause of neck pain characterised by CPPD deposits in the periodontoid tissues. It is generally seen in older female patients and can result in cervical cord compression. It is often misdiagnosed and definitive diagnosis on clinical grounds is difficult due to non-specific presentation. The condition can mimic a range of other pathologies on clinical findings and CT is the gold-standard in identifying the calcification in the periodontal ligaments.

**Purpose**: Our case illustrates the non-specific clinical presentation of crowned dens syndrome in an 88 years old patient. He presented with long standing history of gradually progressing left sided upper limb and bilateral leg weakness, unsteadiness and recurrent falls. CT cervical spine demonstrated a crown of amorphous mineralization extending around the peg, resulting in mass effect and narrowing of the spinal canal at this level. There was a further diffuse halo of mineralisation at the bilateral sternoclavicular joints, consistent with the same process. The findings were consistent with crowned dens syndrome (peri-odontoid CPPD), causing narrowing of the spinal canal, with a similar appearance of CPPD in the sternoclavicular joints. Crowned Dens Syndrome is an under-recognised condition and clinicians should be aware of its clinical feature to avoid unnecessary investigations.

**Summary**: It will include the above information and various radiological images, including CT and plain films for the C-Spine.

p080 **The detection of wooden foreign bodies: An experimental study comparing DDR and ultrasonography**

Christopher Hayre; Louisse Mercardo

*University of Suffolk*

**Background** This study investigates and compares direct digital radiography (DDR) and ultrasonography in the detection of wooden foreign bodies in soft-tissues. Patients attending the accident and emergency department following suspected wooden foreign body are often referred for radiographic investigation. Evaluation of retained foreign bodies remains paramount for assessment of these wounds as they are frequently missed on initial assessment (DeBoard et al., 2007, pp.23-39). The misdiagnosis of retained wood may cause harm to a patient as this can result in the damage of nerves or adjacent blood vessels (Kaiser et al.,1997, p.107). It is therefore of paramount importance that the most suitable imaging modality is used to detect and localise foreign bodies in order to ensure that removal is quick and accurate, and that the patient will have minimally associated complications.

**Method** Four pork feet were used to insert wooden foreign objects. Images were judged on the image acceptability and foreign body detection using a radiographer and sonographer. This compares the observed and expected proportions to see if they are any observed differences between the two imaging modalities (Chilisa and Preece, 2005, p.133).

**Results** Results are currently being undertaken and will be accessible at the end of January 2017.

**Conclusion** To follow.

*Chilisa, B. and Preece, J. (2005) Research Methods for Adult Educators in Africa. Hamburg, Germany: UNESCO Institute for Education. DeBoard, R. H., Rondeau, D. F., Kang, C. S., Sabbaj, A. and McManus, J. G. (2007) 'Principles of basic wound evaluation and management in the emergency department', Emergency Medicine Clinic of North America, 25 (1) pp.23-39. Kaiser, C.W., Slowick, T., Spurling, K.P. and Friedman, S. (1997) 'Retained foreign bodies', The Journal of Trauma, 43 (1), pp.107-111.*

p081 **A pictorial review on lesions of the paediatric pelvis: What not to miss!**

Veena Vishwanath [1]; Rochelle Lamb [2]; Julian Soares [2]; Vivian Tang [3]; Rachel Dixon [3]; Rui Santos [3]; Neville Wright[3]

[1]*North West School of Radiology;* [2]*Pennine Acute NHS Trust;* [3]*Royal Manchester Children's Hospital*

**Purpose** In this pictorial review, we present six cases, describing clinical history and characteristic radiographic findings. The aim is to highlight important review areas when evaluating paediatric pelvic radiographs. Pelvic lesions are often difficult to appreciate due to overlying anatomical structures.

**Methods** We selected six cases of iliac bone lesions at Royal Manchester Children's Hospital, reviewing clinical history and imaging findings.

**Results** An 11 year old female was confirmed to have a tuberculosis cold abscess after pelvic X-rays, CT pelvis contrast and MRI pelvis. These images demonstrated destructive changes within the iliac blade, fluid collection and peripheral contrast enhancement. A skeletal survey in a 6 year old male showed an incidental finding of fibrous dysplasia with diffuse sclerotic changes throughout the pelvic bones. An 11 year old female was diagnosed with osteosarcoma. Pelvic X-ray and MRI contrast demonstrated a sclerotic right iliac bone associated with a surrounding large calcified soft tissue mass. A 15 year old male was confirmed to have an aneurysmal bone cyst in the right acetabulum following pelvic X-ray and MRI, which demonstrated a well defined septated expansile lesion. Lastly we have 2 cases of Ewings Sarcoma in a 16 year old male and a 9 year old female. Both cases had patchy sclerotic changes in the pelvic bones, associated with surrounding soft tissue masses. These were confirmed on plain pelvic radiographs, MRI and CT.

**Conclusion** With careful scrutiny, plain radiographs are fundamental in the diagnosis of bone lesions. This poster outlines the importance of review areas.

p082 **Horsing around: A summary of the CT findings in horse related major trauma**

Peter Abernethy

*Peninsula Radiology Academy, Plymouth*

Horseback riding is considered more dangerous than motorcycle riding, skiing, automobile racing, football and rugby<1>. This is a retrospective look at the injury types and patterns of horse related trauma at the regional trauma center with a large rural population. We regularly encounter major trauma related to horse riding. This poster aims to look at previous cases with a pictorial review of injuries and statistical analysis to help the reader with future trauma reporting, particularly in the case of horse related injury.

The following issues will be addressed; what are the most common injuries and effected systems? Is there a correlation between patient demographics and severity of injury? Are there any tips for review areas from difficult cases? This will be displayed answering the 3 questions above with one column for each question with patient images to illustrate.

*<1>Jill E Ball, Chad G Ball, Robert H Mulloy, Indraneel Datta and Andrew W Kirkpatrick; Ten years of major equestrian injury: are we addressing functional outcomes? Journal of Trauma Management & Outcomes 20093:2*

## HEAD, NECK AND NEURORADIOLOGY

p083 **Percutaneous CT-guided biopsy of the spine**

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*Salford Royal NHS Foundation Trust*

**Background**: Our aim was to determine the success rate of percutaneous spinal biopsies for infection and neoplasia in comparison to national data and regional guidelines.

**Methods**: The 1st audit was between January 2010-February 2012, the 2nd audit November 2014-November 2016. Local radiology information systems were used to obtain data on all patients undergoing a percutaneous biopsy noting the site, indication, histology and microbiology.

**Results**: 1st Audit: 82 biopsies with 37 for infection and 45 for neoplasia. In 17% of cases bacteria were isolated with tuberculosis being most common. 56% had a definite neoplasia and 44% had no neoplasia/indeterminate biopsy. 2nd Audit: 91 biopsies with 19 for infection, 68 for neoplasia and 4 for infection or neoplasia. In 36% of cases bacteria were grown, with staphylococcus aureus being most common. 60% had a definite neoplasia, 33% had no neoplasia, 7% had indeterminate biopsy. In each audit, 3 cases with initial negative biopsy showed a neoplasia on subsequent sampling.

**Conclusion**: Following the low yield results for infection from previous auditing, a change was made to the protocol. A higher proportion were performed for atypical imaging features or failure to respond to antibiotics, which may account for the reduced number and yield when comparing to national standards. Increased biopsies of neoplastic lesions may reflect trends for more aggressive management of metastatic disease and need for histology. Although we have a high rate of diagnostic sampling, it is lower than the national findings and may suggest a lower regional threshold for sampling indeterminate lesions.

p084 **CBCT for temporal bones: The new gold standard**

Amanda Smith; Maria Cavadas; Veronique Sauret-Jackson

*Cavendish Imaging, London*

Cone Beam CT (CBCT) is fast proving its capability for temporal bone exploration, therefore in order to understand the diagnostic potential of CBCT for temporal bones, a retrospective radiology report investigation was conducted and case studies chosen to display a number of ear pathologies/variants.

**Referring criteria:** anatomical variants, dysplasia, chronic otitis, deformity, trauma, pre and post-cochlear implantation.

**Imaging:** JMorita Accuitomo F170 and NewTom 5G

**Radiation dose:** Typically between 150 microSv & 250 microSv (approx. 20-40% of conventional CT)

**Findings:** The case review clearly indicates semi-circular dehiscence. CBCT's low sensitivity to metallic artefacts makes it the technique of choice in the follow up of cochlear implants if location of electrodes in question and similarly for post-tymanopasty surgery. The Newtom 5G 15x5cm FOV is proving to be diagnostically advanced when imaging temporal bones with high depiction and differentiation of the inner and middle ear complexes as well as identifying bilateral otitis media. The 80-micron high resolution CBCT slices allow visualisation of very early anatomical changes such as minor soft tissue lining of the epitympanic membrane, minor thickening and faint calcification. Alongside CBCT's high specificity, the significantly lower radiation doses delivered using CBCT in relation to CT complement guidance for best clinical practice.

*1. Liktor, B. (2014) Diagnostic value of cone-beam CT in histologically confirmed otosclerosis. Eur Arch Otorhinolaryngol. 271(8):2131-8. 2. Pein, M.K. (2014) Visualization of subtle temporal bone structures. Comparison of cone beam CT and MDCT. Radiologe. 54(3):271-8. 3. Sauret-Jackson, V. (2011) Cone-beam computed tomography imaging of the middle ear: Refining scanning and visualisation protocols. UKRC*

p085 **Are ultrasound detected thyroid nodules graded and investigated in accordance to the British Thyroid Association guidelines?**

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[1]*North West School of Radiology;* [2]*Pennine Acute NHS Trust;* [3]*Macclesfield District General Hospital*

**Introduction**: The prevalence of thyroid nodules is common, varying between 30-70% in the general population with an increasing incidence of thyroid malignancy. 1. However mortality remains stable with clinicians becoming increasingly reliant on ultrasound grading within their MDT approach. 2. There is much dependence on the morphological features of ultrasound imaging with poor correlation between nodular size and malignancy risk .3-6.

The aim of this quality improvement project was to evaluate whether ultrasound detected thyroid nodules were assigned a grade in accordance with the British Thyroid Association (BTA) 2014 Ultrasound (U) classification(U1-U5) and whether US guided fine needle aspirations (FNAC) were performed for nodules assigned a grade U3-U5.

**Methods**: We retrospectively identified 87 patients between January-April 2016. Radiology reports, imaging and laboratory results were analysed for ultrasound grading (U1-5) of thyroid nodules, and cytology specimen outcomes.

**Results**: Out of 87 patients, 30 patients had thyroid nodules detected with 50% assigned a grade varying from U1-U3. For nodules which had FNAC performed, 67% were ungraded, 25% were U2 and 8% were U3. There was a 50% inadequacy rate for cytology specimens.

**Discussion**: Following local presentation of the results, it was stressed there was a need for improvement with ultrasound grading standards. In particular, operators felt the BTA guidance was ambiguous with regard to multinodular goitres which accounted for 70% of the thyroid nodules in this population. There was also difficulty with accessing and understanding the ultrasound chart. After education and further distribution of the guidelines, we aim to re-evaluate practice.

*1. Davies, L. & Welch, H.G. (2006) Increasing incidence of thyroid cancer in the United States, 1973â€" 2002. JAMA, 295, 2164â€"2167. 2. Frates, M.C., Benson, C.B. & Charbonneau, J.W. (2005) Management of thyroid nodules detected at US: society of radiologist in ultrasound consensus statement. Radiology, 237, 794â€" 80 of print]. 3. Kamran SC, Marqusee E, Kim MI, et al. Thyroid nodule size and prediction of cancer.J Clin Endocrinol Metab 2013;98:564-570. 4. Moon W-J et al. Benign and Malignant Thyroid Nodules: US Differentiation, a multi-center retrospective study. Radiology 2008; 247(3): 762 â€" 770. 5. Shrestha M, Crothers BA, Burch HB. The impact of thyroid nodule size on the risk of malignancy and accuracy of fine-needle aspiration: a 10-year study from a single institution. Thyroid 2012;22:1251-1256 6. Smith-Bindman R, Lebda P, et al. Risk of Thyroid Cancer Based on Thyroid Ultrasound Imaging Characteristics: Results of a Population-Based Study. JAMA Intern Med. 2013 Aug 26. doi: 10.1001/jamainternmed.2013.9245. [Epub ahead of print]. 7. Wharry LI, McCoy KL, Stang MT, et al. Thyroid Nodules (≥4 cm): Can Ultrasound and Cytology Reliably Exclude Cancer? World J Surg 2013 Oct [Epub ahead of print].*

p088 **Pathology of the external auditory canal - what every radiologist should know**

Fiona Lyall; Jonathan Stokes; Benjamin Rock

*Royal Cornwall Hospital*

**Background**: The external auditory canal is regularly imaged as part of a CT of the head. Common pathologies of this area are often benign, such as uncomplicated otitis externa, and do not require imaging. However, less common pathologies such as necrotising otitis externa and squamous cell carcinoma of the external auditory canal may cause significant morbidity and even mortality. The general radiologist should include the EAC as an important review area on CT head and have an appreciation of the common and serious pathologies.

**Purpose:** We present a pictorial review of pathologies of the external auditory canal, emphasising the key findings that should be recognised by the general radiologist. As the EAC is frequently covered by a CT head, this is pertinent to any general or on-call radiologist.

**Summary:** The poster will describe the normal anatomy of the external auditory canal. Congenital abnormalities, infections, neoplasms and other acquired conditions, such as exostoses and cholesteatoma will be presented, together with salient imaging findings and key distinguishing features, as well as important negatives.

p089 **Central nervous system tuberculosis: A pictorial review of radiological findings**

Ahmed Ali; Muhammad Khan; Raheel Nazir; Shahid Hussain

*Birmingham Heartlands Hospital*

Causing an estimated 1.4 million deaths in 2015, Tuberculosis (TB) is the deadliest infectious disease in the world[1]. With the potential to affect virtually any organ, TB can present in a variety of radiological fashions. Central nervous system (CNS) involvement is perhaps its most devastating form, carrying with it formidable complications[2]. These include cranial nerve neuropathies, TB meningitis, cerebral infarction and abscess formation[3,4]. Radiological signs may mimic other pathologies such as lymphoma and metastasis, thereby adding to the diagnostic confusion. Early recognition of imaging signs is thus a critical step in improving patient care. Tuberculous meningitis is the most common manifestation of CNS TB[5]. Clinical findings include headache and fever as well as signs of meningeal irritation such as photophobia and neck stiffness. Post contrast magnetic resonance (MR) being the imaging modality of choice, leptomeningeal enhancement and exudates in the Fossa interpeduncularis may be seen[3,6,7]. A common complication is communicating hydrocephalus which develops secondary to cerebrospinal fluid (CSF) disruption in the basal cisterns[8,9]. The most common brain parenchymal lesion in CNS TB is a tuberculoma[9] which is usually seen as a ring-like lesion with minimal surrounding oedema. This may present as solitary or multiple lesions[10,11]. Depending on the histological composition, a target sign may be visualised on contrast enhanced computed tomography (CT). This is composed of an outer ring enhancement with a central focus of calcification and is diagnostic[12]. The aim of this poster is to pictorially review the common radiological findings of CNS TB.

*1. World Health Organisation (2016) Global Tuberculosis report. Available at: http://apps.who.int/iris/bitstream/10665/250441/1/9789241565394-eng.pdf?ua=1 (Accessed 28/11/2016) 2. Uysal G, Köse G, Güven A, Diren B (2001) Magnetic resonance imaging in diagnosis of childhood central nervous system tuberculosis. Infection 29:148–153. 3. G. Bathla, G. Khandelwal, V. G. Maller, and A. Gupta (2011) Manifestations of cerebral tuberculosis. Singapore Medical Journal vol. 52, no. 2, pp. 124–131. 4. V. V. Ahluwalia, G. Dayananda Sagar, T. P. Singh, N. Arora, S. Narayan, and M. M. Singh (2013) MRI spectrum of CNS tuberculosis. Journal, Indian Academy of Clinical Medicine vol. 14, no. 2, pp. 83–90. 5. Morgado C, Ruivo N. (2005) Imaging meningo-encephalic tuberculosis.. Eur J Radiol 55:188–192. 6. S. Andronikou, B. Smith, M. Hatherhill, H. Douis, and J. Wilmshurst (2004) Definitive neuroradiological diagnostic features of tuberculous meningitis in children. Paediatric Radiology vol. 34, no. 11, pp. 876–885. 7. G. Uysal, G. Kose, A. Guven, and B. Diren (2001) Magnetic resonance imaging in diagnosis of childhood central nervous system tuberculosis. Infection vol. 29, no. 3, pp. 148–153. 8. R. B. Rock, M. Olin, C. A. Baker, T. W. Molitor, and P. K. Peterson, "Central nervous system tuberculosis: pathogenesis and clinical aspects," Clinical Microbiology Reviews, vol. 21, no. 2, pp. 243–261, 2008. 9. Bernaerts A, Vanhoenacker FM, Parizel PM, et al. Tuberculosis of the central nervous system: Overview of neuroradiological findings. Eur Radiol. 2003;13:1876-1890. 10. Carcia-Monco JC (1999) Central nervous system tuberculosis. Neurol Clin 17:737–759. 11. Palmer PES (2002) Tuberculosis of the central nervous system. In: The imaging of tuberculosis. Springer, Berlin Heidelberg New York, pp 125–133. 12. M. L. H. Whiteman, "Neuroimaging of central nervous system tuberculosis in HIV-infected patients," Neuroimaging Clinics of North America, vol. 7, no. 2, pp. 199–214, 1997.*

p090 **Imaging the facial nerve**

Jonathan Stokes [1]; Fiona Lyall [1]; Benjamin Rock[2]

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**Background** The facial nerve is comprised of motor, sensory and parasympathetic neurones. Its predominant function is to supply motor innervation to the muscles of facial expression and other muscles derived from the second branchial arch. The facial nerve nuclei are located in the pontine tegmentum. From here their fibres exit the brainstem, traverse the cerebellopontine cistern, and pass into the internal auditory meatus, entering the petrous temporal bone via the fallopian canal. Within the temporal bone, the parasympathetic, motor and sensory fibres divide at the geniculate ganglion. The motor fibres for

the muscles of facial expression emerge via the stylomastoid foramen, passing through the parotid gland, dividing into 5 terminal branches.

The variety of tissues by which the facial nerve is surrounded and through which it passes, means not only that it can be affected by a host of pathologies, but also that no single imaging modality is best suited to visualise the facial nerve in its entirety.

**Content** We review the course of the facial nerve and pathologies which commonly affect it. We aim to refresh the reader's knowledge of the circumstances in which each modality is best implemented for accurate diagnosis and treatment.

**Summary:** The poster will contain a pictorial review of the anatomy of the facial nerve, with select cases to illustrate the pathologies which commonly affect its different subsites, and the modalities with which these are best seen.

p092 **CT-head scanning for traumatic head injury: Auditing for NICE-guideline compliance and investigating its diagnostic value for intracranial haemorrhage**

Anand Pandit; Hong Gao; Ghali Salahia

*King's College Hospital NHS Foundation Trust*

**Background**: Head injury is the commonest cause of death and disability in individuals between 1-40 years in the UK. Prognosis could be improved with early detection of intracranial haemorrhage, which would promptly facilitate appropriate management. NICE guidelines (QS74) recommend that adult head injuries should have a CT-head performed within 1 or 8-hours depending on identified risk factors, and that a provisional report should be made available within 1-hour of the scan being performed. These criteria formed the standard for our report, namely that 100% of patients who fulfil these criteria should have a scan and report within above time frames.

**Methods**: We performed a retrospective study of all CT-head scans (n=185) following trauma at a district general hospital in a one-month period. We interrogated 'breach' scans as to the cause of delay and also examined the diagnostic yield of CT-head scans for intracranial haemorrhages.

**Results**: 5% of CT-head requests did not meet time-limit standards. Following discussion in radiology and emergency medicine multi-disciplinary meetings, inadequate request information and logistical difficulties were cited as putative causes. 7% of CT-head scans were found to be positive for intracranial haemorrhage.

**Conclusion**: Our results demonstrate that the majority of scans were performed and reported within expected time frames, but there remains capacity for improvement. Suggested changes include: improved requesting information and elimination of redundant steps between scan-request and patient transfer to scanner. Further research is warranted to improve the diagnostic yield of CT-head scans for intracranial haemorrhage, however our results are comparable to other centres.

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p093 **3T MR Neurography of the brachial plexus: Combining 3D and multi-segmented diffusion weighted imaging**

Amanda Kah Mei Pua; Tee Meng Tan; Ling Ling Chan

*Singapore General Hospital*

**Background:** Brachial plexus injuries are most effectively evaluated by MRI. Fat suppressed T2- weighted, inversion recovery sequences usually demonstrate brachial plexus disease whilst the T1- weighted images are used to delineate the anatomy. However, conventional techniques are limitated by their inability to produce 3-dimensional (3D) images and similarity of signal of the brachial plexus to adjacent background tissues and veins.

**Purpose:** To illustrate our experience with transition to MR Neurography (MRN), which combines 3D and multi-segmented diffusion-weighted imaging (DWI), and benefits of MRN through case examples.

**Content:** Multi-segmented DWI when used concurrently with maximum intensity projection (MIP) and post-processing techniques increases the contrast of brachial plexus compared to the surrounding tissues markedly.

Additionally, 3D isometric sequences scanned in the main plane allow visualisation of the long axis and short axis of the brachial plexus. Due to its curvature, the brachial plexus is often not well demonstrated and difficult to trace in a single plane on conventional sequences. Reconstruction can be done to optimally view the plexus in 3D, and allowing the nerves to be traced easily.

Retrospective review of all brachial plexus MR imaging in which MRN was performed from January 2015.

**Discussion** Although MRN has both advantages and disadvantages, the advantages outweigh the disadvantages as shown through the case examples. Nevertheless, new protocols should be introduced gradually to streamline processes and learning

curves for both technologists and radiologists while the process is still being set up. The cases collected thus far validates the advantages of MRN vis-à-vis conventional protocol.

p094 **Good gas, bad gas: A pictorial overview of intracranial gas, its causes, distribution and prognosis**

Thomas Davies; Harriet Bowles; Mufudzi Maviki; Jo Fowler

*Plymouth Hospitals NHS Trust*

**Background** Pneumocephalus is defined as the presence of air or gas in the cranial cavity. There are a number of causes including trauma, surgical intervention, intracranial infection and invasive neoplasms. In the context of trauma pneumocephalus occurs in 0.5-1% of cases, and the average reporter of emergency CT will see up to 2-3 cases per year.[1] Whilst pneumocephalus overall is rare, it may have significant implications for clinical management of patients. Furthermore, it is important to recognise incidental, benign causes of intracranial air as these patients, if correctly identified, will not require unnecessary clinical follow up or further imaging studies.

**Purpose** This poster outlines the common causes of pneumocephalus and describes the underlying pathology. Cases displaying different anatomical distributions of gas will be individually discussed and the use of this as a prognostic indicator will be explored. This poster will also highlight the importance of windowing in the detection of pneumocephalus during routine reporting. The poster is aimed at those who routinely report CT imaging of the head, whether as a trainee, general radiologist or those with a neuroradiology specialty interest. Cases explored include: Trauma, infection, iatrogenic and benign venous gas.

**Conclusion** This poster explores the different appearances and causes of pneumocephalus, and the techniques for evaluation. Several cases will be used to demonstrate the different underlying pathologies and the relationship between distribution of air and prognosis.

*1. Leong, K.M. (2008) Pneumocephalus: an uncommon finding in trauma. Med. J. Malaysia.* ***63****(3), 256-258.*

p095 **Is it isn't? The role of CT perfusion (PCT) in monitoring possible pseudoprogession of glioblastoma multiformes (GBM) - a pilot study**

Thomas Kelly; Kumar Das; Mark Radon

*Walton Centre Liverpool*

**Content**: Recent advances in treatment regions have led to the emergence of the phenomena of pseudo progression (PSP). This can have important clinical imperative on the treatment management of this group of patients. This problem is particularly with present follow-up imaging. Previous studies have suggested that PCT may have a role in differentiating between PSP and recurrence or true progression.

**Aims**: To examine the suitability of perfusion CT in monitoring changes in cerebral blood volume following treatment for Glioblastoma.

**Methods**: 10 patients with previously treated GBM who showed possible recurrent or progressive enhancing lesions on their follow-up MR imaging underwent both MR and CT perfusion imaging examinations. Perfusion maps of cerebral blood volume, cerebral blood flow and mean transit time were generated using vendor workstation software.

**Results**: After processing the perfusion data obtain for both the MR and CT scans patients. Parametric maps of CBV, CBF and MTT. The initial results were suggestive that the study's null hypothesis that CT perfusion is no better than MR perfusion could be rejected. The full study data is at present undergoing further statistical analysis.

**Conclusion**: The results of the study have suggested that PCT may be equal to, if not possibly superior to MR perfusion imaging as to whether new contrast enhance seen on post treatment follow-up imaging is actually PSP and not true progression.

p096 **Gradient echo T2 for MRI brain should be a routine sequence to avoid misdiagnosis - a district hospital experience**

Garryck Tan; Rakhee Vaja; Juan Pena

*Darent Valley Hospital, Dartford*

Gradient echo T2( GRE-T2) is an advanced sequence not used routinely in all hospitals. New guidelines recommend gradient echo T2 as part of stroke specific sequences, however we believe it should be used for all neururadiology cases and we present a pictorial review of how this sequence has helped reach the correct diagnosis, and will include cases of misdiagnosis before the sequence was used.

The following topics with examples will be discussed:

1a) Diagnose focal subarachnoid bleed presenting with focal neurology and no headache.

1b) Helping to differentiate causes of high signal within the subarachnoid spaces- causes include meningitis, carcinomatosis, subarachnoid bleed and local vascular ischaemia.
2) As part of the workup of intracranial parenchymal bleed- GRE-T2 can identify sites of previous bleeds not seen on CT or conventional MRI sequences, identify cavernomas and microbleeds. This will help in diagnosing the aetiology of parenchymal bleed.
3) Increase the sensitivity of venous thrombosis by picking up cortical vein thrombosis not readily seen on MRV or standard sequences.
4) Diagnosing capillary telengieactasia which is a "do not touch" lesion, which can be initially misdiagnosed as a tumour.
5) Stratify bleeding risk in stroke patients and evidence of associated bleeding.
6) In cerebral oedema of unknown cause it can point to inflammatory cerebral amyloid angiopathy which is an uncommon cause of cerebral oedema.
7) Common artefacts that the reporter will need to be aware of. There will also be a brief account of the physics of gradient echo T2 .

p097 **Role of Computed Tomography Angiography (CTA) in acute stroke cases: Relevance to patient management**

Zena Arumugam; Santhosh Raj Seela Raj; Sohil Equbal Pothiawala

*Singapore General Hospital*

**Background**: Ischemic stroke is characterized by the sudden block of blood circulation to an area of the brain, resulting in a corresponding loss of neurological function. Limited time is available to obtain information for careful treatment, because of the relatively rapid onset of irreversible neuronal damage. Computed Tomography Angiography (CTA) is a fast and reliable method to detect the potential cause of the stroke event. This study aims to show how CTA can help decide subsequent patient's management.

**Methodology**: A retrospective study was carried out from September 1, 2015 to September 30, 2016 comprising of 132 patients with a high suspicion for stroke. Data collection was divided into two parts: namely, imaging whereby CTA reports were reviewed and characterized based on the site and extent of vessel occlusion; and patient management, basically the type of treatment carried out e.g. thrombolysis, thrombectomy no-treatment, etc.

**Results**: A total of 132 ischemic stroke patients were included in the study. Large vessel occlusions were detected in 37% of studies, 6% showed stroke mimics (including arteriovenous fistula, meningioma, and Moya-Moya disease) and the remaining 57% showed no significant findings. Large vessel occlusions occurred in the following sites which included the internal carotid artery, M1, M2, basilar and vertebral arteries. Of the patients with LVO, 17% underwent both thrombectomy and thrombolytic therapy, while 69% of patients received only thrombolytic therapy, and the remaining 14% were untreated.

**Conclusion**: CTA is able to detect large vessel occlusions in acute ischemic stroke and subsequently help to decide patient management.

p098 **Can the extent of the ischemic stroke penumbra be predicted by NIHSS and ASPECT scores?**

Manal Alnaas [1]; Shona Matthew [1]; Alexander Doney [1]; Avinash Kanodia [2]; Graeme Houston[1]

[1]*University of Dundee;* [2]*NHS Tayside*

**Background**: The identification of potentially salvageable brain "PNEUMBRA " using imaging may help in this selection process of patients suitable for thrombolytic therapy. A CT scan is the first line of imaging in acute stroke due to its sensitivity in excluding or confirming intracranial haemorrhage, however the detection of cerebral infarction on CT can be depicted in only a portion of patients and the penumbra is not visible. The aim is to find a simple readily available and non-expensive method that may help identify patients with penumbra. NIHSS is clinical tool used to quantify the neurological impairment. It is composed of 11 items, scored between a 0 and 4. ASPECT score is topographic scoring system used quantify the ischemic changes on CT scan. The brain is divided into 10 areas, each scored 1 for normal tissue, 0 for ischemic change.

**Method**: Retrospective study of 83 patients diagnosed with acute ischemic stroke. NIHSS and ASPECT scores were obtained after admission. Scores were compared to find an association or 'match' for each item of NIHSS and each ASPECT area of the brain.

**Results**: There are Strong correlation between some items of NIHSS and some areas of ASPECT Visual field "NIHSS" match M3,M5 with match P vaule =0.02, 0.01 Best motor RT/LT side weakness"NIHSS" match caudate, lentiform nucleus with P value =0.01,0.03 Best language"NIHSS"match M1,insula with match P value=0.05, 0.005

**Conclusion**: Early results show that a match between NIHSS and ASPECT scores may be used as an indicator for clinical penumbra.

p099 **Incidental findings on CT intracranial and cervical angiography in the context of acute stroke**

Harriet Bowles; Thomas Davies; Mufudzi Maviki

*Plymouth Hospitals NHS Trust*

**Background** For patients presenting with acute stroke, most centres perform a non-contrast CT brain in order to confirm the diagnosis of stroke and exclude contraindications to intravenous thrombolysis such as haemorrhage and tumours. In Hyper-acute Stroke Units (HASU), a CT angiogram of the head and neck vessels is added to identify intracranial vascular occlusion, quantify carotid stenosis and provide a roadmap for mechanical thrombectomy. The study is performed from the vertex to the aortic arch and covers a wide range of extracranial and extravascular anatomy including the cervical spine, lung apices and neck soft tissues.

**Purpose** This poster presents a brief outline of a standardised reporting strategy, including windowing techniques, assessment of the circulation of the head and neck and stating key review areas where pathologies can be missed. This will aid reports to be completed in a clear, logical structure, ensuring that all aspects of the study are comprehensively evaluated. The poster will then detail incidental extra-vascular and extra-cerebral findings which can be present on CT Angiogram of the head and neck vessels and their clinical significance. These include pulmonary emboli, vocal cord palsy, piriform fossa tumour and Paget's disease.

**Summary** This poster outlines a structured technique for reporting CT Angiogram of the head and neck circulation in stroke patients. Key examples of incidental extra-vascular and extra-cerebral findings are also detailed to aid the reporter detect concurrent pathologies in "review areas" which may be missed.

p100 **Southend imaging study**

Paula Harman [1]; Christine Law [2]; Farhad Huwez [3]; Sweni Shah [1]; Aarti Sharma [1]; Annalu KvºhnÊ [4]; Richard Aspinall [5]; Iris Grunwald[1]

[1]*Anglia Ruskin University and Southend University Hospital NHS Foundation Trust;* [2]*Stanford University;* [3]*Southend University Hospital NHS Foundation Trust;* [4]*University of Massachusetts Medical School, USA;* [5]*Anglia Ruskin University*

**Purpose**: Resting state fMRI (RS-fMRI) is a potential biomarker to aid in the diagnosis of different types of dementia; however scans would usually be performed in a dedicated research 3T scanner. The aim of this study is to evaluate if RS-fMRI can be used in routine practice on a 1.5T scanner to differentiate various types of dementia in selected cases.

**Method**: This is part of a prospective study on up to 300 patients. Patients with known Alzheimer's disease, Parkinson's disease dementia or vascular dementia undergo RS-FMRI in addition to conventional MRI and, separately, a battery of neuropsychological assessments. Functional connectivity in the Default Mode Network is evaluated and then correlated to the different types of dementia.

**Results**: We were able to show a correlation between individual measures of functional connectivity and global and episodic cognitive performance as measured by the neuropsychological tests.

**Conclusion**: Despite a current number of limited participants we were able to show that use of RS-fMRI on a 1.5T scanner is feasible in a routine clinical setting, outside of a dedicated research scanner. Differences in functional connectivity patterns can be used to differentiate between different neurodegenerative diseases in a routine clinical setting. Our findings could encourage other clinical sites to incorporate RS-fMRI for routine clinical diagnosis of various dementia types and may allow enhanced detection of dementia at various stages.

p101 **The diagnostic value of FDG and amyloid PET in Alzheimer's disease**

Louise Rice; Sotirios Bisdaz

*University College London*

**Background**: By 2050 it is projected that 115 million people worldwide will have Alzheimer's disease (AD) (WHO, 2012). The shift towards viewing AD as a clinico-biological continuum and our increasing knowledge regarding its aetiology has led to advances in the use of neuroimaging in the diagnostic workup of AD. This review aimed to investigate the current diagnostic use of amyloid PET and FDG PET in AD to detect amyloid plaque and neurodegeneration, respectively. Searches were performed using pubmed, EMBASE and the Cochrane library. The search and subsequent refinement process yielded 33 papers on FDG-PET, 29 papers on amyloid PET and 13 papers examining both techniques.

**Purpose**:

- Discuss the diagnostic accuracy of amyloid and FDG-PET compared to the gold standard (histopathology)
- Role of amyloid and FDG-PET in identifying which patients with mild cognitive impairment were likely to convert to AD
- Application of both modalities in distinguishing AD from other dementias

- The clinical application of FDG and amyloid-PET, with regards to safety, radiological reporting and economics

**Conclusion**: FDG and amyloid PET both identify AD with high specificity and sensitivity. To date their use has been mainly restricted to research and AD drug trials. They are of definite benefit in the hands of a specialist dementia expert who wishes to confirm/outrule AD in a case of diagnostic uncertainty, however our limited knowledge and therapeutic options to treat AD restricts their use in everyday clinical settings.

## BREAST

### p102 UK National Breast Screening Programme: Is there a demand for out of hours appointments?

Rupali Gleeson; Paula Evans

*Warrington and Halton Hospitals NHS Foundation Trust*

The UK National Breast Screening Programme has attempted to attract as many women as possible since its inception in the late 1980s in the UK following the Forrest report. Age extension was brought in nationwide during the past few years. However in recent times, the uptake has been generally lower, particularly in the initial round of screening. In addition, there has been a strong government drive to offering services 24 hours a day 7 days a week where possible. Traditionally breast screening was offered during office hours only, Monday to Friday. An audit was originally carried out in 2009 to determine whether out of hours appointments would attract women, and how this varied across age demographics. This audit was extended and updated earlier this year. This poster will demonstrate whether there is indeed a demand for out of hours appointments, how this varies across age and location demographics, and how this could work in reality.

### p103 The outcome of a departmental audit into digital mammography blurring.

Beverley Moran

*Dudley Group NHS Foundation Trust*

**Background** The screening service noted an increase in the number of technical issues associated with blurring. A review of related articles discussed the effects of compression paddle movement as a cause(1 and 2). With limited resources and academic support, the department attempted a more basic practical attempt to address the issue of blurring in our mammographic images.

**Method** An audit was undertaken where all patients were asked to hold their breath during their mammographic examination over a period of 6 months. Any exceptions were documented with a given reason. During film reporting, all images with blurring were documented.

**Results** 192 examinations contained a significant amount of blurring for audit purposes. 25% of these were recalled for Technical Recall examinations. A comparative analysis of the compression factors was undertaken for blurred images versus non blurred images per patient. The results demonstrated a 57% drop in compression factors for the blurred images compared to the non blurred side. In over 47% of the images, this was a difference of over 10 Newtons.

**Conclusion** The results demonstrated that this was significant in 3 members of Mammography staff. The audit was discussed at Team meetings and discussed as a learning exercise with the 3 individual staff to improve overall image quality, standardise compression factors, reduce Technical Recalls and improve the service user experience.

*1.Hogg, P Kei Ma, W Kelly, J Millington, S (2015) A method to investigate image blurring due to mammography machine compression paddle movement Radiography 21 36-41. 2. Brittle, D Howard,D Kelly, J Kei Ma, P (2014) Extra patient movement during mammographic imaging: an experimental study. British Journal of Radiology*

### p104 What is the impact of delayed double reading of symptomatic mammograms?

Anne-Marie Culpan [1]; Nicola Dobrowolski [2]

[1]*University of Leeds;* [2]*Mid-Yorkshire Hospitals NHS Trust*

**Aim** To examine the consequences of double reporting symptomatic mammograms at one large District General Hospital in the North of England.

**Method** In a retrospective observational study, data from patients attending the one-stop diagnostic breast clinic from January - December 2012 were reviewed. The number of discrepant reads, number of additional cancers detected and volume of work generated by double reading were determined and an estimate of the economic cost of second reading made. The number of cancers not detected at initial presentation was determined during a 3 year follow-up period (December 2012 -- 2015). Results 1790 patient cases were reviewed. 231 malignancies (prevalence 1.3%) were reported by the first reading radiologist. Out of

1761 (98.4%) cases which were second read, 4 (0.2%) were discrepant. After consensus discussion three cases were recalled for additional mammography (n=2), ultrasound (n=2) and tissue sampling (n=1); no additional malignancies were detected. The economic cost of delayed second reading was estimated at over £6500 and the additional time requirement estimated at approximately 300 hours. Delayed second reading failed to identify 8 cancers that presented during three year follow-up.

**Conclusion** Despite the perception that the rapid access breast clinic is a 'uniquely chaotic environment' which might make it 'difficult for single reading radiologists to detect every small, subtle, unexpected and incidental cancer', at this site, cold second reading of symptomatic mammograms did not increase cancer detection and required additional human, time & financial resource which might be better spent reading asymptomatic (family history / annual surveillance)

p105 **The impact of image blurring on lesion detection performance in full field digital mammography (FFDM)**

Ahmed Abdullah [1]; John Thompson [2]; Claire Mercer [2]; Rob Aspin [2]; Judith Kelly [3]; Peter Hogg [2]

[1]University of Diyala, Iraq; [2]University of Salford; [3]Countess of Chester Hospital NHS Foundation Trust

**Purpose**: Image blurring is a known phenomenon in FFDM, but no research has quantified its impact on lesion detection performance. This study investigates the detection of malignant masses and microcalcifications using FFDM with varying magnitudes of simulated blurring.

**Method**: Seven observers (15±5 years' reporting experience) evaluated two image sets for three conditions; each set consisted of 124 cases (62 normal; 62 abnormal). Abnormal cases contained malignant masses and microcalcifications; these were confirmed as malignant by biopsy. Images were evaluated for 3 conditions - without blurring (0mm), and two magnitudes of simulated blurring (0.7mm & 1.5mm), introduced by mathematical simulation. A free-response observer study was conducted to compare lesion detection performance in blurred and non-blurred images. Equally weighted jackknife alternative free-response receiver operating characteristic (wJAFROC) analysis was used for statistical analysis. Test alpha was set at 0.05 to control probability of Type I error.

**Results**: A statistically significant difference was evident for the detection of masses ($F(2,22) = 6.01$, $P=0.0084$) and microcalcifications ($F(2,49) = 23.14$, $P<0.0001$). Statistical differences were found between multiple pairs for masses (0.0mm v 0.7mm, and 0.0mm v 1.5mm) and microcalcifications. No difference was detected between 0.7 mm and 1.5 mm for masses. The observer averaged wJAFROC figures of merit are 0.905(0.859, 0.952) [0 mm], 0.869(0.814,0.924) [0.7 mm] and 0.862(0.810,0.915) [1.5 mm] for masses, and, 0.899(0.859,0.939) [0 mm], 0.813 (0.757,0.870) [0.7 mm] and 0.745(0.679,0.812) [1.5 mm] for microcalcifications.

**Conclusion**: A mathematical simulation of image blurring caused a statistically significant reduction in lesion detection performance; this could have implications

p106 **Hot legs: Bone scan lower limb metastases in breast cancer**

Leon Sergot; Nicholas Ridley

*Great Western Hospital, Swindon*

**Background** Our staging for breast cancer currently includes CT Chest/Abdomen/Pelvis and a whole body bone scan. Some centres only use CT. We were interested to review bone scan abnormalities in the femora and below as these sites are not normally covered on a standard staging CT scan. Lesions in the femur can be at risk of pathological fracture.

**Method** 188 consecutive whole body bone scans were reviewed retrospectively from November 2015 -- November 2016.

**Results** 188 patients.
133 were normal (no metastases).
30 had skeletal metastases but no lower limb metastases.
25 had lower limb metastases, 14 of which were seen on standard staging CT. 11 were not seen on staging CT as it only extends as far as the proximal femur.
Of the lower limb metastases: 22 were Femoral, 1 Knee, 1 Tibial, and 1 in the soft tissues of the thighs.
1 had a distal femoral metastasis (not seen on standard staging CT) but none elsewhere.
Excluding osteoarthritis there were 7 incidental abnormalities seen. These included 5 hot spots associated with knee and hip replacements, 1 case of shin splints, and 1 case of bilateral femoral head osteonecrosis.

**Conclusion** A significant number of breast cancer patients have lower limb metastases (13.3% in this study). These are not always covered on a standard staging CT alone. In this study, 11/25 (44%) of lower limb metastases were not covered, one of whom did not have any other skeletal metastases. For complete staging, a bone scan or extended CT is required.

p107 **Brachial plexopathy in breast cancer - what the radiologist needs to know**

Charlotte Goss; Edward Green; Shaheel Bhuva

*Oxford University Hospitals NHS Trust*

**Background**: Breast cancer commonly metastasises to supraclavicular and cervical paravertebral regions. In addition, the standard treatment for breast cancer involves radiotherapy to the supraclavicular fossa. The brachial plexus, an intricate and challenging anatomical region to image and interpret, is subsequently vulnerable to damage and dysfunction, either due to the malignant infiltration or as a complication of radiotherapy-induced nerve damage. While brachial plexopathy is a relatively rare occurrence, the radiologist needs to be able to differentiate between these causes. The superior soft tissue contrast and multi-planar imaging offered by magnetic resonance imaging (MRI) enables the accurate assessment and characterisation of abnormalities of the brachial plexus, as well as delineation of the extent and integrity of adjacent structures. Our local MRI brachial plexus protocol includes multiplanar T1, T2, STIR, and post-contrast sequences.

**Purpose**: We offer a pictorial review of the anatomy of the brachial plexus and discuss the clinical presentation of brachial plexopathies. We present cases from our metastatic breast cancer multi-disciplinary team meeting at a large tertiary oncology centre, which illustrate the MRI features of brachial plexopathies from tumour recurrence versus radiation-induced damage secondary to supraclavicular radiotherapy. In addition, we highlight how FDG-PET/CT imaging plays an important adjuvant role in the imaging and assessment of the state of the brachial plexus, supplementing the MRI findings, differentiating the causes of the plexopathy, restaging disease, and monitoring response.

p108 **Evaluating the impact of best practice guideline implementation for women aged 35-39 years attending a diagnostic breast clinic**

Anne-Marie Culpan [1]; Imelda Marshall[2]

[1]*University of Leeds;* [2]*Bradford Teaching Hospitals NHS Foundation Trust*

**Background** Following implementation of new national guidelines (Willet et al., 2010) which removed mammography from the first-line investigations performed in women aged 35 -- 39 years attending diagnostic breast clinics, this retrospective study reviewed the ultrasound findings in 35-39 year old women diagnosed with cancer one large DGH in the North of England. Method A retrospective audit of ultrasound findings and outcomes (histology and / or follow-up) of all women aged 35 -- 39 years who attended the diagnostic breasts clinics at a DGH between 1.1.12 and 31.7.15.

**Results** 1141 women met the study inclusion criteria. 17 breast cancers were detected. Malignancy was suggested on the basis of ultrasound appearances in 23 (false positive) and 14 (true positive) cases. Three further malignant (false negative) cases were classified as normal (n=1) or benign (n=2) at ultrasound. Two of these malignant cases were diagnosed at the time of presentation on the basis of mammography performed in accordance with other guidelines (positive family history and unexplained deep vein thrombosis). One case was diagnosed at representation after an 8 month interval. In this study the sensitivity of target ultrasound scanning was 82.35%, specificity was 97.95% and overall diagnostic accuracy 97.77%.

**Conclusion** Ultrasound examinations targeted to the site of a presenting focal abnormality in women aged 35 -- 39 years will fail to detect a small number of malignancies due to overlap in benign and malignant appearances and due to the low, but finite, prevalence of asymptomatic cancer elsewhere in the breasts in this population.

*WILLETT, A. et al. 2010. Best practice diagnostic guidelines for patients presenting with breast symptoms. DH, London.*

## LUNG AND HEART

p109 **The diagnostic adequacy of lateral chest radiographs: A district general hospital experience**

Veena Vishwanath [1]; Suresh Babu [2]; Julian Soares [3]; Robin Sil[2]

[1]*North West School of Radiology;* [2]*Macclesfield District General Hospital;* [3]*Pennine Acute NHS Trust*

**Background**: The lateral chest radiograph (CXR) is important in detecting lower-lobe pathology and mediastinal masses [1] It allows clear visualization of the mediastinal compartments and spaces[2]. A frontal chest radiograph may only provide visualization of about 80% of the lungs.

The protocol at Macclesfield District General Hospital includes a lateral CXR for any patient presenting with first episode of haemoptysis. In this audit, we evaluate the diagnostic quality of the lateral chest radiographs obtained, comparing results from two subsequent audit cycles.

**Methods**: We retrospectively evaluated outpatient lateral chest radiographs performed over 6 week periods.

**Standards**:

* 100% for clear visualization of the upper third of the lung zones
* 100% for both hemidiaphragms being visible
* 100% for true lateral projection

Following local presentation of the first audit and recommending improvements, we carried out a re-audit after a 6 month interval.

**Results**:

After 2 audit cycles, there was an improvement of :

* 60% of patients having the upper third of lung upper zones visible, previously 17% in the first cycle
* 65% of were a true lateral projection compared to 26% previously
* 95% of radiographs had both hemidiaphragms visible compared to previously 87%,

**Conclusion**: A considerable improvement in all criteria has been seen, particularly regarding the areas of important diagnostic value. Following local presentation of the second audit cycle, it was agreed to continue with recommendations such as providing prompt regular feedback to radiographers, re-calling patients if necessary and further education.

*1. Ahmad,N. (2001). Good positioning is key to PA chest X-ray exams. [Online] Available from: http://www.auntminnie.com/index.aspx?sec=ser&sub=def&pag=dis&ItemID=52189. [Last accessed 17.05.16.] 2. Ballinger and Frank. (1999) Merrill's Atlas of Radiographic Positions and Radiologic Procedures. 9th ed. London: Mosby. 550.*

p110 **The lost art of the lateral chest radiograph? - Relevant indications and pathology**

Huub Wit; Graham Dack; Sophie McGlade; Richard Riordan; Tinu Purayil

*Plymouth University Hospitals NHS Trust*

**Background:** The lateral chest radiograph is an extremely valuable but often underutilised tool for clarifying equivocal abnormalities observed on the frontal chest radiograph. Despite technological advances in computed tomography and plain radiography (such as digital tomosynthesis, dual energy subtraction and bone suppression) the lateral chest radiograph remains a powerful tool for problem solving when used in appropriate situations, and should not be assigned to the annals of radiological history. The rise in alternative imaging for follow-up of abnormalities observed in the frontal chest radiograph has, for some trainees, resulted in lack of familiarity with the lateral chest radiographs and perpetuates the underutilisation and under-recognition of its value.

**Purpose:** This two poster series will reunite the reader with the tools needed to accurately interpret the lateral chest radiograph. This second poster will provide an explanation of the appropriate indications for a lateral radiograph and give a pictorial review of the relevant pathologies which can be demonstrated.

**Content:** The poster will provide the reader with pathological examples to illustrate the utility of the lateral chest radiograph as a relevant tool in the modern radiologist's armamentarium.

p111 **The lost art of the lateral chest radiograph? - Thoracic anatomy and systemic review method**

Sophie McGlade; Graham Dack; Huub Wit; Richard Riordan; Tinu Purayil

*Plymouth University Hospitals NHS Trust*

**Background:** The lateral chest radiograph is an extremely valuable but often underutilised tool for clarifying equivocal abnormalities observed on the frontal chest radiograph. Despite technological advances in computed tomography and plain radiography (such as digital tomosynthesis, dual energy subtraction and bone suppression) the lateral chest radiograph remains a powerful tool for problem solving when used in appropriate situations, and should not be assigned to the annals of radiological history. The rise in alternative imaging for follow-up of abnormalities observed in the frontal chest radiograph has, for some trainees, resulted in lack of familiarity with the lateral chest radiograph and perpetuates the underutilisation and under-recognition of its value.

**Purpose:** This two poster series will reunite the reader with the tools needed to accurately interpret the lateral chest radiograph. This first poster will demonstrate the anatomical structures which may be appreciated on a normal study and provide the reader with a tool for systematic review of the lateral chest radiograph.

**Content:** This poster will contain examples of normal lateral chest radiograph studies and demonstrate a process which the reader can follow to ensure systematic review.

p112 **CATCH protocol: is it effective?**

Elizabeth Barclay; Shelly Lamb; Anna Sharman

*University Hospital of South Manchester*

**Background**: A significant number of GP-requested chest radiographs (CXRs) are acquired to rule out underlying pathology in patients with persistent coughs, often heavy smokers. Plain films provide reassurance when normal, and useful guidance for management when pathology is clearly visible. However, a proportion of CXRs are ambiguous and require further imaging. The CATCH protocol was designed this year to trial the effectiveness of low dose chest CT scans in clarifying equivocal CXRs. The protocol intends to identify early lung cancers and other subtle pathologies, or discern normal variants whilst limiting patients' exposure to radiation; low dose CT scans use a quarter of the dose of radiation of standard CT scans. The CATCH pathway requires GP-requested CXRs to be reported within 24-48 hours and low dose CT scans to be arranged within 3-4 weeks after the CXR is acquired. There is a different pathway within our hospital for the CXRs demonstrating a definite lung cancer.

**Purpose**: To demonstrate the effectiveness of the CATCH protocol using data from the first 6 months of the pathway. Outcomes include; 1. Are we meeting the standards set for CXR reporting time (24- 48hours) and subsequent CT scan appointment scheduling (3-4 weeks)? 2. CT findings of equivocal CXR appearances: Are we picking up early lung cancers? 3. Patient survey

**Results**: What is the impact on patients? Summary of content: Title, Background (incl CATCH protocol), results of pathway, CXR and CT images, Patient survey results. Organisation/display: focus of poster will be on CXR &CT images.

p113 **Gentle reminder: Normal anatomic variants seen in chest X-ray**

Abeeku Hammond

*University Hospital of South Manchester*

The chest radiographs is a common imaging examination and usually the first study in any evaluation of thoracic disease and some abdominal emergencies. Much pathology can be diagnosed by the chest X-ray and similarly its comprehensive anatomy distribution can also lead to misdiagnosis. Most chest evaluation from chest X-rays are mostly standard irrespective of race, however few variations in the anatomy of structures makes it susceptible for wrong diagnosis. A number of anatomic variants in the chest compartment can mimic significant pathology. The subject of this review is gentle reminder of normal variants within the chest identified by chest X-rays. Anatomical variation refers to an anatomic structure that is different from normal but it is mostly non pathological. They do not constitute a disorder and most patients are asymptomatic. Almost every organ in the body has a variation and the onus lies within the clinician or the radiologist to identify it. Anatomical variants are due to defects in developmental stages.

*1. http://www.radiologymasterclass.co.uk/gallery/chest/variants/normal_chest_X-ray*

p114 **Assessment of the adequacy of contrast enhancement in CT pulmonary angiograms: 3 audit cycles at a large teaching hospital**

Sophie Cheshire; Caterina Dalcol; Klaus Irion; Marcio Samuel Samuel Cunha Rodrigues; Eva Filipa De Sousa Dias Padrao; Marie Stokes

*Central Manchester University Hospitals NHS Foundation Trust*

**Background**: Research suggests that a level of 210 Hounsfield Units (HU) is required to differentiate chronic thrombus from enhancing vessel (1) and up to 10.8% of CTPAs may be suboptimal due to all causes, including poor contrast enhancement and motion artefact (2). The RCR has defined the standard for CTPAs as a level of contrast enhancement of the main pulmonary artery (MPA) of >210HU in <11% of all scans. This audit consists of three full audit cycles at a large teaching hospital to evaluate the diagnostic quality of CTPAs.

**Method**: Retrospective audits were completed in 03/2015, 09/2015, 04/2016 and 09/2016. The average HU of the MPA was measured and compared to the standard.

**Results**: A total of 396 CTPAs were analysed. To date, the target has not been met. During the first audit, we measured HU <210 in 15.3%. Recommendations were to incorporate bolus tracking at the SVC. Reaudit demonstrated HU <210 in 24%, so bolus tracking of the MPA was introduced. This protocol is used at our sister site where the target was met with HU <210 in 8%. Second reaudit showed14.9% suboptimal scans. Further recommendations included a saline chaser and third reaudit showed 13.9% CTPAs HU <210. Further changes in protocol have now been implemented to include a bolus test, optimisation of patient positioning and further radiographer training.

**Conclusion**: Despite multiple protocol changes, the standard has not been achieved. Further changes are currently being implemented and reaudit will take place in 3 months time.

*1. Wittram C, Maher MM, Halpern E, Shepard JO. Hounsfield unit values of acute and chronic pulmonary emboli. Radiology 2005: 235; 1050-1054. 2. Adequate contrast enhancement of CT Pulmonary Angiograms. https://www.rcr.ac.uk/audit/adequate-contrast-enhancement-ct-pulmonary-angiograms*

## p115 Can the frequent use of computed tomography pulmonary angiography be justified by finding diagnoses other than pulmonary embolism?

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*Kings College London Foundation Trust*

**Background**: Frequent use of computed tomography pulmonary angiogram (CTPA) is partly due to belief that it gives alternative diagnoses if negative for pulmonary embolism (PE). We determined the yield of CTPA in finding alternative diagnoses for pulmonary embolism (PE) in acute medical admissions.

**Methods**: Retrospective cohort study of consecutive CTPAs for suspected PE over two-months. Presence/absence of PE was recorded. In 'negative' studies, presence of alternative diagnoses was recorded. The preceding chest radiograph was reviewed for presence of alternative diagnosis; if none evident, novel pulmonary pathology on CTPA was present. Case notes were evaluated whether novel CTPA findings accounted for symptoms. Patients with pulmonary nodules were followed-up for 12 months.

**Results**: Of 145 CTPAs, PE present in 20 patients (14%). Of remaining 125 patients, 29 (23%) had an alternative diagnosis, of which 9 (7%) had novel alternative diagnosis. One patient didn't have chest radiograph. Novel diagnoses comprised: septic-emboli; subcentimetre pulmonary nodule (n=5 patients; largest 7mm); reactive hilar lymph node; aortic dilatation; breast mass (later biopsy-proven benign fibroadenoma); bronchopleural fistula; empyema; hydropneumothorax; aortic root dilatation; and minimally-displaced endotracheal tube. Novel CTPA features explaining symptoms seen in n=4 (3%). Four patients with pulmonary nodules had two further chest CTs (14mSv/patient) and one patient had one further chest CT over 12-months. Benign pulmonary nodules in 4 patients; one patient remains under review pending repeat chest CT.

**Conclusions**: CTPA use is not justified by finding alternative pulmonary pathology. Incidental findings of benign nodules lead to further investigation with implications for radiation exposure and cost-effectiveness.

*1. Chandra, S. (2013) Finding al alternative diagnosis does not justify increased use of CT-pulmonary angiography. BMC Pulmonary Medicine. 13(9/12), 1-8. 2. Gosalia, R. (2010) Pulmonary Embolism at CT Angiography: Implications for Appropriateness, Cost, and Radiation Exposure in 2003 Patients. Radiology. 256(8/12), 625-32.*

## p116 A review of the impact of 2015 British Thoracic Society pulmonary nodules guidelines on cases in a virtual follow-up clinic

Sunna Asghar [1]; James Hawthorne [1]; Aanand Vibhakar [2]; Kristopher Swarski [1]; John Murchison[1]

[1]*Royal Infirmary of Edinburgh;* [2]*University Hospitals of Leicester*

**Background** Pulmonary nodules detected on imaging are a marker of potential lung cancer. The British Thoracic Society (BTS) issued new guidelines for investigating pulmonary nodules in 2015, one reason for this was to reduce the number of unnecessary follow-up CT scans (Callister et al. 2015). Our aim was to compare our current practice against the new BTS guidelines.

**Methods** 169 cases in a virtual nodule clinic were retrospectively analysed. Using electronic patient records data was obtained on baseline demographic, nodule characteristics, number of scans performed in follow up, scan interval times, and the resulting malignancies over a 4.5 year period.

**Results** A total of 578 CT scans were performed within this time period, the average number of CTs per patient was 3.45. Using the new BTS guidelines there would have been 77 less CT scans performed within this time period. There were 8 (4.7%) recorded malignancies and all malignant cases would have been identified using the BTS guidelines.

**Conclusion** The number of malignancies identified in our virtual clinic is in line with previous studies (McWilliams et al. 2013). By using the new BTS guidelines no malignancies within our clinic would have been missed, however the guidelines would have allowed less CTs to be performed. This could lead to a reduced radiation risk to patients as well as cost-savings for the department.

*1. Callister, M.E., et al. (2015) BTS guidelines: British Thoracic Society guidelines for the investigation and management of pulmonary nodules: accredited by NICE. British Thoracic Society Pulmonary Nodule Guideline Development Group , on behalf of the British Thoracic Society Standards of Care Committee. Thorax 2015;70:Suppl 2 ii1-ii54 doi:10.1136/thoraxjnl-2015-207168 2. McWilliams, A., et al. (2013) Probability of Cancer in Pulmonary Nodules Detected on First Screening CT. N.Engl.J.Med., 2013, 369, 10, 910-919, Massachusetts Medical Society*

p117 **Does delay in presentation with pulmonary embolus relate to thrombus load and right ventricular dilatation?**

Sunna Asghar [1]; Karim Samji [1]; Aanand Vibhakar [1]; Jh Reid [2]; Ejr Van Beek [3]; John Murchison[1]

[1]*Royal Infirmary of Edinburgh;* [2]*Borders General Hospital;* [3]*University of Edinburgh*

**Background** Pulmonary embolism (PE) is commonly viewed as an acute disease however patients frequently present with a more sub-acute clinical history. Our study aim was to quantify the delay in presentation in a series of patients, and relate that delay to thrombus load at diagnosis with CT pulmonary angiogram (CTPA), and to right ventricular dilation as measured on that CTPA.

**Methods** We retrospectively reviewed the admission notes and CTPAs of 55 patients with PE to calculate the CTPA delay. From the CTPA, the modified Miller Score (MMS) (range 1-16) was used to quantify thrombus load (≥13 constituted massive PE) and the right ventricular/left ventricular (RV/LV) ratio was calculated.

**Results** The average CTPA delay was longer (226.9 hours vs. 70.8 hours) in patients with a larger thrombus load (MMS≥13 vs. MMS12≤). CPTA delay was longer for patients with RV/LV ratio 1≤ vs. RV/LV ratio ≥1 (159.3 hours vs. 90.4 hours) reflecting greater thrombus load in this group. Patients with Massive PE and RV/LV ratio 1≤ had longer delay (420.2 hours) than those with RV/LV ratio ≥1 (138.6 hours).

**Conclusion** Our data confirms there is often a delay in presentation in patients with PE and with increasing delay to CTPA there is an associated increase in thrombus load. Patients with a larger thrombus load but a lower RV/LV ratio tend to have a longer clinical history. We hypothesise that the time delay may have produced an element of compensatory RV hypertrophy in this group which has resulted in the reduced RV dilatation.

p118 **Variants of pulmonary sarcoidosis**

Nicholas McGlashan; Sue Matthews

*Sheffield Teaching Hospitals*

**Background:** Sarcoidosis is an idiopathic granulomatous disease that can affect any organ. The radiological and clinical expression of sarcoid is markedly varied. The many different radiological guises of this disease can lead to incorrect or delayed diagnoses.

**Purpose:** Sarcoidosis commonly presents as asymptomatic symmetrical bilateral hilar and mediastinal adenopathy with or without perilymphatic pulmonary nodularity. Less common radiological patterns, however, do occur with which the radiologist should be familiar. The different imaging forms of sarcoid are not mutually exclusive and can overlap. Radiologists should be aware of the natural history of the disease from the many different acute presentations to established fibrosis as well as the differential diagnoses including any disease causing a granulomatous reaction or thoracic adenopathy. PET-CT can be used to monitor disease activity.

**Summary:** Examples of the many imaging appearances of sarcoidosis are illustrated and described. Typical parenchymal features are symmetrical adenopathy, nodular opacities, ground glass opacification, linear opacities and fibrosis. Atypical features include the alveolar form, necrotising sarcoid, primary cavitation and mosaic attenuation. Aspergilloma, pleural disease, pulmonary hypertension and direct/indirect airway involvement can occur but are uncommon in clinical practice.
PET-CT is being increasingly used as a second line investigation to target biopsy or establish whether the disease is active or responding to treatment: examples of PET-CT in sarcoidosis and sarcoid reaction are displayed. Sarcoid reaction is an uncommon but important phenomenon that can result in cancer patients being inappropriately staged or labelled as non-responders to therapy.

p119 **A multimodality pictorial review of Hypertrophic Pulmonary Osteoarthropathy (HPOA)**

Leon Sergot [1]; David Shatti [2]; Andy Beale [1]; Martin Williams [2]; Cassandra Speers[2]

[1]*Great Western Hospital, Swindon;* [2]*North Bristol NHS Trust*

**Background:** Hypertrophic Pulmonary Osteoarthropathy (HPOA) is characterised by diaphyseal and metaphyseal periostitis and new bone formation, most commonly of the distal extremities. The periosteal new bone is laid down in response to pulmonary abnormalities such as bronchogenic carcinoma (typically NSCLC), mesothelioma, bronchiectasis, chest sepsis, and pulmonary lymphoma. A painful condition, it can potentially be the first radiographic presentation of an underlying pulmonary lesion.

**Purpose:** To review the multi-modality appearances of HPOA and differing ways in which patients may present. The modalities include plain film, CT, and Whole Body Bone Scan.
The learning objectives include:
1) recognition of HPOA across differing modalities;
2) to facilitate early diagnosis of potential underlying pulmonary abnormalities driving the condition.

**Summary:** The poster will display plain radiograph, CT and whole body bone scan images of at least 4 different cases of HPOA. It will also illustrate how the patient presented and pertinent causative diagnoses underlying each case.

*1. Renton, P. (1998) Orthopaedic Radiology. Pattern Recognition and Differential Diagnosis 2nd Ed, London, UK: Martin Dunitz Ltd, p. 327-8*

p120 **Follow-up of incidentally detected pulmonary nodules - Are we following the BTS guidelines?**

Harris Hameed [1]; Colin Noble[2]

[1]*NHS Greater Glasgow and Clyde;* [2]*Glasgow Royal Infirmary*

**Background**: CT detected pulmonary nodules occur commonly and the number being identified is rising due to increased use of CT. The 2015 British Thoracic Society guidelines have replaced Fleischner guidelines for investigation and management of pulmonary nodules and are significantly different. By routinely dismissing nodules < 5mm without knowing clinical pre-test probability and by generating vital volumetric analysis to guide future follow-up, radiologists now have a key role in implementation of these guidelines.

**Method**: The audit assessed local compliance with BTS guidelines and agreed standard was that 100% of patient should have their nodules followed up in accordance with BTS guidelines. Thoracic CT studies performed over 5 weeks were identified where an indeterminate nodule had been identified for the first time (index scan) or was being followed up (f/u scan). Previous scan findings, physician's request, radiologist's report including, if any, recommended FU, and patient outcomes were assessed for adherence to guidelines.

**Results**: 61 scans were identified (7 index,54 f/u). Appropriate future FU was recommended in 13 (21%) of reports of scans identified and in the remaining cases, 30 (49%) were recommended appropriate followup by physicians. In almost a quarter of reports, there was no mention of volumetry and this affected the future followup.

**Conclusion**: Overall compliance with BTS guidelines is poor at our centre, with many radiologists quoting Fleischner guidelines in their reports. Volumetric analysis and VDT for subcentimeter nodules is not routinely measured by radiologists and a significant number of nodules weren't discharged from followup due to this

p121 **Combined Pulmonary Fibrosis and Emphysema (CPFE): Coincidence or combination?**

Graham Dack [1]; Nicholas Hollings[2]

[1]*Peninsula Radiology Academy;* [2]*Royal Cornwall Hospitals NHS Trust*

**Background** Combined pulmonary fibrosis and emphysema (CPFE) is a clinicoradiological entity first defined by Cottin in 2005, characterised as a combination of upper zone emphysema and lower lobe fibrosis with unexpectedly low lung volumes in patients with a heavy smoking history, exercise hypoxaemia and a severe reduction in carbon monoxide transfer[1]. The coexistence of emphysema and pulmonary fibrosis has been described in multiple series[2, 4] despite data suggesting this combination is uncommon and in fact inversely associated[3] and it remains unclear if really is a distinct clinical syndrome or merely a coincidental coexistence of two conditions in the spectrum of smoking-related lung disease. Thus despite its eleven year 'history' CPFE remains a poorly understood and rarely diagnosed condition.

**Purpose** To explore the literature surrounding CPFE and provide the reader with an understanding of the syndrome, its defining characteristics and the implications for prognosis, complications and treatment.

**Content** A description of the syndrome with a guide to it's features and impact.

*1. Cottin V, Nunes H, Brillet PY, et al. (2005) Combined pulmonary fibrosis and emphysema: a distinct underrecognised entity. Eur Respir J. 26:586-93. 2. Hiwatari N, Shimura S, Takishima T. (1993) Pulmonary emphysema followed by pulmonary fibrosis of undetermined cause. Respiration. 60:354-8. 3. Washko GR, Hunninghake GM, Fernandez IE, et al. (2011) Lung volumes and emphysema in smokers with interstitial lung abnormalities. N Engl J Med. 364:897-906. 4. Wiggins J, Strickland B, Turner-Warwick M. (1990) Combined cryptogenic fibrosing alveolitis and emphysema: the value of high resolution computed tomography in assessment. Respir Med. 84:365-9.*

p122 **Thoracic manifestations of vasculitis simplified**

Mohamed Ismail; Catriona Reid; Lucia Chen; Paula Mcparland; Adam Wallis

*Queen Alexandra Hospital Portsmouth*

**Background;** The vasculitides are non infectious inflammatory conditions of blood vessels walls resulting in reactive damage, haemorrhage and infarction. The most widely used classification of primary vasculitis is according to the vessel size affected. Radiologists must be aware of these multisystem conditions as they often have non-specific presentations which can mimic malignancy. We will highlight new terminology which has replaced the eponymous terms for these conditions

**Purpose:** We will review cardiothoracic manifestations of the primary vasculitides, their classification and nomenclature. The large vessel vasculitides Takayasu's Arteritis (TA), Giant Cell Arteritis (GCA) and Behcet's Disease (BD) will be reviewed. TA and

GCA are pathologically similar, GCA affects older patients. These cause aneurysms and stenoses of the aorta and major branches. They can present occultly as suspected malignancy and radiologists may be the first to suggest their diagnosis. BD is an important cause of PA aneurysms. Our review of small vessel vasculitis will focus on the ANCA- associated diseases Granulomatosis with Polyangiitis (GPA), Eosinophilic GPA (EGPA) and Microscopic Polyangiitis (MPA). These have a range of manifestions including nodules/masses, consolidation, airways disease, and cardiac involvement. We will highlight features on multimodality imaging including CT, MRI and PET scanning, will illustrate the role of biopsy and importance of multidisciplinary working to establish diagnosis.

**Summary** The poster will highlight the classification of vasculitis. Cardiothoracic manifestations of primary vasculitis will be reviewed across multimodality imaging. Our cases will highlight the important role radiology plays in the diagnosis and follow up of patients with

p123 **Systemic arterial air embolism after percutaneous lung biopsy: A hypothesised mechanism and a life-saving management algorithm**

Joseph Barnett; Aniket Tavare; Ash Saini; Sam Hare

*Royal Free NHS Foundation Trust*

**Background:** Systemic arterial air embolism is a rarely encountered major complication in percutaneous lung biopsy, occurring in up to 0.21% of biopsies (2). It can be fatal, or lead to neurological or cardiovascular morbidities (3). Its aetiology is disputed in the literature (4). Management of this potentially fatal condition is often poorly understood, perhaps due to confusion between venous and arterial air embolism (1). Prompt management of systemic arterial air embolism has the potential to improve outcome. This requires the radiologist to have a high degree of suspicion of this condition, knowledge of its clinical manifestations and familiarity with effective early management techniques.

**Purpose**: Present a hypothesis of the mechanism of air embolism
Educate radiologists of the clinical and imaging manifestations of systemic air embolus
Provide a management algorithm for this potentially fatal complication.

**Summary**: We present a pictorial review of a case series of two patients who developed systemic arterial air embolism following percutaneous lung biopsy. Using CT images obtained during the procedures we hypothesise that the passage of coaxial needle through bronchovascular bundles causes bronchovenous fistulae, leading to systemic air embolism. We present CT images of coronary and cerebral air embolism in these patients and outline an algorithm for early recognition and initial management of systemic arterial air embolism.

p124 **A pictorial review of imaging findings in lung diseases associated with recreational drug use**

Mark Thurston [1]; Lindsey Taylor [2]; Richard Riordan[3]

[1]*Peninsula Radiology Academy;* [2]*Royal Devon and Exeter Hospital;* [3]*Plymouth Hospitals NHS Trust*

The use of inhaled recreational drugs may result in a spectrum pulmonary disease and these complications are encountered with increasing frequency in day to day practice. Presentation may vary from patient to patient. Appropriate consideration therefore should be given to this group of conditions when formulating a differential diagnosis. We present a series of cases demonstrating the characteristic CT imaging appearances associated with the use of a variety of recreational substances including: tobacco, nicotine vaping, cannabis, crack cocaine and others. This review focuses on CT findings and these are correlated with other imaging, where appropriate.

p125 **High resolution CT: Typical features of common diagnoses**

Kelsey Watt [1]; Jack Looker [2]; Sarah Higgins[2]

[1]*Plymouth Hospitals NHS Trust;* [2]*Torbay Hospital*

**Background**: High-resolution CT (HRCT) is a powerful tool for the diagnosis of interstitial lung disease, though many radiologists, and registrars in particular, may shy away from reporting them due to unfamiliarity or perceived complexity. Differentiating between usual interstitial pneumonia (UIP) and non-specific interstitial pneumonia (NSIP) has significant prognostic implications for the patient. Sarcoidosis has a broad spectrum of findings,but has typical features depending on the severity of disease. Hypersensitivity pneumonitis (HP) or extrinsic allergic alveolitis (EAA) may not necessarily manifest itself on HRCT in the acute phase, but the tomographic features of the subacute or chronic phases can be important for prognostication.

**Purpose**: 1. Describe the typical findings of UIP on HRCT
2. Describe the typical findings of NSIP on HRCT and distinguish it from UIP

3. Describe the spectrum of typical findings of sarcoidosis on HRCT
4. Describe the causes and typical features of HP on HRCT

**Summary**: Here we present HRCT cases that clearly demonstrate the features typical of UIP, NSIP, HP (or EAA), and the broad spectrum of findings typical of sarcoidosis at various stages of disease. The cases demonstrate the typical features which differentiate these conditions from one another, and where appropriate, correlation with chest radiographs is also made.

p126

**A comparison of the radiological findings in patients with pneumocystis jiroveci pneumonia in patients with HIV and non- HIV immunocompromised patients**

Nuthan Devi Gupta [1]; Rashika Fernando[2]

[1]*Mersey School of Radiology;* [2]*The Royal Liverpool and Broadgreen University Teaching Hospital*

**Background**: Pneumocystis jiroveci (PJ) is an atypical fungus that causes pneumonia in immunocompromised human hosts, particularly those with deficiency in cell-mediated immunity. Some studies have shown clear differences in radiological findings in HIV and non-HIV Pneumocystis Jiroveci Pneumonia (PJP).

**Aims and Objective**: To review radiological differences of PJP in HIV and non HIV immunocompromised patients in our population.

**Method**: A retrospective study of all patients who were admitted to a large University Hospital with confirmed PJP from April 2011 to Feb 2015. A total of 55 patients were reviewed. We defined typical HRCT findings of PJP as ground glass opacification ( GGO).

**Results**: Among the 55 patients, 22 were HIV related PJP and 33 were non-HIV related PJP. HRCT was not available in 1 patient in HIV group and 3 patients in non-HIV group. Among the HIV group with HRCT (21 patients), 14 (66%) showed typical HRCT features, 6 (33%) atypical features and 1 was equivocal. Among the non-HIV group with HRCT (30 patients), 10 (33%) patients showed typical HRCT features, 19 (66%) atypical features and 1 equivocal.

**Conclusion**: Typical changes were noted more commonly in HIV immunocompromised patients compared to non-HIV. Absence of ground glass appearance should not rule out PJP pneumonia and further tests may need to be carried out if there is a high clinical suspicion of PJP.

p127 **Should pelvis be included in CT staging of lung cancer?**

Muhammad Masood; Sabrina Alam; Praveen Rao

*University Hospitals of Leicester NHS Trust*

**Purpose**: The NICE guidelines for staging lung cancer (LC) recommends contrast-enhanced chest CT scans, including the liver and adrenals. In our center, we do not routinely scan the pelvis as part of the staging scan. This may raise a potential pitfall of missing pelvic metastasis. Although the incidence of bone metastasis in Non Small Cell lung Cancer is 20-40%, there is little information on the incidence of pelvic metastasis in isolation. This study examines the incidence of pelvic metastasis in LC patients and whether the pelvis should be included as part of staging CT scan.

**Method**: 489 patients diagnosed with primary LC in 2013 were identified from local LC MDT database. Local RIS were reviewed retrospectively for staging CT and any subsequent PET/CT, MRI or bone scans. 6 patients with clinical and CXR diagnosis of LC, were excluded from the analysis as they too unwell for further investigations.

**Result**: Overall incidence of metastasis to the pelvis was 11%(53/483) and almost all of these were osseous (49/53, 92%). 44/53(83%) patients also had multi-organ metastases. 31/53(58%) patients had CT pelvis included in the initial staging CT which were requested for suspected malignancy work-up. The initial CT identified pelvic metastases in 94%. 9/493(2%) patients had isolated pelvic metastases.

**Conclusion**: Our data suggests incidence of isolated pelvic metastasis is low, predominantly osseous, therefore has little additional benefit in including pelvis as part of the staging CT scan. In cases with curative intent whole body PET/CT is indicated, which is likely to detect pelvic metastasis.

## CARDIAC AND VASCUALAR INTERVENTION

### p128 Case files from the ER: A significant finding on a routine scan

Sithara Jipson; Rebecca Simmons

*InHealth Group*

**Presentation**: 71 years old female presented with a history of weight loss and increasing lower back pain radiating to the groin with worsening mobility. An urgent MRI scan of her lumbar spine was requested to rule out possible neurological causes for her symptoms.

**Findings**: MRI showed normal lumbar lordosis. There was no canal or foraminal stenosis. No significant abnormality along the lumbar spine. On review of the sagittal images a large mass pertaining to the abdominal aorta could be seen, with mixed signal characteristics. An additional coronal STIR was performed to help identify, and this showed bright signal and the appearances of a large infrarenal aneurysm, most probably leaking. The biggest danger in having such an aortic aneurysm, or any aneurysm, is the risk that it will rupture. Most aneurysms gradually develop over time and can be symptomless, which is why they are so dangerous. Since most infrarenal aortic aneurysms are symptomless, they are hard to diagnose until they burst or rupture. They are often found when doing a physical exam, ultrasound or CT scan for another issue, such as the MRI in this case.

**Outcome**: The patient was immediately transferred to CT within the emergency centre for an aortic angiogram, the outcome of which was as a large leaking infrarenal aneurysm. Patient was transferred to the closest vascular centre for Intervention. An endovascular aneurysm repair was carried out. The Procedure was a success and the patient made a full recovery. Incidental detection on the MRI helped expedite the required treatment

### P129 Improving working practice in the vascular hybrid setting during complex endovascular aneurism repair (EVAR) procedures

Leonardos Pappadopoullos, Roy Hughes, Rachel Ranson

*Royal Liverpool Hospital*

**Background**: Prior to the installation of the hybrid theatre, the vascular team utilised a standard operating theatre for vascular procedures. A Zhiem Vision RFD was used for image guided endovascular procedures. With the increasing complexity of endovascular aortic repairs (EVAR) over the years, limitations were highlighted in regards to the standard operating theatre and it's capabilities to provide a safe and efficient working environment in regards to clinical practice.

**Purpose**: To outline the improvement in clinical practice that has been made since our transition from a standard operating theatre to a hybrid theatre in regards to radiation dose reduction and improved working relationships between the Vascular and Radiology departments.

**Summary**: Use of the hybrid theatre has allowed for a faster and efficient workflow of patients. The daily provision of dedicated radiologist cover for endovascular cases has reduced the number of complications that may arise. Utilisation of Raysafe badges, peripheral radiation dose monitoring, led screen protectors, Radpads, in addition to staff's radiation training has allowed for a safer working environment and a further reduction in radiation dose. A preliminary dose audit comparing the radiation dose of fenestrated EVAR's before and after the hybrid theatre showed a 46% reduction in the average dose.

The poster aims to show, that improved communication and training between the two areas has greatly improved patient & staff safety in the Vascular Hybrid theatre.

### p130 The role of CT in the assessment of suspected aortic root abscess

Rhona Taberham; Sobana Battison; Ausami Abbas; Stephen Harden

*University Hospital Southampton NHS Foundation Trust*

Aortic root abscess secondary to infective endocarditis is associated with a high morbidity and mortality and is more prevalent in patients with prosthetic valves. Antibiotics alone are usually insufficient in controlling such infections, with high risk surgical intervention often inevitable. Computed tomography (CT), in combination with other imaging modalities, provides vital diagnostic information, which aids surgical decision making.

The key CT findings suggestive of an infected collection include abnormal enhancement of periaortic low attenuation material, collections that increase in size on serial imaging, locules of gas, pseudoaneurysms and fistulas to adjacent structures. Vegetations may be visible on the aortic valve. Appreciation of normal and abnormal post-operative findings in conjunction with

knowledge of the previous surgical intervention is important in identifying life threatening complications and guiding the need for urgent surgical intervention.
The aim of this poster is to educate the reader by demonstrating the key CT findings of aortic root abscess and the differentiation of this from normal post-operative findings.

p131 **Retrieval of intravascular foreign bodies: An endovascular fishing trip**

Laura Cunliffe [1]; Cha-Ney Kim [2]; Thanjavur Bragadeesh [2]; Mubarak Chaudhry [2]; Vivek Shrivastava[2]

[1]*Hull York Medical School;* [2]*Hull and East Yorkshire NHS Trust*

**Background:** Over the last decade, minimally invasive pin-hole surgery by the interventional radiologists has become an attractive option for the retrieval of intravascular foreign bodies. It can be a safe and effective approach that avoids open surgery in the majority of patients. We present three cases of intravascular foreign body retrieval performed by the interventional radiology (IR) unit to highlight the role of IR in managing these patients.

**Purpose:** This poster highlights the versatility of interventional radiology, and the applications it has in managing unexpected and emergent clinical situations. Compared to open surgery, endovascular retrieval can reduce length of hospital stay, post-operative complications, general anaesthetic exposure and cosmetic outcome. Our aim is to raise awareness of these techniques, and their availability to help clinical teams offer their patients optimal care.

**Summary:** We present three cases in which an endovascular approach was successfully used to retrieve intravascular and intra-cardiac foreign bodies.

Case 1: A porta-cath tunnelled central line had fractured inside the chest, with the distal line fragment within the right ventricle.

Case 2: Retrieval of a lost guide wire during routine insertion of a central line. The wire migrated through the heart into the IVC, whilst being transferred from another hospital. Images demonstrate this migration, via plain films of the chest and lumbar spine.

Case 3: Self-inflicted injury with an intra-cardiac foreign body. CT chest used to show the position of the object. Selected fluoroscopic images demonstrate removal using snares and guidewires.

p132 **Duplex ultrasound assessment of arterial disease in the lower limbs of Zimbabwean diabetic patients**

Josephine Tityiwe [1]; Gillian Crofts [1]; Paul Comfort [1]; Godfrey Azangwe [2]; Max Patana [3]; Rudo Gwini [3]; Nichodimus Kadumbo [3]; Douglas Gandanhamo[4]

[1]*University of Salford, UK;* [2]*National University of Science and Technology Zimbabwe;* [3]*Mpilo Central Hospital, Zimbabwe;* [4]*Diagnostic X-Ray Centre*

**Introduction** This is an abstract of ongoing PhD work and the poster will be presented with results in time for the conference.

**Background** Zimbabwe currently has no robust testing protocol for detection of lower extremity Peripheral Arterial Disease (PAD) in diabetic patients and these patients progress to late stage complications of critical limb ischaemia. A reliable diagnostic test for assessing early changes of PAD and ways of combating the progression of mild forms of PAD to critical limb ischaemia are therefore critical.

Work package 1 of this study aims to determine the reliability of the ultrasound protocol in detecting any differences in blood flow between healthy and diseased diabetic lower limb arteries and work package 2 aims to establish the effectiveness of the ultrasound protocol from work package 1 to detect any blood flow changes in these arteries after ingestion of beetroot juice by this same Cohort of subjects.

**Method** In work package 1, the ultrasound protocol will be utilised to detect any differences in blood flow parameters in the diseased diabetic lower limb arteries of 35 and 35 healthy lower limbs arteries 35 and in work package II, the ultrasound protocol will be used to determine any immediate blood flow changes in these arteries after ingestion of beetroot juice.

**Results** The findings will firstly justify whether the ultrasound protocol is reliable in detecting PAD in early stage diabetics and secondly whether the ultrasound protocol will be able to detect any immediate blood flow changes after beetroot juice ingestion.

**Conclusion**. The findings from this study may be used to establish a new diagnostic pathway for early detection and therapeutic management of PAD in type II Zimbabwean diabetics.

p133 **Pictorial review of superior vena cava pathology and normal variants**

John Asquith; Chris Day; Arun Pherwani; Justin Pugh

*University Hospital of North Midlands*

**Background**: A range of clinical conditions affect the superior vena cava (SVC). This includes congenital variants, intrinsic or extrinsic benign and malignant diseases. Appropriate imaging is important in their diagnosis and management.

**Purpose**: To be familiar with pathology and normal variants of the SVC. We present a pictorial review of the imaging of congenital variants of the SVC, this includes duplicated and left SVC and a discussion regarding the embryology of the SVC. We also review the range of acquired abnormalities that can affect the SVC, including common conditions such as line induced stenosis, thrombosis and fibrin sheath formation. More unusual pathology will also be demonstrated such as neoplasms and fibrosing mediastinitis. SVC interventional procedures and strategies for management of some of these conditions will also be discussed. An understanding of SVC anomalies is important for the reporting Interventional or Diagnostic Radiologist.

**Summary**: Pictorial review of SVC normal variants, pathology and Interventional Radiology for some of these conditions.

p134 **Pictorial review of the use of cone-beam CT to improve safety and outcomes in prostate artery embolisation**

Jen-Jou Wong; Pradesh Kumar

*University Hospital Aintree, Liverpool*

Prostate artery embolisation (PAE) is an increasingly utilised procedure for the treatment of benign prostatic hyperplasia. The basic premise of the procedure involves the use of small particles delivered via selective catheterisation of arterial vessels supplying the prostate, reducing the arterial supply thereby reducing the prostate size. It has been shown to be effective in treating lower urinary tract symptoms [1], but with none of the common surgical side effects of bleeding, urinary incontinence, retrograde ejaculation and impotence [2]. Furthermore, PAE is performed under conscious sedation and is usually done as a day case procedure. Potential complications specific to PAE include non-target organ embolization to adjacent organs such as the urinary bladder and rectum. Detailed pre-procedure planning CT and real-time intra-procedural imaging techniques are essential in order to visualise the complex arterial anatomy of the pelvis so as to ensure safe delivery of embolisation particles to the target destination. Although digital subtraction angiography remains the most typical mode of intraprocedural imaging technique, the use of cone-beam CT can reduce the likelihood of inadvertent non-target embolization [3]. The ability to manipulate 3D multiplanar reconstructions (MPRs) allows complex pelvic arterial anatomy to be more clearly defined, paving the way for more confident super-selection of vessels as well as deciding whether it would be safe to proceed with the procedure. In this poster we aim to review the conventional arterial anatomy of the prostate and illustrate the use of cone beam CT in preventing inadvertent non-target embolization.

*[1] Uflacker A et al. Meta-Analysis of Prostatic Artery Embolization for Benign Prostatic Hyperplasia. J Vasc Interv Radiol. 2016 Nov;27(11):1686-1697 [2] Gao YA et al. Benign prostatic hyperplasia: prostatic arterial embolization versus transurethral resection of the prostate - a prospective, randomized, and controlled clinical trial. Radiology. 2014 Mar;270(3):920-8 [3] Bagla S et al. Utility of cone-beam CT imaging in prostatic artery embolization. J Vasc Interv Radiol. 2013 Nov;24(11):1603-7*

p135 **Extent and distribution of carotid atherosclerosis in patients with early inflammatory arthritis: Results from the Norfolk Arthritis Register**

Fahad Farhan Almutairi; Sarah Skeoch

*University of Manchester*

**Background**: Patients with inflammatory arthritis(IA) have an increased risk of cardiovascular disease(CVD). The presence, but also burden and location of carotid plaques may influence CVD risk. We have previously demonstrated increased prevalence of carotid plaque in an early IA population. In the current study, we sought to compare plaque burden and distribution in early IA.

**Methods**: Patients enrolling in the Norfolk Arthritis Register (an inception cohort study of IA patients) were invited to take part in a CVD sub-study. Age/sex matched controls were also recruited. Bilateral carotid artery ultrasound was performed and presence, size and location of plaques recorded (within bulb, common, internal, external carotid segments). Total plaque scores were calculated. Non-parametric statistics were used to compare presence and plaque scores in patients and controls. Then, in those with plaque, the proportion of plaques occurring in each segment, frequency of bilateral plaque and plaque scores were compared between groups.

**Results**: 349 patients and 115 controls were recruited. Higher plaque prevalence and plaque scores were noted in patients compared to controls (both $p<0.001$). On comparison of patients and controls with plaque, there was no difference in distribution of plaques or prevalence of bilateral plaque (all $p>0.05$). There was a trend towards higher plaque scores in patients compared to controls, which did not meet statistical significance (median[IQR]: 2[1,4] vs 1[1,2], patients and controls respectively, $p=0.08$).

**Conclusion** While prevalence of plaque is higher in IA, we found no evidence of an altered plaque distribution or higher frequency of bilateral carotid disease.

p137 **Prophylactic placement of carotid endovascular covered stents to prevent carotid blowout syndrome: Safety and efficacy in a single centre**

Scott Rice; Zach Saloojee; Luke Williams; Joe Brookes; Colin Hopper

*University College London Hospitals*

**Introduction**: Carotid blowout syndrome is a potential complication of advanced head and neck malignancy resulting in significant morbidity and mortality. Traditional management focused on surgical ligation of bleeding vessels in the acutely bleeding patient. This study reports the experience of using endovascular covered stents placed under radiological guidance to manage threatened carotid blowout.

**Methods**: Departmental database identified 21 patients who had radiological insertion of endovascular covered stents in the setting of advanced head and neck malignancy over a seven year period. The clinical notes were studied to identify any recorded complications arising from this procedure and the incidence of bleeding following stent placement.

**Results**: 21 consecutive patients were identified for inclusion in this study. Mean survival following stent placement was 242 days. Complications arising from stent placement included minor stroke presenting as dysarthria that resolved and one stroke resulting in mild right sided weakness that resolved. There was one mortality from a medical complication in the intensive care setting on day one post stent placement. No patients experienced bleeding from the head and neck following stent insertion.

**Conclusions**: Carotid blowout is the worst case scenario for end stage head and neck cancer. Radiologically inserted endoluminal covered stents are a useful adjunct in the management of carotid blowout in the context of advanced head and neck malignancy.

p138 **Role of interventional radiologist on-call as part of unstable trauma team**

Krit Dwivedi; Joe Kaczmarczyk; Stephen Goode; Trevor Cleveland; Steven Thomas; Daniel Kusuma; Douglas Turner; Mark Regi

*Sheffield Vascular Institute*

**Background**: Endovascular management of bleeding in trauma is well described. It offers reduced operating time, blood loss, lower mortality and length of stay compared to open surgical intervention. It potentially enables faster time to haemostasis, particularly in anatomically challenging sites such as subclavian, carotid arteries or solid organs. The role of CT in major trauma is well proven. However, currently the role of the Interventional Radiologist in acute trauma is not centrally defined or recognised.

**Method**: We implemented a system in which the Interventional Radiology (IR) consultant was pre-alerted in acute unstable trauma, being onsite within thirty minutes and being first reader of the unstable trauma CT. In parallel, the IR team would prepare the cath lab, should the case proceed to intervention. We audited pre-alerts received and interventions performed.

**Results**: In one calendar year (2014), the system had 50 pre-alerts for unstable trauma, requiring the IR consultant to be present. 13 of the cases proceed to intervention. In total, including stable cases, there were 23 interventions.

**Conclusion**: We highlight three reasons for the on-call IR consultant to be a central member of the acute trauma team, with a defined pre-alert system. Firstly, in all situations, having the consultant as first reader of the trauma scan enables expert assessment, improve accuracy of reporting. Secondly, in cases requiring intervention, this expedites and avoids delay, enabling better clinical outcomes. Thirdly, such a mechanism highlights the importance of the IR service and places its role central in the management of haemodynamically unstable patients.

## GI UROLOGY and OBSTETRICS & GYNAECOLOGY

p139 **Dual lateral decubitus CT colonograpy is preferable to supine-prone scanning in obese and/or frail patients**

Andrew Macallister; Monique Vekeria; Paul McCoubrie

*North Bristol NHS Trust*

**Background**: CT colonography (CTC) image quality is dependent on good quality colonic insufflation. Currently, additional decubitus scans are performed when suboptimal images are obtained with prone and supine positions. Supine-prone imaging in the elderly and obese is often difficult and suboptimal (Buchach et al., 2011). We evaluated our practice of performing dual decubitus positioning in these patients.

**Method**: This was a single-centre retrospective review of 181 consecutive CTCs. Demographics, patient body mass index and scan positions were recorded. Adequacy of insufflation of each colonic segment was assessed using a validated 4 point scale (Burling et al., 2006).

**Results**: Mean patient age was 69.7 years (range 34-88, IQR 17) and mean BMI was 27.5 (range 15.4-55.4, IQR 6.8). 94 patients had a supine-prone scan only and 57 patients had a dual lateral decubitus scan only. The primary dual lateral decubitus scan group had a higher mean age (74.4 vs 66.3) and BMI (29.5 vs 25.7) compared to the primary supine-prone group. 30 (16.6%) patients required a third scan in addition to a primary dual lateral decubitus or supine-prone scans and these were split equally between the two groups. Mean colonic insufflation in the dual decutibus group (left lateral decubitus 3.48, right lateral decubitus 3.55) was equivalent to that of the supine-prone group (supine 3.50, prone 3.50).

**Conclusion**: Dual lateral decubitus positioning in obese and/or frail patients produces good colonic insufflation. This avoids the requirement for additional scans thereby reducing scan time and dose.

*1. Buchach C, Kim D, Pickhardt P. Performing an additional decubitus series at CT colonography; Abdominal Imaging 2011; 36:538-544 2. Burling D, Taylor SA, Halligan S et al. Automated Insufflation of Carbon Dioxide for MDCT Colonography: Distension and Patient Experience Compared with Manual Insufflation; AJR 2006; 186:96-103*

## p140 A pictorial review of the imaging features of treated hepatocellular carcinoma

Azadeh Taheri

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Hepatocellular carcinoma (HCC) is the most common primary tumour of the liver. Although there can be varying imaging features, several international working groups have developed criteria for "classical" radiological features that help radiologists and clinicians be more confident in making a diagnosis on imaging features alone. Whilst these guidelines are helpful in the initial stages of diagnosis, the evolution of imaging features after treatment may not be as clear. One of the challenges the radiologist must face is determining whether there is evidence of recurrence, or if the imaging changes are related to treatment. Treatment options themselves are varied -- radiofrequency/microwave ablation, percutaneous ethanol ablation, and trans-arterial chemoembolisation are often utilised in lieu of traditional surgical resection. It is therefore important for the radiologist reporting these scans to not just be made aware of the treatment in the clinical history, but to have a basic understanding of the techniques employed and the resultant imaging changes that result during follow up. In this pictorial review, we will give a basic overview of the classical radiological features of HCC. We will also give an overview of the interventions mentioned above, and present images of their effects on imaging in subsequent follow up scans, which will aid the reader in differentiating between recurrence, and expected post-treatment change on follow-up scans.

## p142 The appropriateness of paediatric ultrasound kidney ureter and bladder requests in the primary care setting

Vishnu Naidu; Sharenja Jeyabaladevan

*Princess Alexandra Hospital NHS Trust*

**Background**; The Ultrasound (US) guidelines for UTIs in children between 3-16 are very specific (1, 2). To be considered for an US scan (USS), children must suffer from "recurrent UTIs": (≥3 lower urinary tract infections (UTI); or ≥ 2 upper UTIs, or one upper UTI and ≥1 lower UTI). An USS must be done within 6 weeks. In general practice (GP), kidney and bladder ultrasounds accounted for 30% of the total radiology requests in 2015/16 (3).

**Method**: Patients in one primary care centre were identified over a 10-year period (from 31st October 2006-1st November 2016). The criteria for inclusion included (1) having an "US Kidneys Ureter and Bladder" or US Urinary Tract" and (2) being between 3-16 years of age during the scan. The appropriateness of the USS request and the time to USS was investigated.

**Results**: 52 patients fit the inclusion criteria. 21 patients were excluded for various reasons, leaving a total of 31 patients. 8/31 patients were correctly referred. Of these, 2/8 had abnormal scans. Of the 23/31 patients who did not fit the criteria only 2 had abnormal scans. 20/31 patients received an USS within 6 weeks, with 8/31 between 6-7 weeks and 3/31 over 7 weeks.

**Conclusion**: The adherence to NICE/iRefer guidelines is poor. A higher proportion of scans were abnormal in those who met the referral criteria when compared to those who didn't. The majority of patients had a USS within 6 weeks. Awareness of referral criteria will mean that less unnecessary scans are done.

*1. NICE guidance 'Urinary tract infection in under 16s: diagnosis and management' Clinical guideline [CG54] Published date: August 2007 2. Diagnostic Imaging Dataset Annual Statistical Release 2015/16, NHS England, available at https://www.england.nhs.uk/statistics/wp-content/uploads/sites/2/2015/08/Annual-Statistical-Release-2015-16-DID-PDF-1.5MB.pdf 3. Irefer.org.uk [cited 14 December 2016]. Available from: http://www.irefer.org.uk/*

p143 **Percutaneous nephrostomy service: A retrospective analysis**

Taryn Kalami; John Colville; David Jarosz; Simon Burbidge

*Leeds Teaching Hospitals NHS Trust*

**Aim**: To audit the performance of the percutaneous nephrostomy service in Leeds Teaching Hospitals. Audit standards for performance and complication rates are based on the UK national nephrostomy audit 2007 and the American College of Radiology practice parameters.

**Method**: All patients who underwent a percutaneous nephrostomy between October 2014 and October 2016 were included in the audit. Data with regards the indication for nephrostomy, time of day, blood results, seniority of the individual performing the procedure, complications and death within 30 days of the procedure were audited.

**Results**: 364 patients were audited. The most common indication for nephrostomy was malignancy (47%) followed by calculi (21%). 74% of patients had deranged renal function pre-procedure. 1% of patients had haemorrhage post treatment with 1 patient experiencing major haemorrhage. A number of patients sustained a minor complication with malposition or dislodged nephrostomy post procedure. The vast majority of procedures were performed by a consultant radiologist within working hours. 8% of patients died within 30 days of their nephrostomy insertion.

**Conclusion**: The nephrostomy service provided in Leeds Teaching Hospitals is comparable to other UK centres. Audit findings suggest we are providing predominantly a consultant lead service within office hours. Major complication rates are very low and within the threshold reported in the literature by the American Society of Radiologists.

p144 **Can ADC predict prostate cancer and aggressiveness of the disease? Retrospective study in assessing the positive predictive value of the ADC value in diagnosing prostate cancer and its correlation with the disease aggressiveness**

Soek Leng Mui; Shyam Sunder

*Pennine Acute Hospitals NHS Trust*

**Background** Current PIRADS guidelines for evaluating prostate cancer are more heavily reliant on the T2 and DWI sequences compared to the ADC. Furthermore, the ADC value is not routinely measured in day to day reporting. It is thought that the ADC value should have a more vital role in the diagnosis of prostate cancer.

This study is done to evaluate the positive predictive value of the ADC in diagnosing prostate cancer and to assess the correlation of ADC values with the aggressiveness of the disease.

**Method** Retrospective study of 50 patients with histologically proven prostate cancer. The MR scans are reviewed and ADC values measured by 3 radiologists who are blinded to both the sites of the cancer and the Gleason scores. The cut-off value of the ADC for the diagnosis of prostate cancer for this study is 900mm$^2$/s. Based on this, the positive predictive value of the ADC value is calculated. The ADC values obtained are also correlated with the Gleason scores.

**Results** The initial empirical results have been promising. Nearly all malignant lesions seen on the pilot study have ADC value less than 900 mm$^2$/s, and where there is extra-prostatic extension, values have been less than 700 mm$^2$/s.

**Conclusion** Each institute involved in prostate MRI cancer reporting should look at the absolute ADC value, based on histology review, and establish their own cut off ADC values. This would enable us to prognosticate better, prior to biopsy and histological confirmation.

p145 **Pictorial review of visceral/atypical metastatic disease in prostate cancer**

Hannah Marsh; Mark Hawkins

*Great Western Hospital, Swindon*

**Background**: Advanced prostate cancer has a well-recognized pattern of metastatic spread to bone and regional lymph nodes. Studies have shown that rates of non-skeletal metastases are probably increasing, with the prevalence of visceral disease in prostate cancer being reported to be between 20 and 46% in patients with advanced disease. The presence of lung and liver metastases are most common, but, irrespective of site, the presence of visceral metastatic disease is a marker of poor prognosis in prostate cancer, with a reduction in overall survival.

The increase in visceral and atypical metastases may in part be due to the increased utilization of cross sectional imaging in prostate cancer and detection of previously undiagnosed visceral metastases. However, with emerging treatments and improved outcomes, it has also been suggested that changes in the natural history of metastatic disease in patients with prostate cancer could be changing as result of longer survival.

The current understanding of visceral metastatic disease in prostate cancer is poor. Improved awareness of the atypical metastatic manifestations of prostate cancer will enable accurate staging and therefore prognostication, and will facilitate the development of new, targeted treatments.

**Purpose**: To illustrate and review atypical and visceral metastatic disease in prostate cancer, with images selected from the recent experience of a District General Hospital Radiology Department.

**Summary**: We present a review of atypical and visceral metastatic disease in prostate cancer.

p146 **Does giant multilocular prostate cyst adenoma respond to LHRH or is it a case of mistaken diagnosis of prostate cyst adenocarcinoma, both rare cases**

Abeeku Hammond

*University Hospital South Manchester*

Prostatic cyst adenomas and cystadenocarcinoma of the prostate are rare tumours of the prostate with few reported cases all over the world. Few literatures have reported mixed response of prostate cyst adenoma with LHRH, is it a case of mistaken diagnosis considering the rarity of both cases. We report a case of both cases where prostate cyst adenocarcinoma respond well to LHRH but prostate cyst adenoma doesn't. The first case is a 59 year old Caucasian man presented with both worsening lower urinary symptoms and high PSA. The prostate was enlarged and TRUS biopsy revealed a small foci of 3+4 (mostly 3) adenocarcinoma prostate. MRI requested for staging showed a large multi-cystic mass lesion arising from lateral aspect of base of prostate. LHRH shrunk the mass and repeat MRI 3 months showed improvement of the peripheral zones that contained the carcinoma. PSA was also unrecordable. The second is a 79 Year old seen as a case of a rising PSA. MRI diagnosed large cystic and solid mass arising from the prostate and extending to the abdomen. TRUS biopsy plus aspiration of the fluid from the multiloculated cyst showed benign cystic adenoma with no evidence of any malignancy. He was put on LHRH and repeat MRI in 6 months showed multiloculated cyst adenoma of the prostate appears stable with no significant reduction in size. Rarity of both diseases makes misdiagnosis a possibility and reported cases of giant multilocular prostate cyst adenoma might actually be a prostate cyst adenoma carcinoma

*1. Maluf, H.M., et al., Giant multilocular prostatic cystadenoma: a distinctive lesion of the retroperitoneum in men. A report of two cases. Am J Surg Pathol, 1991. 15(2): p. 131-5. 2. Allen, E.A., et al., Multilocular prostatic cystadenoma with high-grade prostatic intraepithelial neoplasia. Urology, 2003. 61(3): p. 644. 3. Datta, M.W., et al., Giant multilocular cystadenoma of the prostate responsive to GnRH antagonists. Urology, 2003. 61(1): p. 225*

## PAEDIATRICS

p148 **The use of sedation in non-accidental injury skeletal surveys?**

Angela Staley [1]; Vanessa Waspe[2]

[1]*Nottingham University Trust;* [2]*Nottingham University Hospital*

**Purpose**: Skeletal surveys are lengthy and often distressing examinations. This is a very emotive time for the families / carers. It is also difficult for staff involved with increased allegations being made against radiographers. High quality images are essential for accurate diagnosis, to avoid misdiagnosis and ultimately to protect the child. Poor radiography has been highlighted in high profile safeguarding cases. The required time to perform a SKS, leads to X-ray rooms being occupied for lengthy periods, impacting on our other services users. Historically, the CT was performed under sedation prior to the SKS examination. A decision to reverse this process was taken. Evaluate this change of practice.

**Methods**: We collected the data from examinations pre and post-trial. This included the timings in department, the dose and type of sedation prescribed. Survey Monkey was used to gather information from other external centres on their practise with regard to sedation. Survey Monkey was used to capture the views of the nursing staff that accompanied the patients within our Trust.

**Results**: The time the patient spent in the department was reduced when sedated correctly. All CT head scans performed was still successful The survey from the nurses within our Trust favoured our change of practice.

**Conclusion**: Our change in practice has had a positive impact on the service we provide. The survey showed other centres were overwhelmingly opposed to the use of sedation. We developed a sedation protocol for the medics to follow on the wards ensuring the correct doses were given.

p149 **Imaging of the paediatric pelvis aid to the newly qualified radiographer**

Jenna Knowles; Paula Evans

*Warrington and Halton Hospitals NHS Foundation Trust*

Within the UK, there are only 28 specialist Children's hospitals which means that in a large number of non-specialist centres (eg. District General hospitals) the radiographers are X-raying children under the age of 18. Primary imaging was requested 128 times within a year to help diagnose a pathology/injury from the Accident & Emergency department within our District General hospital. As this is not a specialist unit for Paediatrics, some radiographers (both experienced and newly qualified) are more cautious about imaging and interpreting X-rays when dealing with children under the age of 16 years old. My aim is to help aid these radiographers on decision making regarding pelvis radiography in a paediatric patient which help to aid with different diagnoses with a particular focus on Perthes Disease, Transient Synovitis, Slipped upper femoral epiphysis (SUFE) and the atraumatic limping child. This will in turn help to reduce radiation exposures as well as promote awareness of different pathologies and how they appear on the images we produce.

p150 **The hitchhiker's guide to childhood body tumours: 3 year experience of a tertiary referral centre for paediatric oncology**

Linda Stephens [1]; Rachel Dixon [1]; Edmund Cheesman [1]; Ross Craigie [1]; Bernadette Brennan [1]; Cristina Dias [2]; Neville Wright [1]; Rui Santos[1]

[1]*Royal Manchester Children's Hospital;* [2]*The Francis Crick Institute*

**Background**: Childhood cancers, although individually rare, represent up to 1% of all new tumours in the UK. The treatment journey is arduous for patients and their families, and associated morbidity and mortality is not uncommon. Early diagnosis is crucial to achieve the most effective treatment that will allow the best outcome. The survival rate of children with cancer has improved significantly in recent years as a result of strong collaborative multidisciplinary approach, innovative imaging techniques, precise histopathological identification, genetic characterization and effective multimodality treatment.

**Purpose**: This educational exhibit is intended to give a brief overview of the types and spectrum of presentations of childhood body tumours and emphasize their salient clinical and radiological features with pathological correlation. This is a single unique information resource, with contribution from different specialities, which is an important tool for all levels of healthcare professionals that are involved in the management of childhood cancer.

**Summary**: Retrospective review of childhood body tumour cases presented at the paediatric oncology multidisciplinary team meeting over a period of 3 years (2014-2016) was undertaken and selected cases with input from oncology, radiology, histopathology, genetics and surgical specialities were chosen to illustrate the wide range of paediatric body tumours seen in our institution. Typical and atypical presentations of common tumours and more rare tumours are discussed, and a concise review of the most important clinical, radiological, histopathological and surgical findings that have played a fundamental role in the diagnosis and management of these patients is presented.

*1. Office for National Statistics (2015) Cancer Registration Statistics: England Statistical Bulletins 2. Bhatia, Saro, Armstrong et al. (2015) Collaborative Research in Childhood Cancer Survivorship: The Current Landscape. Journal of Clinical Oncology 33(27), 3055-3064. 3. Weiser D, Kaste S, Siegel M, Adamson P. (2013) Imaging in Childhood Cancer: A Society for Pediatric Radiology and Children's zncology Group Joint Task Force Report. Pediatric Blood Cancer 60(8), 1253–1260.*

p151 **Managing discomfort in non-emergency MRI: Children's coping strategies during their first procedure**

Sundaran Kada [1]; Milka Satinovic [1]; Paul Miller [2]; Lisa Booth[2]

[1]*Bergen University College;* [2]*University of Cumbria*

**Background**: Undergoing an MRI examination can be a stressful event at any age, however though some evidence exists as to how adult patients cope with MRI examinations, very little research exists as to how children manage and prepare for these exams.

**Methods**: Children who had no previous experience of MRI, undergoing a non-emergency examination of the brain were included. Semi-structured interviews with N=22 children, aged between eight and sixteen years, were conducted immediately post-MRI procedure. Qualitative data were thematically analysed in accordance with Straussian Grounded Theory.

**Results**: The primary concern among interviewees related to how they had coped with the discomfort of an unfamiliar medical procedure; this was managed through a process herein termed Involving participation. This comprised three phases. The first, preparative preparation, describes the children's attempts to ready themselves for the examination (with parents) ahead of arriving in hospital. The second, enabling participation, describes how the children (immediately before examination, with input from parents and radiographers) endeavored to understand what was to come, and select viable distraction techniques. Finally, sustaining participation describes the children's reports of actualising their preparations during the examination itself.

**Conclusion**: While much work in the domain portrays children as relatively 'passive' agents during an MRI procedure, the findings point to how they can (with varying degrees of success) actively and constructively work with others. This has direct import for the improvement of support, both prior to and within a procedure itself.

p152 **Transcranial Doppler screening in children with sickle cell disease**

Shruthi Patel; Laurence Abernethy

*Alder Hey Children's Hospital, Liverpool*

**Background**: Stroke in young children is one of the complications of sickle-cell disease. TCD helps in monitoring these children by identifying those at risk and guiding subsequent pharmacological therapy. Our study describes the practical procedure of patient evaluation and illustrates through STOP criteria, the importance of uniform methodology and operator experience in a centre with small but rapidly growing population of affected children.

**Methodology**: A retrospective evaluation was performed of the outcomes in patients with a TCD examination at our institution from September2015-August2016 using PACS.All ultrasound were performed by the same operator, using Philips iU22 scanner with 1-5MHz transducer. The patient's age, previous TCD imaging, along with analysis of 8major intracranial vessels with highest peak velocity was recorded for analysis.

**Results**: The annual study cohort at our institution was 56patients with total of 58TCD examinations.2examinations were excluded from data analysis as they were TCDs for known non-sickle cell disease. These patients had mean age of 7.6years with range from 2-18years.Of 56TCD examinations,1(1.7%) was conditional,3(5.3%)incomplete and 52(92%)normal by STOP criteria. The sole reason for incomplete examinations was restless patients under age of 5 years. Most common vessels unable to measure the peak velocities leading to incomplete examinations were at the site of bifurcation of ICAs and ACAs.

**Comments**: This was an annual audit following STOP criteria for analysis of intracranial vessels using TCD. By measuring peak velocities in co-operative child, TCD screening is the best tool to detect high risk of stroke in children with underlying diagnosis of sickle-cell disease. Performing TCD in younger, restless children can be difficult, and provision of this service for small but rapidly growing population presents many challenges.

*1. Jones A, Granger S, Brambilla D, Gallagher D, Vichinsky E, Woods G, Berman B, Roach S, Nichols F, Adams RJ. Can peak systolic velocities be used for prediction of stroke in sickle cell anemia? Pediatr Radiol. 2005;35:66–72.Adams RJ, McKie VC, Hsu L, Files B, Vichinsky E, Pegelow C, Abboud M, Gallagher D, Kutlar A, Nichols FT, et al. N Engl J Med. 1998;339:5–11. 2. Armstrong-Wells J, Grimes B, Sidney S, Kronish D, Shiboski SC, Adams RJ, Fullerton HJ. Utilization of TCD screening for primary stroke prevention in children with sickle cell disease. Neurology. 2009;72:1316–1321. 3. Arkuszewski M, Krejza J, Chen R, Kwiatkowski JL, Ichord R, Zimmerman R, Ohene-Frempong K, Melhem ER. Sickle cell disease in children: accuracy of imaging transcranial Doppler ultrasonography in detection of intracranial arterial stenosis. Neuroradiol J. 2012;25:402–410.*

p153 **A pictorial review of nasal obstruction causing respiratory distress in the newborn**

Elaine O'Boyle [1]; Sahil Chhabda [1]; Fiona Lam [2]; Kanchana Rajaguru [3]; Kapila Jain[3]

[1]*Chelsea and Westminster Hospital;* [2]*Royal Free Hospital, London;* [3]*Lister Hospital, Stevenage*

**Background:** Respiratory distress is one of the most common reasons a neonate is admitted to the intensive care unit. The extra thoracic causes of respiratory distress in a newborn are diverse and may be secondary to cardiovascular, neuromuscular and airway pathologies. Congenital nasal obstruction results in respiratory distress in newborns as they are obligate nasal breathers. Variation of normal development is the most common cause of congenital nasal obstruction. The different causes for congenital nasal obstruction in newborns include choanal stenosis/atresia, darcocystoceles, pyriform aperture stenosis and encephaloceles. Failure to accurately diagnose congenital nasal obstruction can lead to both short- and long-term complications, including chronic lung disease, respiratory failure and even cardiopulmonary arrest. Imaging and radiological interpretation therefore plays a vital role in the diagnosis and correct management of nasal obstruction in the newborn.

**Objectives:** The objective of this poster is to briefly review the embryology of the nasal passage and present a pictorial review of different nasal obstruction cases from our institution. This exhibit will provide a pictorial review of choanal atresia (Figure 1), darcocystoceles (Figure 2) and pyriform aperture stenosis and the salient imaging features used to help make the clinical diagnosis.

**Conclusion:** Due to the wide range of differential diagnoses discriminating the cause of respiratory distress in the newborn is often a diagnostic challenge. We endeavour to highlight the significant radiological features of nasal obstruction which can cause respiratory distress and that can often help make the fundamental diagnosis and prevent long term complications.

*1. Adil E et al: Congenital nasal obstruction: clinical and radiologic review. Eur J Pediatr. 171(4):641-50, 2012 2. Reuter S et al, Respiratory Distress in the Newborn, Pediatr Rev. 2014 Oct; 35(10): 417–429. 3. Lowe LH et-al. Midface anomalies in children. Radiographics. 20 (4): 907-22*

p154 **Neonatal head ultrasound for paediatricians - a website and workbook**

Iwan Roberts; Lucy Bradley

*Sheffield Children's Hospital NHS Foundation Trust*

**Background**. Paediatricians in training may be expected to carry out neonatal head ultrasound with limited training and support. Without access to RITI, there seem to be limited resources to support good practice. This project was carried out as part of a 6-week medical student attachment in paediatric radiology.

**Method**. Existing resources were explored and were found to be limited. A web-site was created and information was loaded with a view to helping paediatricians in training. Trainees are often quite capable of handling and manouevring the probe and need help to obtain the necessary views. Details included machine set-up, images required and common pathologies. Trainees were consulted throughout the process and their feedback was used to help with design. The website is accessible via smart-phone. A workbook has been developed with tips for technique, updated learning objectives for ST1/2, ST3/4 and neonatal grid trainees. There is a sign-off sheet to monitor progress.

**Results**. Early feedback has proved very positive. Trainees have limited time and resources for training and the resources have proved popular.

**Conclusion**. Clinicians need accessible resources to support high-quality clinical and radiological practice. This project has explored how non-radiologists view resources for ultrasound.

p156 **A retrospective study in the United Kingdom to establish the prevalence of spinal fractures on skeletal survey in suspected inflicted injury, the radiation dose associated with the lateral spine and the necessity of this projection for initial and follow up imaging**

Jenna Tugwell-Allsup; Walid Al-Deeb

*Betsi Cadwaladr University Health Board, Wales*

**Background**: The number of spinal fractures detected on skeletal survey (SS) for suspected inflicted injury varies within literature causing debate as to the necessity of lateral spinal projection/s within the protocol. This study aims to strengthen evidence as to the prevalence of spinal fractures in these cases at a UK paediatric hospital by exploring both initial and follow up surveys and the associated radiation.

**Method**: A retrospective study of SS performed for suspected inflicted injury in children younger than 24 months from 1st June, 2007 - December 31st, 2013. Data was collected from the Radiology Information System where reports were analysed for definite verses equivocal fractures. Follow-up imaging was also considered and reviewed. Dose area product (DAP) was recorded for each SS and individually for the lateral spine.

**Results**: Of all 179 SS identified, no definitive spinal fracture was reported. Two equivocal cases were identified with suspicion of vertebral body fracture on initial SS, but both were confirmed to be normal variants on subsequent spinal MRI scan. The average DAP for all SS was 43.8 cGycm2, (24.3 SD) with lateral spine contributing to 18% of the total DAP of the entire SS.

**Conclusion**: Although no spinal fractures were identified for this study, strong evidence still exists to the inclusion of the lateral spine radiograph(s) for the initial SS. Consideration should however be given to its exclusion from follow-up SS. Also, MRI scan is suggested if there is a positive spinal fracture identified on initial survey in order to confirm diagnosis.

## IMAGING TECHNOLOGIES & INFORMATICS

P157 **An audit on errors in voice recognition generated radiology reports**

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*Burton Hospitals NHS Foundation Trust*

**Background** Voice Recognition Software (VRS) has been available to the medical profession for over three decades[1]. However, the widespread use of VRS in Radiology was delayed until more recent advances in technology such as PACS[2]. Studies have shown the use of VRS significantly reduces the Radiology report turnaround time[3]. However, it is not a flawless system. Through an audit we aimed to look at the error rate of VRS-generated reports by Consultant Radiologists at our Hospital.

**Method** We made use of the Royal College of Radiologists (RCR) guidelines as our standard and classified errors into three groups - Minor, Moderate and Major[4]. Overall error rate should be <5% and Major errors 0%. We looked at reports over a four-month period and from four different modalities - Plain film, Ultrasound, CT and MRI. For each Consultant we randomly selected 12 reports per modality (3 per month) making a total of 48 reports per Consultant. A total of 336 reports were analysed and classified into one of the three groups.

**Results** 294 reports (88%) contained no errors. However, 42 reports (12%) contained an error. Of these 36 were Minor, 5 Moderate and 1 Major.

**Conclusion** The Hospital Radiologists were missing the target of overall error rate by 7% and Major errors by 0.3%. Additionally, almost 75% of errors were in CT or MRI. These reports were on average significantly longer than Plain film or Ultrasound. Hence, highlighting a correlation between length of report and probability of errors.

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## p158 Implementation of paperless workflows in radiology departments across the UK

Sarah Booth

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**Background** The government drive for paperless working in the NHS has been well documented. The multi-faceted complexity of the radiology workflow makes implementing paperless processes particularly challenging. The aim of this research was to ascertain the extent to which radiology departments have implemented paperless workflows across four key workflow processes; examination referral, examination vetting, ID and pregnancy verification and report communication.

**Method** An online questionnaire comprising both open and closed questions was completed by 91 respondents from radiology departments across the United Kingdom, from 5 respective job roles.

**Results** Departments have implemented paperless working for all four processes, however some more successfully than others. Figures show reduced usage of electronic referrals from referrers outside the organisations compared to those from within. Vetting, ID/Pregnancy and report communication all demonstrate some electronic working however there is evidence of tandem systems utilizing paper and electronic methods suggesting not all departments have made the transition and there is still some reliance on paper.

**Conclusion** This research gives an indication of progress of paperless implementation in radiology departments across the UK. Some departments are well on their way to being paperless by 2020; however there is disparity amongst organisations. Departments who have successfully implemented electronic workflows could provide valuable learning for those who are still addressing the paperless challenge.

## p159 Utilising wireless hospital network to improve workflow and efficiency of mobile radiography

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*Singapore General Hospital*

**Background**: There had been increasing demand for mobile radiographic images to be available in the Picture Archiving and Communication System (PACS) as soon as they were acquired for better patient management and care. Therefore there was a need to improve workflow and efficiency of mobile radiography without any compromise on radiographic image quality and service delivery.

**Aims/objectives**: To reduce image arrival time in PACS by improving the work processes of mobile radiography.

**Materials and Method**: A pre (non-wireless) and post (wireless) approach was employed for this study. The total duration of this study was four weeks, two weeks for each of the approach. The acquisition times of all radiographs from the mobile radiography system were taken and the arrival times of all radiographs in PACS were also taken for both non-wireless and wireless approach. The non-wireless and wireless data were populated and compared.

**Discussion**: Present study showed that the availability of radiological images in PACS from the time of acquisition improved significantly using the wireless approach. The data showed that the mean time of 44 minutes was required for images to arrive in PACS after acquisition for the non-wireless approach while the wireless approach took only 2.3 minutes. Our preliminary experience suggested that the wireless mobile radiography system were able to operate seamlessly with shorter time interval for image arrival. The system would enhance workflow and improve efficiency of mobile radiography by speedy delivery of radiological images and information to the clinicians for making timely diagnosis and treatment for patients.

## p160 The use of global worklists for peer review: A Scottish reporting radiographer's perspective

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**Background**: The availability of the global worklist has streamlined the process for the reporting radiography team across several sites in Greater Glasgow and Clyde to participate in frequent peer review for audit and teaching purposes.

**Relevance/Impact**: Peer review is essential for assessment of a reporting radiographer's performance in clinical practice. Looking to the future of Radiology services in Scotland and the proposed model of working as 'shared services'.

**Discussion**: - Engaging with IT solutions available to facilitate cross site learning. - Less time out of department and travelling to peer review meetings - Increasing feasibility and frequency of peer review across geographical boundaries

p161 **The diagnostic radiological image - identifying the benefits from the literature**

William Cox [1]; Penelope Cavenagh [2]; Fernando Bello[3]

[1]*University of Portsmouth;* [2]*University of Suffolk;* [3]*Imperial College London*

**Background** The volume and costs of diagnostic imaging examinations are rising (NHS England 2016). Therefore, there is a need to ensure that the maximum benefit is extracted from these resources. Benefits management literature suggests that the initial step for benefits realisation is identification (Bradley 2006). A literature review was undertaken to assess existing understanding of the available benefits.

**Method** A structured narrative approach was utilised in order to promote trustworthiness & dependability, whilst minimizing bias and error. 5 databases (CINAHL, Cochrane, ProQuest, PubMed, ScienceDirect) were interrogated using search terms identified through application of the SPIDER tool: The returned literature was screened for quality and content using predefined inclusion and exclusion criteria.

**Results** After screening, n=519 papers were returned and categorized as follows:

- Primary benefits (n=470). These are benefits extracted from the image which align with the rationale for acquisition (e.g. detection). These benefits tend to accrue directly to clinical stakeholders and patients by extension.
- Secondary benefits (n=63). These are benefits unrelated to the rationale for acquisition. They were categorised as being educational (e.g. promoting understanding) or relational (e.g. promoting communication, engagement, or trust) in nature. These benefits may accrue to a wider group of stakeholders, e.g. patients or carers.

**Conclusion** There is currently limited evidence in the literature of appreciation of secondary benefits. This lack of recognition means that some of these benefits may not be realized. There is a need, therefore, for further work to identify these benefits, if they are to be accessible for all stakeholders.

p162 **A comparative analysis on the fastest modality and fastest method to load multiple images when reporting on an integrated national PACS system**

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[1]*Tallaght Hospital, Dublin;* [2]*Waterford Regional Hospital, Ireland;* [3]*Adelaide and Meath National Children's Hospital, Dublin*

**Background**: Nimis PACS is the National integrated computerised system in Ireland for reporting radiological images. As with any system, speed in downloading images is critical to functionality. This study aims to record and compare the actual time taken to load single studies in four modalities; Plain Film Radiographs (PFR), ultrasound (US), CT & MRI. It compares loading times opening single studies versus multiple studies cumulatively. In addition, it assesses if there is any temporal relation to time taken to load studies.

**Method**: Data was collected over 4 days; 2 mornings and 2 afternoons. Image loading times were recorded for 80 PFRs, 40 USS, 40 CTs & 21 MRIs. The time taken from clicking "open study" to the first image appearing on-screen was recorded.

**Results**: An average of 6.29, 4.05, 5.38 and 5.93 seconds were taken to load PFR, USS, CT and MRI images respectively. It took 6.88 seconds to open PFRs in the morning versus 5.96 seconds in the afternoon. The load times for opening 5 studies cumulatively for PFRs, US, CTs and MRIs were 9.87, 13.88, 3.85 and 2.53 seconds respectively.

**Conclusion**: PFR take the longest time to load, followed by MRI, CT and last US. Studies load 0.92 seconds faster in the afternoon than in the morning. Loading five studies at a time versus opening one study at a time took longer for both PFRs and US but shorter for MRI and CT. Overall, it is faster loading 5 scans cumulatively than loading 5 scans separately per patient.

p163 **Open upright MRI in the real world**

Melanie Jones [1]; Deborah Horne [1]; Alan Breen[2]

[1]*Bournemouth Open Upright MRI;* [2]*Institute for Musculoskeletal Research and Clinical Implementation, AECC*

**Background** The spread of open upright MRI scanning is a relatively new development in the UK and such scanners are seldom, if ever found in NHS sites. The intricacies of such technology are of little interest to some in the medical profession, but to patients it can open up a field of imaging from which they may have previously been excluded.

**Purpose**: The purpose of this poster is to demonstrate that the need for open upright MRI isn't always based on performing weight bearing studies. This new innovation allows us to image patients who may never have been able to undergo MRI due to inability to lie flat or to severe claustrophobia.

**Summary**: In our first year of service nearly a third of patients referred for upright MRI of the lumbar spine had reportable findings relating to the spinal or nerve root canals that were in some way differentiated by upright MRI scans. Due to the changes in dimensions in the spine and spinal canal, Upright and positional MRI can also assist in the identification of dynamic instability. Approximately 30% of our patients are claustrophobic and would not otherwise be able to be scanned without sedation or anaesthesia. In addition, a small proportion require open or upright scanning due to physical deformities, gastrointestinal or respiratory conditions that prevent enclosed and/or recumbent positioning. Overall, 24% are scanned upright. Image 1 semi recumbent position for brain MRI

p164 **Recurrent prostate cancer following therapy: Can textural analysis of Attenuated Diffusion Coefficient (ADC) MR and T2 images help?**

J. Stirling [1]; R. Alonzi [2]; N.J. Taylor [1]; W.L. Wong [1]; A.R. Padhani [1]; B. Sanghera[1]

[1]*Paul Strickland Scanner Centre, Northwood;* [2]*Academic Oncology Unit, London*

**Background**: Aftertherapy, prostate glands lose zonal image contrast which hampers interpretation. Texture and lacunarity analysis may help characterise recurrent tumour from normal post therapeutic tissue. Currently, scanning techniques are reliant on the clinicians' visual interpretation of the final image. Textural analysis is a post processing technique, unlike region-of--interest or histogram analysis, that is able to quantify underlying visual aspects using the spatial distribution of measured signal intensities, not seen by the human eye.

**Purpose**: Readers will be shown how to optimise prostate DWI sequences. The reason why texture and lacunarity analysis may help in the classification MRI images of recurrent prostate cancer will be explained. An insight into many of the challenges of texture analysis and how it relates to different MRI sequences will be presented.

**Summary**: This poster investigates differences between diffusion weighted and T2 imaging post therapy using quantitative texture and lacunarity analysis and how it may help to characterise recurrent prostate cancer. It will be illustrated by images such as figure 1. It will show and explain a couple of common texture analysis methods. Figure 1:(a, d) ADC and T2 image of the prostate gland, (b) a ROI of restricted diffusion (red), non-restricted diffusion (blue)and (c) lacunarity plots showing curves from restricted areas (red) and non-restricted areas (blue). Likewise, (e) a ROI of low T2 intensity (red), higher T2 intensity (blue) and (f) lacunarity plots showing T2 intensity corresponding to restricted areas (red) and non-restricted areas (blue) on the ADC image.

*References 1) Goh V, Sanghera B, Wellsted DM, Sundin J, Halligan S. Assessment of the spatial pattern of colorectal tumour perfusion estimated at perfusion CT using two-dimensional fractal analysis. Eur Radiol 2009;19(6):1358â€"1365 2) Sanghera, Bal, Stirling, J James, Glynne-jones, Rob, Goh, Vicky. Reproducibility of 2D and 3D Fractal Analysis Techniques for the Assessment of Spatial Heterogeneity of Regional Blood Flow in Rectal Cancer. Radiology 2012; 263(3): 865-873*

p165 **Barriers to introduction of X-ray patient dose management systems**

Hugh Wilkins

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**Background** Dose management systems, which automatically collect and analyse patient dose indicators from image files, have been introduced in recent years, made possible by the transition to digital radiological imaging. They offer significant benefits, for example the ability to collect high quality 'big data' in real time, overcoming problems of transcription errors, small sample sizes, delays and occasional selection bias associated with traditional methods of manual paper-based dose audits. However their adoption into routine practice has been slower than might be expected, given that in theory they can transform the process of auditing of radiation doses to patients from X-ray imaging procedures, in turn facilitating derivation of reference levels and optimisation of diagnostic X-ray medical exposures.

**Method** Anecdotal accounts attest to resistance to attempts to introduce dose management systems. This has led to reflection on reasons for such resistance. Such reasons constitute barriers to the introduction of these systems.

**Results** Real and postulated barriers to the widespread adoption of this innovative technology include: capital/revenue costs at a time of significant cost pressures; competing IT/management priorities; information governance patient confidentiality fears; perceived reluctance to divulgence of dose data (perhaps for fear of it being seen as a key performance indicator ushering in 'Big Brother' performance management); and poor understanding of radiation dose risks and IRMER legal requirements.

**Conclusions** Individuals and organisations seeking to introduce dose management systems may need to be aware of such barriers when considering their introduction, and weigh them against the substantial potential benefits offered by these systems.

p166 **Compliance with RCR standards for sign offs in radiological reports**

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The Royal College of Radiologist states that those radiologists who formally reports images must sign off with the following as a minimum: 1. Full name 2. Professional status 3. General Medical Council Number.

We looked at 100 reports from various consultants in a single trust and recorded which of the above were included in the sign off. The results we obtained showed the following: 1. Full name 95% 2. Professional status 95% 3. General Medical Council Number. 15% The results were positive with respect to name and status, we were surprised to that 5% were not signed off at all and only 15% had their GMC number on their reports. The results were fed back to the department and we are working on trying to make the sign off include all the aspects automatically when the radiologist signs there name.

We implemented an auto-signature for the radiologist when they dictate which gives an automatic signature including their name, professional status and GMC number. Following this we re-audited this with the following results. 1. Full name 97% 2. Professional status 97% 3. General Medical Council Number. 93% The results showed a large improvement in the compliance. We also found that the main reason why it wasn't 100% was due to amendments which were made without dictate. In

Conclusion the use of an auto signature improves the overall compliance with the RCR standards and we hope to implement this trust wide.

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## RADIATION PROTECTION AND QUALITY ASSURANCE

p167 **Assessment of doctors' knowledge on radiation risks and exposure during in emergency department**

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**Background**: With the growing use of diagnostic imaging modalities in emergency medicine practice, comes the concern about their risks. This study aims to assess the knowledge of radiation exposure doses and risks among doctors working in emergency department.

**Methods**: A validated questionnaire was distributed to 120 emergency doctors and doctors from other specialties rotating in emergency departments of 8 hospitals. Participants were asked to answer questions regarding possible risks associated with radiation exposure and to estimate the radiation doses that patients were exposed to during various radiological procedures. Chi-squared test, an Independent t-test and One-Way ANOVA with LSD as Post-Hoc analysis were used for analytical purposes.

**Results**: A total of 90 doctors completed the questionnaire. 52 of them were residents, 26 were specialists, and 11 were consultants. 22% of them had formal training on radiation protection. None of the doctors estimated all the doses correctly. The overall correct answer rate for residents was 17.1%, compared to 22.7% for specialists and 40% for consultants ($p = .003$). Those who had formal training did not have a statistically significant higher rate of correct answers ($p = .411$), and no specialty had a statistically significant higher rate of correct answers when compared to other specialties ($p = .857$).

**Conclusion**: This study delineates that doctors working in emergency department had poor knowledge about radiation doses received by their patients and the risks associated with the exposure to radiation in the different imaging procedures. This issue warrants attention considering the increasing use of the radiological

p168 **MRI incidents: A review and proposed categorisation**

Darren Hudson

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**Background**: Safety is paramount in MRI, with review of incidents and monitoring for trends a key aspect of providing assurance and reducing risk.

**Purpose**: An internal review of incidents over an 18month period was conducted, which included both static and mobile magnets nationwide, looking at safety and drug related events. During this period only 1973 MR related incident reports were submitted via Sentinel accounting for 46% of all incidents documented. Of these 0.024% were MR safety related, and to be able to better assess any significant trends these were sub-categorised under 15 headings which were thought to summarise the key causes of safety events. Of the drug related incidents occurring in MRI; 60% were reactions which represented a 1% adverse drug rate, 20% extravasations, with the remainder relating to other issues such as cardiac drugs, medicines management and dynamic scan timing.

**Summary**: From the subcategories used for looking at MRI Safety, the biggest issue seen is around contraindicated referrals, particularly from GP's, and mainly pacemakers probably due to confusion over conditional devices that not all sites currently scan. The next significant categories of 'unable to confirm safety' and 'unexpected implant/foreign body', suggest issues associated with screening processes and interaction with patients. The key message from this is around the importance of engaging and effective screening in order to be able to obtain a reliable and sufficient medical history to be able to assure patient safety.

## p169 The effect of Exposure Index (EI) on the subjective analysis of image quality

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*University of Exeter*

**Background**: Exposure Index (EI) is a logarithmic index that provides a quantitative marker of the exposure received by an image receptor during projectional radiography. [1] This study investigates if the presence of EI data biases radiographers' subjective perception of image quality.

**Method**: 25 staff and student radiographers were invited to rate the image quality of 15 chest radiographs of an anthropomorphic model using Likert scales. Within the 15 images used, six images were duplicated, with the EI values hidden on one. There was ethical approval to deceive participants regarding the true aim of the study. Image quality scores for the duplicated images were compared in the presence and absence of EI data using the Wilcoxon Signed-Rank Test.

**Results**: A statistically significant difference in image quality scores for images with and without EI was only observed for one image (p=0.001). Crucially however, this image was considered most "borderline" in terms of diagnostic quality. 52% of participants would have repeated the image when EI data was hidden, versus 84% when it was shown.

**Conclusion**: Although only a pre-clinical pilot study, results suggest the presence of a quantitative EI number may bias how radiographers perceive image quality for borderline diagnostic images. This has implications for practice if it potentially leads to unnecessarily repeated images. Given the paucity of guidance on the clinical use of EI, further research in the clinical setting is required to observe how radiographers use EI in practice.

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## p170 Eye lens exclusion in CT head scans at a district general hospital - Completing the audit loop

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**Background:** Computerised tomography (CT) scans of the head are becoming increasingly common in hospitals following the update in NICE Guidelines (2004). A strong relationship between repeated CT head scans and cataract formation has been well documented. The standard for lens exclusion in CT head scans is 100% unless specifically looking for orbital abnormalities.

**Method:** A retrospective analysis of 50 consecutive CT head scans from a district general hospital was conducted in October 2016. Orbits were studied to visualise lens inclusion. Exclusion criteria applied to scans which had been requested for assessment of orbital disease. Audit guidance was obtained from AuditLive regarding the number of patients to include.

**Results:** Cycle one audited in July 2016 revealed 96% of head CT scans had lens inclusion. Results were presented departmentally and recommendations made. Re-audit in November 2016 revealed 98% of head CT scans had lens inclusion. No improvement in lens exclusion was noted.

**Conclusion:** Lens exclusion from CT scans will reduce the radiation exposure to the eye. Consequently, the likelihood of lens damage and cataract formation will be reduced. Limitations in patient positioning and the local CT scanner (difficulty angling the gantry) were contributing factors. The audit results have warranted further education and reminders to local staff until a new CT scanner has been purchased. Engaging in the audit process has highlighted the importance of monitoring standards and implementing further strategies to capture deficits.

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## p171 Are X-ray exposures being managed effectively in the clinical environment?

Christopher Hayre

*University of Suffolk*

**Background** In the United Kingdom (UK) radiographers are required to keep radiation doses 'as low as reasonably practicable' (ALARP) whilst ensuring optimum image quality for radiological reporting. This legislative practice stems from the hypothetical linear non-threshold dose response model, which maintains there is 'no safe radiation dose', thus informing radiation safety today. The importance of reducing ionising radiation is published in numerous studies demonstrating dose optimising opportunities in chest and skeletal radiography whereby 33-80% dose reduction is reportedly achieved (depending on clinical query). This paper challenges whether X-ray exposures are being managed effectively in contemporary practices and how this is likely attributed to dose creep and integrity of the profession.

**Methodology** Research from a PhD study explores the use of X-ray exposures and exposure indexes and challenges whether improper techniques are being critically reflected upon by staff. Data stemming from both qualitative and quantitative paradigms is presented for this argument. Radiographers were observed and interviewed, supported by X-ray experiments supporting and/or refuting claims made by diagnostic radiographers.

**Results** Results demonstrate that radiographers may not be wholly practicing the ALARP principle. This is support with radiographers being unfamiliar with exposure indexes. Whilst exposure indexes have limitations they can be used as clinical aids enabling radiographers to reflect clinically, which may not be apparent.

**Conclusion** The use of X-ray exposures remains an essential part of the imaging process, yet it may not be managed effectively by both radiographers and managers in contemporary practices. It is proposed that unless challenged, it may continue.

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## p172 Challenging light beam diaphragm design: A method of dose optimisation to radiosensitive organs?

Christopher Hayre

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**Background** This article offers dose reduction to radiosensitive organs within general radiography. In contemporary practices the light beam diaphragm (LBD) is generally accepted to limit ionising radiation using horizontal and longitudinal lead shutters, yet this article offers further dose limitation to radiosensitive organs by placing lead-rubber inferior to the LBD device.

**Method** Using an anthropomorphic phantom and arm construction quantitative data was collected in a controlled X-ray environment. A lateral projection of the elbow was selected due to the close proximity of radiosensitive organs. Dose readings (µGy) were recorded before and after the placement of lead-rubber inferior to the LBD. A paired two sample t-test was undertaken challenging how likely dose reduction was attributable to chance ($p < 0.05$). Correlation and regression analysis significantly ($p < 0.001$) supported pre and post dose readings, maintaining reliability and validity.

**Results** Descriptive and inferential statistics demonstrate dose reduction to radiosensitive organs upon placement of the lead-rubber inferior to the LBD. The paired two sample t-test demonstrated statistically significant dose reduction ($t = 2.04$, $df = 7$, $p = 0.04$) thus significant for radiographic practice.

**Conclusion** The study concludes by offering an alternate method of dose limitation to radiosensitive organs within the general radiographic environment. It strongly suggests that that this method can offer dose limitation to more than one radiosensitive organ within a single X-ray exposure, conforming to the 'as low as reasonably practicable' (ALARP) principle.

## DOSE OPTIMISATION AND MEASUREMENT

### p173 Evidence of dose optimisation with a single UK radiology department

Andrew England [1]; Louise Harding [1]; Rachel Penney [1]; Ryan Wilde [2]; Fergus Dunn [2]; Anthony Manning-Stanley [3]; Maureen Taylor [1]; Paula Evans[1]

[1]*Warrington and Halton Hospitals NHS Foundation Trust;* [2]*Integrated Radiological Services Ltd;* [3]*University of Liverpool*

**Purpose**: Optimisation is a fundamental requirement of radiographic practice. The degree in which this is routinely undertaken is likely to vary and is difficult to quantify. The aim of this study was to assess dose optimisation within common radiographic projections using novel DICOM header data extraction software.

**Methods**: Within a large state hospital DICOM information was extracted from three digital radiography rooms over a two month period. Radiographic examinations assessed included chest, abdomen, shoulder and knee. Data extraction was by bespoke software and included demographics and all available procedure/dose related parameters. Study data were then compared with default protocols to identify evidence of optimisation. Patients under the age of 16 were excluded and all projections were subject to visual scrutiny.

**Results**: Data from a total of 1250 examinations were collected. With paediatric patients removed data analysis was undertaken on 1245 (99.6%) examinations (724 women; mean (SD) age 57 (18) years). Examinations were equally split between the four anatomical areas. In terms of kVp, for chest radiography, parameters were adjusted from the default in six (2.4%) cases. For abdominal radiography parameters were adjusted in a greater number of cases (29/247; 11.7%). For shoulder and knee radiography kVp settings were adjusted in 3.2% of cases. For mAs (non-AEC examinations) 6 out of 581 (1.0%) projections (knee/Shoulder) had adjustments from the baseline protocol.

**Conclusion**: Based on this initial assessment of DICOM header data exposure factors appear to be infrequently adjusted and this raises questions regarding levels of dose optimisation within clinical practice.

### p174 Exploring how altering exposure factors effects the entrance skin dose for paediatric extremity imaging using direct radiography

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*Coventry University*

**Background**: With the wider use of Direct Radiography (DR) systems it has become apparent that there are differences within protocols used in Radiology departments(2). Literature suggests an increase in image quality when a lower range of kV is used(3,4,5,6) contradictory to previous literature regarding paediatric dose, high kV technique, and older technologies(1). The aim of this study is to explore the relationship between kV and entrance skin dose when imaging paediatric extremities on two styles of DR X-ray equipment.

**Method**: Using two different styles of DR equipment (portable detector and under table detector), experiments of similar set up will be carried out using a phantom to monitor entrance skin dose over a range of exposure parameters, using a dosemeter at the level of the skin surface for a typical paediatric extremity. Image quality will be monitored using a TOR18 test tool and radiologist analysis to ensure transferability to practice. The results will be analysed using a linear statistical model to answer three core hypotheses.

**Results**: The desired outcome of the study is to identify where the trade-off between image quality and entrance skin dose lies in DR imaging, and whether these results can be replicated between manufacturers and styles of equipment.

**Conclusion**: This study will provide guidance for Radiographers, department managers, and protocol developers in making evidence-based decisions on their DR imaging practice. The experimental design is easily replicable for use in other departments with several manufacturers allowing for optimisation of paediatric entrance skin dose on a national level.

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p175 **Measurement and use of effective detective quantum efficiency for the optimisation of three digital mammography systems, including photon counting scanning detector technology**

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*Hull and East Yorkshire Hospitals NHS Trust*

**Background**: Effective detective quantum efficiency (eDQE) accounts for the resolution and noise properties of an imaging system along with scatter and primary transmission, all measured under clinical conditions. Studies have shown eDQE to be useful in optimising the combination of target, filter and grid for different breast thicknesses in flat panel digital mammography systems. The aim of this study was to develop a methodology for measuring eDQE on a Philips MicroDose photon counting scanning mammography system.

**Method**: A custom made lead-blocker was manufactured to enable the accurate determination of the system transfer property. Effective modulation transfer functions, normalised noise power spectra, scatter and transmission factors, pre-phantom exposure and q-factors were then measured or calculated using published techniques.

**Results**: Measurement of the eDQE has shown there are significant differences in performance between the 'scan' and 'sub-scan' directions for the photon counting system. eMTF has been shown to be the most significant limiting factor in the scan direction, which results in very rapid fall-off in eDQE at mid-to-high spatial frequencies. Comparison with two flat panel mammography systems demonstrates that image quality for small micro-calcifications is limited on the scanning system. This correlates with imaging performance as assessed with more conventional metrics such as CDMAM automatic image scoring (as required during routine quality assurance testing in the UK NHS Breast Screening Programme).

**Conclusion**: We have shown poorer high frequency eDQE performance of a scanning system compared to two flat field systems. This may have implications with detecting small objects such as micro-calcifications.

p176 **Radiation risk in surveillance imaging of multiple endocrine neoplasia type 1**

Debbie Saunders; Ruth Casey; Ben Challis; Deborah Pitfield; Heok Cheow; Ashley Shaw; Helen Simpson; Tim Rice

*Cambridge University Hospitals NHS Foundation Trust*

**Background** Multiple endocrine neoplasia (MEN1) is a rare condition associated with tumours of the endocrine system [3]. Current guidance recommends frequent surveillance imaging despite an acknowledged lack of evidence base for these guidelines [1,7] Risk of malignant disease and tumour site informs the imaging strategy for each patient. This study assessed the overall radiation risk to MEN1 patients from surveillance imaging, carried out following current recommendations.

**Method** A retrospective review of imaging was carried out for a cohort of MEN1 patients at our centre over a period of 8 years. Imaging using CT and nuclear medicine was common. Radiation doses for each specific examination were estimated using DLP to effective dose conversion factors for CT [6] and effective dose per MBq conversion factors for nuclear medicine [2,4,5]. Effective doses for individual patients from all their imaging were summed to estimate a mean effective dose across the whole cohort of patients.

**Results** Imaging was reviewed for 43 patients: mean age 53 years; mean duration of disease 14 years. The estimated mean effective doses were 109 mSv (CT) and 121 mSv (Nuclear Medicine). The maximum estimated individual effective dose was 613 mSv. The mean and maximum lifetime cancer risks from radiation exposure were estimated to be 0.5% and 2.5% respectively.

**Conclusion** Effective doses and risk estimates are considered to be clinically significant for some patients. Recommendations for radiological surveillance should consider the risk of cumulative radiation exposure. This highlights scope to optimise surveillance imaging protocols in addition to equipment based optimisation.

p177 **PA vs AP lumbar spine radiographs - are there benefits from effective dose reduction**

Christopher Green; Karnati Guru; Ashok Subramanian; Subbarao Chaganti

*Taunton and Somerset NHS Foundation Trust*

**Background** Lumbar spine imaging constitutes 2.1% of radiographic examinations in the UK, and 2.2% of the collective dose (1). The majority of these are performed with the patient orientated AP to the X-ray beam. There is evidence from studies on phantoms of effective dose reductions of up to 37% when PA radiographs are obtaining compared with AP (2,3,4). To date, no studies have verified these findings in patients. The aim of this study is to evaluate the potential dose reduction that can be achieved by changing the direction of the imaging and assess any effect on image quality.

**Methods** 200 sequential patients weighing between 60-100kg having a standing lumbar spine X-ray performed (100 AP & 100 PA each including a lateral) will have their DAP (µGym2) measured at a constant FFD. Calculations of the organ doses will be made

using the Monte Carlo simulations in the PCXMC software program. Each radiograph will be analysed independently by two specialist MSK radiology consultants and two consultant spinal surgeons for image quality using European guidelines. Any difference in effective dose and image quality will be assessed statistically. Results Data collection is ongoing and expected to be completed by March 2017.

**Conclusion** We believe the outcome of this study will be of general interest to radiology departments nationally with implications for best practice in benefiting patient outcomes.

*1. Hart D, Health Protection Agency (Great Britain). Frequency and collective dose for medical and dental X-ray examination in the UK, 2008. Didcot: Health Protection Agency, 2010. 2. Young KJ. Should plain films of the lumbar spine be taken in the posterior-to-anterior or anterior-to-posterior position? A study using decision analysis. J Manipulative Physiol Ther 2007;30(3):200–205. 3. Heriard JB, Terry JA & Arnold AL. Achieving dose reduction in lumbar spine radiography. Radiol Technol 1993;65(2):97–103 4. Mekiš N, Mc Entee MF, & Stegnar P. PA positioning significantly reduces testicular dose during sacroiliac joint radiography. Radiography 2010;16(4):333–338.*

p178 **AP pelvis X-ray imaging on a trolley: Impact of trolley design, mattress design and radiographer practices on image quality and dose to patient**

Jenna Tugwell-Allsup [1]; Peter Hogg [2]

[1]*Betsi Cadwaladr University Health Board, Wales;* [2]*Salford Univeristy*

**Background**: Physical and technical differences exist between imaging on an X-ray tabletop to imaging a trolley-bound patient. This study evaluates how these differences impact s on image quality and radiation dose for AP pelvis imaging on a trolley in order to optimise this imaging examination.

**Materials and Method**: An anthropomorphic pelvis phantom was imaged on a commercially available trolley under various imaging conditions. Variables explored were two mattresses, two image receptor holder positions, three source to image distances (SIDs) and four mAs increments. Image quality was visually evaluated using a 2 alternative forced choice (2AFC) method with the reference image acquired on the X-ray tabletop. Contrast to noise ratio (CNR) was also calculated for comparison. Effective dose was established by using Monte Carlo simulation software. Optimisation scores were derived as a figure of merit by dividing effective dose with visual image quality scores.

**Results**: Visual image quality significantly reduced by 13 % ($p<0.05$) whilst effective dose significantly increased by 56% ($p<0.05$) for the images acquired on the trolley using identical acquisition parameters to the reference image. The trolley image with the highest optimisation score was acquired using 130cm SID, 20mAs, the standard mattress and platform not elevated. A difference of 12.8mm was found between the image with the the lowest and highest magnification factor (18%).

**Conclusion**: The acquisition parameters used for AP pelvis on the X-ray tabletop are not transferable to trolley imaging and should be modified accordingly to compensate for the differences that exist

p179 **The impact of a single site trauma centre status on interventional radiology**

Stephanie Pennington

*Aintree University Hospital, Liverpool*

Until recently we have been part of a trauma collaborative working with various healthcare trusts in the area. We have recently become a single site centre for trauma care, this has meant we have changed the way we work with regards to trauma patients. This change has affected the way that Interventional Radiology works and has an impact upon the staff and the way we deliver healthcare in this setting. These changes have been brought in to ensure that the patients who are in need of the most complex and quick care receive it in a safe and appropriate manner, provided by staff who are best trained to ensure this care is given. (RCR: Standards of practice and guidance for trauma radiology in severely injured patients)

*Royal College of Radiologists (2011). Standards of practice and guidance for trauma radiology in severely injured patients. https://www.rcr.ac.uk/sites/default/files/BFCR%2811%293_trauma.pdf*

## SERVICE INNOVATION & OPTIMISATION

p180 **Edit series: Saving you time and money**

Andrew Macallister; Anthony George; Naomi Fenton; Toby Hall

*Royal United Hospitals Bath NHS Trust*

**Background**: It was noted that many plain radiographs were reported after patients had a reported CT scan of the same body part. Many are privately outsourced costing £4.95 per radiograph. Our RIS system allows reports to be combined using the 'edit series' function.

**Aim**: To assess the number of privately outsourced radiographs for patients who have already had a reported CT scan of the same body part.

**Method**: Our RIS system was used to identify all patients with a locally reported inpatient CT scan and a plain radiograph of the same body part within the preceding 3 days. Reporting method and several other data items were collected over a 2 week period.

**Results:** 123 events were identified, 28 were excluded as the radiograph was reported before the CT scan or not reported at all. Of the 95 radiograph reports generated after the CT report 61 (64%) were privately outsourced, 29 (31%) were reported locally and 5 (5%) used the 'edit series' function. Private outsourcing cost £301.95, extrapolated to £7,850.70 annually. The opportunity cost of a locally reported radiograph is an outsourced radiograph, costing £3,732.30 annually with a total cost of £11,583.

**Conclusion**: Many plain radiographs are needlessly privately outsourced or reported in retrospect which can easily be avoided by using the RIS 'edit series' function to combine reports. There is the potential for a significant financial saving.

p181 **An economic evaluation of CT head reporting radiographers in clinical practice**

Paul Lockwood

*Canterbury Christ Church University*

**Background** Current NHS England and Royal College of Radiologist (RCR) reports estimate the year on year increase of CT examinations to be 10%, with the designated workforce of radiologists disproportionate to the increase in demand of imaging reporting.

**Purpose**: The aim of this poster is to enable conference participants to review a PICO framework study to evaluate the patient work flow demand from retrospective audit data (n=7,266) at an acute NHS district general hospital (DGH) over 12 months. Reviewing potential outcome risk data (diagnostic thresholds), and feasibility (workforce capacity) of both interventions. The economic evaluation calculated hourly unit costs for comparison estimation of consultant radiologists and reporting radiographers Royal College of Radiologists (RCR), Centre for Workforce Intelligence (CfWI) and Department of Health (DoH) estimates for both interventions. The intended learning outcomes for readers by the end of this poster should be able to:

1. Understand the clinical demand of CT reporting at a DGH hospital and appreciate service development and innovation of a skills mix workforce to report CT head examinations.

2. Begin to evaluate the level of reported diagnostic accuracy of radiographer CT head reporting to reflect level of potential risk of implementation of this service. To start to reflect afterwards on the various costs involved in current provision and the potential for savings in this time of austerity.

p182 **An audit of CT requests for major trauma at a UK level 1 trauma centre**

James Davies; Biju Thomas

*University Hospital of North Midlands*

**Background** Our hospital is a major trauma centre admitting around 1,000 patients with serious injuries yearly, with CT playing a vital role in management. Knowledge of injury mechanism and physiological status is vital for providing informed reports, and in planning further investigations. IR(ME)R mandates all investigations be justified, and trauma is no exception. In our hospital a provisional registrar report is provided, that is checked by a consultant. Anecdotally there is suggestion that clinical information is often lacking. This audit was conducted to address the validity of this claim.

**Methods** A one-month retrospective audit was conducted using July 2016 cases. Patients undergoing whole body CT for major trauma were identified by manual search of CRIS database. Clinical information in the provisional report, and request documents was analysed.

**Results** 45 cases identified. M:F 38:7; age 18-90yrs(48.4). Mechanism; Fall 25%;RTC 73%;Crush 2%. A dedicated trauma form was used in 67%(30) cases and in 9%(4) no form was retrievable. Information was scored by mechanism detail, areas of concern, and physiology ('MAP' score). 11 (26.8%) requests scored fully in all areas. Mechanism was deemed sufficient in 22 (53.6%), areas of concern in 33 (80.4%), and physiology in 21 (51.2%).

**Conclusion** Significant variation exists in information provided. Retrieval of scans was time-consuming owing to manually searching. Changes were made in referrer and radiologist practice, and a trauma-specific CRIS code for easier retrospective identification of cases was created. Noticeable change is already occurring, however prospective re-audit data is awaited in early 2017 to fully assess this.

p183 **Changing perceptions in CT**

Genevieve Sandon

*Birmingham City University*

**Background** The role of the radiographer in CT scanning has evolved dramatically over years: resulting in innovative changes which enable optimisation of service improvement within the imaging modality of computerised tomography.

**Purpose**: The poster aims to identify the key areas of change within the working day of the CT radiographer over the last 30 years and reflect on the progression of the radiographer's role up to the level of Advanced Practitioner. Recognition of the ability of radiographers to be versatile and adapt to change can lead to improved patient service and radiographer career enhancement.

**Summary**: The key categories of change are evaluated: Technical developments in CT Working conditions Education Role extension and advanced practice Improvements for the patient.

p184 **Reporting of staging and treatment response in cancer imaging**

Sarah Hudson; Yvette Griffin

*University Hospitals of Leicester*

**Background**: Imaging to stage cancer and assess treatment response are essential for timely patient management. TNM staging and classification of response into partial response, progressive disease or stable disease are recommended by the RCR, modified RECIST criteria and WHO (1, 3, 4). Aims: 1. Staging scans should be assigned a stage. 2. Post treatment scans should have a response documented.

**Method**: Retrospective review of staging/response assessment reports on CRIS. Consecutive cases from 9 MDTs. Minimum of CT chest, abdomen and pelvis included. Speciality and seniority of reporter noted.

**Results**: 255 cases. All by consultant radiologists except 3 by post FRCR SpRs. CT (63%), MRI with CT (13%) and PET-CT (24%). Of 182 baseline staging scans 77 (42%) gave TNM staging. Of 73 response scans, 57 (78%) gave a treatment response statement. 48 cases by non-speciality reporter, only 9 (19%) had an assigned stage/treatment response.

**Conclusion**: Whilst there was a full description of lesions, a high proportion of radiology reports lacked explicit TNM staging and response. Oncology and GI radiologists were the most likely to give a statement on staging. In 33%, reasonable mitigating factors were given:- when staging and response assessment was not the primary reason for the scan, uncertainty if findings malignant or benign, unknown or ambiguous primary and indeterminate/mixed response. Ensuring reports are issued from speciality radiologist and introducing a report proforma or a checklist could improve documentation of staging and disease response. The latter is in routine use in pathology (2).

*1. Eisenhauera, E.A. et al. (â€Ž2009) New response evaluation criteria in solid tumours: Revised RECIST guideline (version 1.1). 45(2):228-47 2. Gormly, K.L. (2009) Standardised tumour, node and metastasis reporting of oncology CT scans. J Med Imaging Radiat Oncol. 53(4):345-52. 3. Royal College of Radiologists. (2014) RCR Recommendations for cross-sectional imaging in cancer management, second edition. Imaging in the Evaluation of cancer. Faculty of Radiology, Royal College of Radiologists, 63 Lincolnâ€™s Inn Fields, London, UK 4. World Health Organization. (1979) WHO handbook for reporting results of cancer treatment: offset publication no. 48. World Health Organization, Geneva, Switzerland.*

p185 **Radiographer reporting: A peer review audit**

Sophie Cheshire; Carol Swift; James Murphy; Syed Ali

*Royal Preston Hospital, Lancashire*

**Background**: Reporting radiographers have played an important role in our major trauma DGH for the last 13 years. We have 8 reporting radiographers within the trust who have undertaken specialist post graduate training to assist with the increasing demand of reporting appendicular and axial X-rays. The aim of this audit is to determine the accuracy of radiographer reports. The audit involved peer review of reports in order to enhance learning and development.

**Method**: One month retrospective peer reviewed audit with the final quality check performed by a consultant MSK radiologist. The standard was to achieve 95% accuracy, this is a historical benchmark figure.

**Results**: A total of 673 examinations were peer reviewed. Within this sample 75% were true negatives and 23% true positives. Only 1% each were either false positive or false negative.

**Conclusion**: Accuracy can be utilised as a measure of the quality of reporting and this audit demonstrates that radiographer reporting exceeded the 95% benchmark. It is accurate and cost effective. It reduces reporting turnaround times and helps manage the increasing demand for X-ray reporting. Other benefits from this audit have included the education of general radiographers on labelling of X-rays and how to improve image quality as well as the implementation of a new reporting

template for ankle X-rays. This audit has enabled self development and feedback for the radiographers and released radiologists for more complex tasks.

p186 **Developing a radiographer practitioner role within a minor injury unit**

Siobhan Edwards-Bannon

*St Mary's Treatment Centre, Portsmouth*

**Background** The development of AHPs to assist with a variety of clinical roles within the NHS is crucial to the delivery of safe healthcare in an environment of growing workload and limited resource. AHPs bring specialist skills that can be further developed to support medical practitioners in a number of clinical fields to improve patient experience and waiting times. Previous initiatives within the Southern region to develop Radiographers via a MINTs thereby facilitating early discharge from MIU had been unsuccessful due to lack of consistency in training and engagement of departments.

**Learning Outcomes** To understand how the creation of a Radiographer Practitioner Role can be effectively developed and implemented into a busy MIU. This poster will outline the process by which the role was researched, developed and introduced to the MIU. In particular it will look at Radiographer education and the competencies required to develop an effective MIU practitioner.

**Content** Briefly explaining background for initiating role. What is Radiographer Practitioner -- Description of the role and how it works within the MIU setting. Challenges in implementation -- Education, Proving competency, Patient and Professional acceptance. Benefit of the Radiographer Practitioner -- Patients, Professionals, Departments and for the NHS including patient pathway statistics, feedback from patients and professionals.

**Discussion** Review of what has been achieved. Further Development of the role -- proposed introduction of reporting and audit of accuracy and outcomes.

p187 **Referring physiotherapist and emergency nurse practitioner satisfaction with plain image radiological reports**

Ruth Easton; Jonathan McConnell

*NHS Greater Glasgow and Clyde*

**Background**: Professional bodies within radiology recommend that all imaging procedures have a written report [1,2]. Emergency Nurse Practitioners (ENPs) and Physiotherapists request plain radiographic musculoskeletal trauma examinations. To date no-one has asked about the degree of satisfaction of reports received, is the clinical question answered, is there a preferred style to report content and any difference between reporting radiographers (RRs) and radiologists [3]?

**Method**: ENPs and Physiotherapists from a major receiving hospital received 30 RR and radiologists reports/images from hand, knee or shoulder examinations. A mixed methods approach established report satisfaction and style preference scores using a likert scale for three styles, namely: free text (style A); bullet point listed (style B) and Yes/No to abnormality present (style C). Participants were asked if the clinical question was answered. Responses were examined to establish preferred style or content according to professional group reporting the image. A paired t-test calculated significance for satisfaction, style and answering the clinical question and an independent samples t-test compared professions.

**Results**: No statistically significant difference between report styles A and B was detected though style C was widely rejected. Answering the clinical question produced similar results. No statistically significant difference was indicated between professions for either report style A or B (p=0.386).

**Conclusions**: Referrers prefer reports using either free text or as a listed approach. A simple binary response is not valued by the referrer. No significant difference in text based styles is seen between the RRs and radiologists, indicating satisfaction from both reporting professions.

*[1] Robinson P. Radiology's Achilles' heel: error and variation in the interpretation of the Rontgen image. The British Journal of Radiology 1997; 70: 1085-1098 [2] Robinson P, Wilson D, Coral A, Murphy A, Verow P. Variation between experienced observers in the interpretation of accident and emergency radiographs. The British Journal of Radiology 1999; 72: 323-330 [3] Grieve F, Plumb A, Khan S. Radiology Reporting: a general practitioner's perspective. The British Journal of Radiology 2010; 83: 17-22*

p188 **Review of a network CT head out-of-hours service delivered by radiology registrars**

Darren Chan; Nicholas Hollings

*Royal Cornwall Hospitals NHS Trust*

**Aim:** To assess the performance of pre-FRCR registrars in CT head interpretation under a new, regionalised on call system.

**Background**: In- and out-of-hours NHS reporting networks are beginning to evolve in the UK. Prior studies have established that registrars are competent in their interpretation of CT head scans1-2, but governance arrangements surrounding networked reporting are largely untested. The SW Peninsula Radiology Network, covering 4 acute trusts, now sees registrars reporting on-call scans at sites remote from their physical location. These shifts can be busy, challenging for more junior registrars and divorce them from face-to-face interaction with local radiographers and referring clinicians.

**Method**: A retrospective study of 250 consecutive CT head reports performed between 18.00 and 07.00. All reports second read by three consultants with subspecialty interest in neuroradiology.

Reports were categorized as: no change, minor or major discrepancy. Minor discrepancy implied no change to outcome or clinical plan, major discrepancy implied potential for adverse patient outcome.

**Results**: 19 registrars' reports were analysed (8 ST2, 6 ST3 & 5 ST4) from 1/12/15 to 19/3/16: only 1 major discrepancy was found, in one ST2 report (0.4%); 23.6% reports had minor discrepancies, the rest (76%) none.

**Conclusion**: Report accuracy is good across all grades. More senior registrars make fewer errors. Formal assessment of report accuracy was not performed prior to networked service commencement but it is reassuring to know that post inception report quality is high.

*1. Erly, W.K., Berger, W.G., Krupinski, E., Seeger, J.F. and Guisto, J.A., 2002. Radiology resident evaluation of head CT scan orders in the emergency department. American journal of neuroradiology, 23(1), pp.103-107. 2. Patel, M., Ginat, D., Katzman, G., Collins, J., Lee, S., 2015. Radiology resident interpretation of overnight emergency head CT: Accuracy and clinical impact of misinterpretation. Annual Meeting 2015 – American College of Radiology. Available: https://www.acr.org/~/media/ACR/Documents/PDF/Annual%20Meeting/Abstracts/076/ePoster_076.pdf*

## p189 Action research into implementing an open access service in X-ray: Baseline evaluation phase

Nicholas Barlow

*Mid Yorks NHS Trust*

**Introduction** Current drivers for reducing waiting times in X-ray include the NHS cancer plan (NHS England 2016) and government targets (Department of Health 2013). Trusts have implemented open access services to reduce waits (Care UK 2011), however their effectiveness is currently unknown. This study forms the baseline evaluation for wider participatory action research that will investigate effectiveness of the current local general practitioner musculoskeletal X-ray appointments service and identify barriers/enablers to open access

**Methods** This study employs both qualitative and quantitative methods. Quantitative waiting time data was sought from the Trust's radiology information system. Qualitative data was obtained via three semi-structured interviews with key informants and two (cross-site) staff focus groups. A patient survey was then undertaken to measure satisfaction. Quantitative analysis was achieved via descriptive statistics, whereas qualitative analysis was undertaken via template analysis.

**Results** Survey results indicated an average waiting time from referral to X-ray of 11.81 days, with 91% of patients finding this time to be 'adequate' or better. 45% however stated only a maximum wait of 1 week was acceptable. Several drivers for change were identified including external influences (government targets) and delays in the appointments process. Barriers/enablers to open access identified included low staff levels, departmental layout and inadequate communication.

Although most patients are happy with the current service, a preference for appointments within 1 week, including the varying identified managerial drivers support the need for change. Results will inform the next phase of the PAR which will look to implement open access via addressing the barriers/enablers identified.

*1. CareUK (2011). Walk-in X-ray service launched for Leeds and Bradford patients. CareUK. http://www.careuk.com/news/walk-X-ray-service-launched-leeds-bradford-patients-0 Accessed 18 March 2016. 2. Department of Health (2013) The Handbook to the NHS Constitution (Cm18892, 2013). The Stationary office. http://www.nhs.uk/choiceinthenhs/ rightsandpledges/ nhsconstitution/documents/2013/handbook-to-the-nhs-constitution.pdf Accessed: 5 March 2016. 3. NHS England (2016). Achieving World Class Cancer Outcomes: Taking the Strategy Forward (2016). NHS England. https://www.england.nhs.uk/wp-content/uploads/2016/05/cancer-strategy.pdf Accessed 6 April 2016.*

## p190 CT productivity 8am to 9am: Can we do better?

Elizabeth Barclay; Anna Sharman

*University Hospital of South Manchester*

**Background**: There has been speculation within our radiology department that the rate of CT scanning between 8am and 9am is lower than expected. Anecdotally, a slow start to the day causes a backlog of scans and increased pressure on the department throughout the day. Delayed scanning and reporting can lead to a knock-on effect on patient flow throughout the hospital, with many patient discharges being dependent on CT scan results. Therefore, we have assessed the productivity of CT scanning between 8am and 9am in order to identify areas for improvement. Relevance: other hospitals are likely to have similar problems and therefore may benefit from our study findings and recommendations to improve patient flow.

**Purpose**: To demonstrate our findings and recommendations, and provide valuable information for other hospitals. The poster will comprise results of the study, including CT productivity 8am-9am compared with the rest of the working day, and reasons for low scanning rates inferred from our data. Recommendations following multidisciplinary team discussion at the departmental clinical governance meeting will be outlined. Improvements in our service will be demonstrated using the subsequent data collected two months after changes had been implemented.

**Summary**: Changes agreed and implemented. Results of second data collection. Further recommendations. Will include factors affecting rate of CT scanning and therefore rate of patient flow (for those awaiting a 'discharge-dependent' scan) -- likely to be similar factors in other hospitals, therefore transferrable recommendations.

p191 **Are the models of care championed by the NHS constitution fully applicable within radiology?**

Rachael Forton; Maryann Hardy; Anita Sargeant

*University of Bradford*

**Background:** The NHS constitution details the principles, values, rights and responsibilities of the NHS, making explicit to the public, patients and staff what can be expected with regards to quality care and service provision. Underpinned by professional and regulatory body documentation, the principles of care defined in the constitution aim to inform the care culture within the NHS. However, it is unclear what impact this document has on societal expectations of care and the patient-radiographer relationships or whether the principles, as described, are fully applicable within high technology imaging departments.

**Method:** Using Critical Discourse Analysis, guided by the work of Fairclough (2015), a qualitative analytical framework was developed to systematically review the language and phrasing of the NHS constitution, explanatory documents and relevant professional and regulatory body documentation. Extracted data were explored in depth to derive explanatory themes.

**Results:** High quality care, as defined by the NHS constitution, focuses on three interrelated elements: valuing patients as individuals; autonomous professional practice; and the generation of positive working environments. However, these are derived from generic and perhaps idealistic nursing models of care that may have limited application within radiology.

**Conclusion:** Whilst aiming to raise standards, the NHS constitution may be generating unachievable, idealistic models of care when application is considered within radiology. Consequently, failure to meet defined care expectations may result in staff demoralisation and sub-optimal patient-radiographer relationships. Radiography, as a profession, needs to challenge nursing models of care championed by the NHS constitution and develop a more relevant care evidence base.

p192 **Strategic planning for the radiology department of the future**

Simon Rickaby [1]; Vin Majuran [2]; Jim Weir [2]

[1]*Kingston University;* [2]*Kingston Hospital NHS Foundation Trust*

**Rational**: In response to ever increasing business pressures, many radiology departments have adopted unsustainable reactive approaches to service management. However, the authors assert that there is a critical need to develop and employ principled scientific approaches to radiology service management in order to plan for the radiology department of the future.

**Methods**: The authors adapt De Geus's (1997) four key traits of successful companies to the context of a modern radiology department, by proposing four overarching concepts that can guide strategic service management. Each of these concepts is further explored with the use of a SWOT analysis and a local case study.

**Results**: The following are the derived business concepts, with De Geus's original traits in brackets:

- Evidence Based Management (Sensitivity to the business environment)
- In practice - Business analytics via Informatics, research, and local audit.
- Culture & Environment (Cohesion and identity)
- In practice -- Strategic planning, MES, recruitment and retention, professional development, quality.
- Consultation (The ability to build relationships) In practice -- Reflective needs based dialog with stakeholders, patients and staff.
- Financial Resilience (Conservative financing)
- In practice -- sustainable ten year budgetary development, through the use of comprehensive business analytics.

**Conclusion**: The authors adapt De Geus's four key traits of successful companies to the context of the modern radiology department, by proposing four key concepts that can be used when planning the radiology department of the future. It is proposed that a focus on: Evidence based management, Culture & Environment, Consultation and Financial Resilience, can provide sustainable development.

*1. Geus, Arie De. The Living Company. Boston, MA: Harvard Business School, 1997. ISBN 978-0-87584-782-5.*

p193 **Inside the Trailblazer - Development of apprenticeship standards**

Denise Baker

*University of Derby*

The introduction of the apprenticeship levy in spring 2017 will potentially see employers set aside large sums of money which can only be spent on apprenticeships. This has seen a flurry of activity in developing apprenticeships and there is a very real possibility that there will be an apprentice radiographer in departments by 2018. This poster will give information on the development of apprenticeships and aim to dispel some myths about the quality of the training apprentices will need to undertake. The author was privileged to be part of the nursing trailblazer group and has had first hand experience of the development of an apprenticeship standard. The poster will cover: What is a trailblazer? Who can be part of a trailblazer? What is an apprenticeship standard? What is the role of the professional body and regulator? What is end point assessment and why do we need it? What is the Government's role?

p194 **MRI in a specialist emergency setting: Early findings**

Rebecca Simmons; Darren Hudson

*InHealth Group, London*

**Background**: Northumbria Specialist Emergency Care Hospital opened in June 2015, providing specialist emergency care for seriously ill and injured patients from across Northumberland and North Tyneside. Included in the hospital is the MRI unit which is solely used to scan inpatients and emergency cases, and operates seven days a week from 8am-midnight. Referrals are generated from a variety of specialties including, Accident and Emergency, stroke unit, GI and orthopedics.

**Purpose**: After 12 months into service delivery a review of the workload and case mix being provided by MRI was conducted. This showed a steady number of examinations performed each month. Of the 4015 scans performed, 28% and 35% were head and spine respectively, with the next two significant examination areas being abdominal (20%) and MRA Carotids (3%), and the remaining examinations being a mixture of other body areas.

**Summary**: Whilst neurological assessment for cauda equina, cord compression and stroke were expected to form a significant part of the case mix, it wasn't expected that so much abdominal exams would be requested. It is felt that the availability and accessibility to MRI as a first line test has helped this, with many patients presenting with abdominal pain receiving MRCP. The use of MR supports a reduction in radiation dose and utilises the superior soft tissue contrast in improving diagnostic confidence and outcomes. However, along with the benefits and increased utilization of MRI in the emergency setting there are always the considerations over managing patient safety and patient tolerance to factor in.

p196 **Managing scan related anxiety in MRI: Applying an 8C's approach**

Darren Hudson

*InHealth Group, London*

**Background**: Scan related anxiety is a common occurrence within MRI, being one of the main reasons for scan failure or premature termination. This in turn has an impact on providing a diagnosis for patients that can therefore delay treatment, and cost implications for the business in terms of inhibited efficiency and wasted scanner use.

**Purpose**: The most anxiety inducing part of the exam process is positioning on the scan table and placement of surface coils, and to a lesser degree the initial perception when entering the scan room itself. Whilst much around the nature of the beast can't be changed, it is important to remember there are certain aspects of human interaction that may help alleviate scan related anxiety and make having a scan more tolerable for patients.

**Summary**: Improving patient experience is paramount in facilitating successful scan outcomes for patients and resulting in high levels of satisfaction, which in turn help maintain business reputation and department throughput. To be able to provide personalised imaging experiences, the human interaction between patient and staff member is important, and should be focused around acknowledging and actively responding to any patient fears or anxieties so that care can be tailored to their specific needs. It hinges on developing trust which has been shown to reduce anxiety levels, which leads to less failed scans and in turn increased productivity. An 8C's summary approach was developed to help support staff in their interaction and management of patients; consider, communication, compassion, control, comfort, calming, confidence and

p197 **Success rates at cervical catheterisation in a sonographer-led HyCoSy service: A retrospective baseline audit**

Amanda Marland; Gareth Bolton; Paul Miller

*University of Cumbria*

**Background**: HyCoSy (Hysterosalpingo-contrast sonography) is the investigation of choice for the evaluation of tubal patency as recommended by the National Institute for Health and Clinical Excellence (NICE) (2004) - now the National Institute of Health and Care Excellence. Role extension and development in Ultrasound has led to sonographer performed HyCoSy being undertaken in many UK centres in recent years. However, published audit surrounding sonographer-performed HyCoSy is limited.

**Objective**: The aim of the study was to evaluate success/failure rates at cervical catheterisation in women referred for HyCoSy examination in a sonographer-led service and to explore the methods and techniques identified in the literature for improving success.

**Methods**: A baseline audit was undertaken for the purpose of evaluating current service provision. Data were analysed retrospectively for all women undergoing HyCoSy examination over a twelve-month period.

**Findings**: Over the study period, 143 women underwent HyCoSy examination. Cervical catheterisation was successful in 86% of women (unsuccessful in 14%) at first attempt, and in 79% of women (unsuccessful in 21%) at second attempt. Overall, a success rate of 96% was reported (4% failure rate). Failure rates of up to 8% were reported in the literature.

**Conclusions**: The overall failure rate in the current service is acceptable when reviewed alongside rates described in the literature. However, there is a clear need to improve first time success at cervical catheterisation. Management techniques for improving success have been identified and recommendations made to improve the quality of the current service.

p198 **What matters to you? Exploring what's important to patients in a diagnostic radiology department**

Paula Evans; Louise Harding

*Warrington and Halton Hospitals NHS Foundation Trust*

Over recent years, there has been a growing movement in healthcare that is focused around the shift of conversations from 'What's the matter with you?' to 'What matters to you?'

The aim of this shift is to support the development of high quality compassionate support, care or treatment focused on what people really want and need. In the UK, Scotland has been leading the way with innovative work to develop reliable ways to identify what matters to patients, to listen to them and to act upon responses. Currently, there is very little evidence of this type of patient involvement/interaction/satisfaction being undertaken within Radiology departments.

This poster will help raise awareness of this process and encourage change about the way we approach our patients and their needs. It will also show how we have developed 'What matters to you?' within our department and demonstrate the outcomes that we have achieved and any difficulties encountered.

p199 **Using Safety Culture Organisational Reliability and Engagement (SCORE) survey to evaluate safety culture in radiology**

Julie Mills [1]; Christine Heales [2]; Colin Stuckey [2]; Diane Nicholson [2]

[1]*University of Exeter;* [2]*Plymouth Hospitals NHS Trust*

**Background** The culture of an organisation/department is important in ensuring delivery of high quality patient care. One way to evaluate this is to use the Safety Culture Organisational Reliability and Engagement (SCORE) survey

**Purpose**: To disseminate the use of SCORE survey as a valuable tool in evaluating radiology departments. Results from the SCORE survey can help form the basis of current and future initiatives within organisations. The survey also asks questions around Learning Environment Local Leadership/Management * Resilience/ Burnout Teamwork Safety Climate Work / Life Balance

**Summary**: Evaluation of how to access and run the SCORE survey and results and discussion from 2 radiology departments CT and MRI within an acute NHS trust

*1. Safe and reliable healthcare (2014) The Integrated SCORE (Safety, Communication, Operational Reliability & Engagement Survey) available online at https://www.safeandreliablecare.com*

p200 **Introducing preliminary clinical evaluation of nasogastric tube position on adult chest radiographs and removal of incorrectly placed nasogastric tubes by diagnostic radiographers**

Susan Bird; Susan Todd; Alex Gosling; Greg Royle; Fenella Wong; Claire Barker

*The Christie NHS Foundation Trust*

Use of misplaced nasogastric (NG) tubes was recognised as a patient safety issue by the National Patient Safety Agency (NPSA) in 2005 and four further alerts were issued between 2011 and 2016. Introducing fluids or medication into the respiratory tract via a misplaced NG tube is a 'Never Event' (1). At this hospital, the majority of NG tubes placed are checked by pH testing of aspirate but a number still require X-ray imaging to confirm NG tube tip position. Of these, a few per year are misplaced into a bronchus or lung. Although such cases are few in number, there is often a delay before the formal written radiology report is available, with subsequent risk of the NG tube being inadvertently used by the clinical team when the patient returns to the ward. The radiology department is currently training general radiographers: (i) In preliminary clinical evaluation of adult chest radiographs for NG tube position (ii) The subsequent removal of any NG tubes misplaced within the respiratory tract before the patient leaves the radiology department. By implementing radiographers removing these misplaced NG tubes, the risk of a patient having medication/fluids through an incorrectly placed NG tube is reduced. The poster will demonstrate the process taken to introduce this new practice, including training, competency and issues encountered.

*(1) NHS Improvement (2016). Patient Safety Alert - Nasogastric tube misplacement: continuing risk of death and severe harm. Alert reference number NHS/PSA/RE/2016/006.*

p201 **Repeat chest radiographs for consolidation: Do GPs follow advice?**

Nicholas McGlashan; Robin Dale; Sue Matthews

*Sheffield Teaching Hospitals*

**Background**: Consolidation on a chest radiograph has a variety of causes including infection and malignancy. Current RCR and BTS guidance advises a repeat radiograph in films with consolidation after 6-12 weeks if a patient is > 50 years, heavy smoker, persistent signs and symptoms and at risk of malignancy. Failure of resolution on follow-up should prompt further investigation by the respiratory services and / or further imaging with a CT chest.

**Method**: 2 months of GP outpatient films (3588) were filtered to include only studies where the report suggested radiographic follow-up (294). RIS was then used to determine whether a follow-up film or CT had been performed.

**Results**: 85% of GP films were followed-up as advised. 4% of the cohort was subsequently diagnosed with a bronchogenic carcinoma. Only 6 films of the 15% not followed-up had concerning radiographic abnormalities that warranted further follow-up. The mean time to repeat imaging was 8 weeks. No patient < 50 years old was diagnosed with cancer. Repeat imaging was requested in 8% of all GP chest films performed.

**Conclusion**: GP initiated follow-up proved robust. However, there was a high radiology-initiated repeat rate for follow up of small abnormalities such as bronchial wall thickening and tiny areas of atelectasis. The audit provided reassurance that adherence to guidelines should not lead to missed cancer diagnoses. Re-enforcement of guidelines should reduce unnecessary imaging and cost whilst maintaining standards.

*1. Bhaludin, B.N. et al. (2014). Delays and errors in abnormal chest radiograph follow-up: a systems approach to promoting patient safety in radiology. J Eval Clin Pract. 20:453â€"459. 2. Cliffe, H. et al. Follow-up of consolidation on chest radiographs before and after the introduction of radiology initiated follow-up. https://www.rcr.ac.uk/sites/default/files/8_Walsh_SECURED.pdf. 3. Harvey et al. (2014). Recommendations for Chest CT Prompted by Outpatient Chest Radiographic Findings. Radiology 275 (1). 4. Lim, W.S. et al. (2009). BTS guidelines for the management of community acquired pneumonia in adults: update 2009. Thorax 2009; 64(suppl 3):iii1â€"iii55 5. Little, B.P. et al. (2014). Outcome of Recommendations for Radiographic Follow-Up of Pneumonia on Outpatient Chest Radiography. AJR 202:54-59. 6. NPSA Safer Practice Notice 16 (2007). Early identification of failure to act on radiological imaging reports. http://www.nrls.npsa.nhs.uk/resources/?EntryId45=59817 7. Royal College of Radiology. Standards for the communication of critical, urgent and unexpected significant radiological findings, 2nd edition. London: The Royal College of Radiologists, 2012. https://www.rcr.ac.uk/sites/default/files/publication/BFCR(12)11_urgent.pdf 8. Sistrom CL, Dreyer KJ, Dang PP, et al. (2009). Recommendations for additional imaging in radiology reports: multifactorial analysis of 5.9 million examinations. Radiology. 253(2):453â€"461. 9. Wacogne, I. and Negrine, R.J.S. (2003) Are follow up chest X-ray examinations helpful in the management of children recovering from pneumonia? Arch Dis Child 88:457-8.*

p202 **A pilot single-centre single-blinded randomised controlled trial study to compare the use of video demonstration or telephone interview verses routine intervention to alleviate anxiety in patients prior to MRI**

Jenna Tugwell-Allsup

*Betsi Cadwaladr University Health Board, Wales*

**Background**: Patients undergoing MRI often experience anxiety prior and during scanning. Anxious patients can cause early termination of scan but also cause movement artefacts and exacerbate swallowing reflex and peristalsis, increases heart rate/respiration and blood flow; all potentially having a detrimental effect on image quality. The aims of this study was to explore two simple, cheap and easily implemented interventions to reduce anxiety pre MRI scanning by addressing the diverse

informational needs of patients. The majority of interventions previously explored are not routinely practiced due to questions over their cost-effectiveness.

**Method**: Ninety first time attending patient for MRI head, spine or cardiac scan were randomised into one of three interventions; DVD, telephone conversation with a radiographer or routine appointment letter. The State-Trait Anxiety Inventory (STAI) questionnaire was used to measure anxiety levels pre and post intervention. Motion artefacts were visually assessed by 2 observers and a post scan survey was also used to capture patient satisfaction. A convenience sample of six patients had post scan interview.

**Results**: The study has ten more participants to recruit which will take approximately six weeks. Data analysis will then be undertaken promptly by a senior statistician. Data from the STAI questionnaires will be analysed using ANCOVA and image quality analysed using ANOVA. Intra class coefficient (ICC) will be used to compare image quality scores between the two observers. A thematic approach will be used for the interviews and opened ended questions on the survey.

## SIMULATED LEARNING

### p203 Simulated CT learning: The perils and pleasures of remote access education for radiography students

Sarah Lewis; Elaine Ryan; Tara Liley; Michelle Rutledge; Maram Alakhras; Patrick Brennan

*The University of Sydney, Australia*

**Background**: Background: Simulated learning is vital to translating theoretical and early practical experiences into safe clinical practice. Simulation in medical imaging has common limitations of replicating errors around image quality and radiation dose to the patients.1 The NETRAD CT facility at the University of Sydney comprises of a Toshiba 16-slice CT scanner which students use to scan a range of phantoms in real time via remote-share labs internet access.

**Methods**: Students engage with extensive learning resources in patient preparation, scanning procedures, dose modification techniques and 3D reconstruction when using NETRAD within their undergraduate curriculum. In this study, we surveyed the experiences of Australian students who have availed of this remote access scanner (Phase 1, n=28) and their attitudes about CT simulation for preparation for clinical placement (Phase 2, n=80).

**Results**: Phase 1 results showed that students valued opportunities to repeat and refine CT skills and appreciated the strong relevance to future roles (87% Strongly Agree (SA)). However, students made the clear distinction that remote access was different to real life scenarios (70% SA), with minor frustrations about remote access login and lack of educator facilitation. Phase 2 data collection is currently ongoing and preliminary results indicate that CT simulation is most valuable for pre-clinical skills and reduces in effectiveness after dedicated CT placement.

**Conclusion**: The acceptance of simulation to enhance and replace current clinical education rotations needs further exploration from education and professional perspectives. However it is clear that CT simulation promotes student engagement and provides mastery of CT skills.

*1. Bridge, P., Gunn, T., Kastanis, L., Pack, D., Rowntree, P., Starkley, D., Wilson-Stwart, K. (2014). The development and evaluation of a medical imaging training immersive environment. Journal of Medical Radiation Sciences, (61), 159-165. Doi: 10.1002/jmrs.60*

### p204 Student radiographer attitudes towards the older patient - A longitudinal study

Lisa Booth [1]; Sundaran Kada [2]; Peter Phillips [3]; Milka Satinovic [2]; Paul Miller [1]

[1]*University of Cumbria;* [2]*Bergen University College;* [3]*Universty of Cumbria*

**Background**: The ageing population is creating greater pressure on health care services; radiology is no exception. Care of the older population has been reported as inadequate and as a consequence of the Mid-Staffordshire enquiry, care of the older patient has become a central feature of education and training. However little evidence exists as to the effectiveness of this education in the radiography arena.

**Method**: This longitudinal study evaluated student radiographer attitudes towards older people. In the first phase an educational intervention, aimed at improving student radiographer attitudes towards the older person was designed and implemented. Attitudes were measured pre and post intervention using Kogan's attitudes towards older people scale (KoP). Students were then followed throughout their training to determine any changes in attitudes.

**Results**: Students held positive attitudes towards older people pre intervention, which increased significantly post intervention (p=0.01). This significance was not noted at 6 and 12 months' post intervention; here average scores reduced to an almost identical level to those found pre-intervention. At 24 months' post intervention attitudinal scores increased, though this was not found to be significant.

**Conclusion**: The initial results suggested that an educational intervention can have a significant impact on student radiographer's attitudes towards older people. However, the six and twelve months' post intervention scores suggest that these positive attitudes do not endure. Though the 24 months' post intervention findings demonstrate an increase in positive attitudes, these were still lower than the immediate post-interventiontaa

p205 **Evaluating interprofessional simulation in the operating theatre**

Denise Foulkes; Sarah Naylor

*Sheffield Hallam University*

The operating theatre is an area of practice that newly qualified Diagnostic Radiographers find challenging (1). Interprofessional education (IPE) and simulation are becoming widely used in healthcare education in order to prepare students for practice. Failures in interprofessional communication are well-documented with poor communication an established cause of medical error and negative health outcomes. Socio-historical issues like imbalances in power and status are particularly prevalent in the operating theatre environment, and add complications to interprofessional working. As part of an action research study to develop and pilot an interprofessional simulation experience for Operating Department Practitioner (ODP) and Diagnostic Radiography (DRAD) students. Diagnostic Radiography students took part in a simulation in the mock operating theatre on the university campus with an ODP student, ODP and Diagnostic Radiography lecturers. A purposive convenience sample of 48 second year Diagnostic Radiography students participated in the simulation. Following the simulation students were asked to evaluate the session using Padlet and to reflect on the impact of the experience on practice. The simulation was a positive experience. The timing and organisation of the simulation is important for the students to get the most out of the experience. There are benefits of being immersed in a high fidelity simulation and the realism plays a role in preparing students for real life experiences.

*(1) Naylor, S., Ferris, C., & Burton, M. (2016). Exploring the transition from student to practitioner in diagnostic radiography. Radiography, 22(2), 131-136. (2) Gough, S., Hellaby, M., Jones, N., & MacKinnon, R. (2012). A review of undergraduate interprofessional simulation-based education (IPSE). Collegian, 19(3), 153-170 18p. (3) Kirschbaum, K. A., Rask, J. P., Fortner, S. A., Kulesher, R., Nelson, M. T., Yen, T., et al. (2015). Physician communication in the operating room. Health Communication, 30(4), 317-327 11p.*

p206 **Evaluation of a patient complaints simulated activity**

Alexandra Partner; Naomi Shiner

*University of Derby*

**Background** Simulation is a recognised method of learning particularly for areas difficult to teach in a classroom or clinical environment. One area that has been considered in our undergraduate programme is patient complaints; adopting appropriate reactions and behaviours to reduce confrontation and minimise escalation. A simulation was developed for 3rd year students following a gaps analysis that indicated this was an area they did not feel confident in.

**Method** Ethical approval was not required as this formed part of the programme evaluation. The clinical skills ITU environment was used to set the scene. Nurses were consulted to increase the fidelity. Service users participated as the ITU patient's relative that would become agitated and complain. All students were involved undertaking different roles. Service users and students were briefed and debriefed after the event to gain observations. The simulation was recorded and uploaded to the Universities VLE to encourage reflective practice. Students completed an evaluation of their learning experience and confidence levels.

**Results** Quantitative and qualitative data analysis is on-going. The main themes emerging are: the simulation was challenging but informative; confidence and knowledge has increased through this activity.

Simulation is a fun, interactive way of getting students to do hands on practical experience in a safe environment. Having input from real nurses and service users in a ward area added value to the learning experience. The debrief and evaluation allowed reflection on the decisions made and further understanding to take place.

*Booth, L.A. and Manning, D,J. (2006) Observations of radiographer communication: An exploratory study using transnational analysis Radiography (12) 276-282 Halkett, G.K.B., McKay, J. and Shaw, T. (2011) Improving students' confidence levels in communicating with patients and introducing students to the importance of history taking Radiography (17) 55-60. Mole, L.J. and McLafferty, I.H.R. (2004) Evaluating a simulated ward exercise for third year student nurses Nurse Education in Practice (4) 91-99*

p207 **Using simulation, video and a coaching approach for X-ray room assessment**

Kirsty Wood; Julie De Witt

*University of Derby*

**Background** Previously baseline exams for radiography students on technique within the X-ray room were conducted with a student 'X-raying' another student being marked by a lecturer with a clipboard. We felt that this wasn't authentic and did not encourage development of them into autonomous practitioners.

**Method** Simulated patients (experts by experience) were employed for the exams to add a real patient to the scenario. A lecturer was watching remotely as a safe guard measure. Once the examination was complete the student took the SD card from the video camera and joined another lecturer in a separate room- a neutral space. The video was played back to the student and the student them formulated and wrote their own feedback using an appreciative enquiry approach. The lecturer employed coaching approach to encourage the students to discover their own strengths and make an action plan for clinical placement. The GROW model was used as a framework for the subsequent development discussions arising in feedback session.

**Results** The student feedback was very positive. Before and during the exam they were very focused on the technical skills elements but watching the video back highlighted their patient care skills; this approach helped each student to focus on their patient interaction.

Using a combination of authentic simulation, reflection using video and a coaching approach to feedback, patient communication was the focus of the student's personal and professional development.

*1. MsDowall, A. Freeman, K. Marshall, S. (2014) Is FeedForward the way forward? A comparison of the effects of FeedForward coaching and Feedback. International coaching psychology review 9 (2) 135-146 2. Sharpnack, P.A. Goliat, L. Baker, J.R. Rogers, K. Shockey, P. (2013) Thinking like a nurse: Using video simulation to rehearse for professional practice. Clinical Simulation in Nursing 9 e571-e577 3.Shelly, J. Andrews, C.M. Ravert, P.R. (2013) Debriefing simulations: Comparison of debriefing with video and debriefing alone. Clinical Simulation in Nursing 9 e585-e591*

## EDUCATION & RESEARCH

### p208 Learning from Excellence

*Sowkhya Ramachandraiah* [1]; Baltej Pandher [2]

[1]*South West Peninsula Deanery;* [2]*Derriford Hospital*

**Background**: Since the publication of Standards for Radiology Discrepancy Meetings by the RCR in 2007, regular discrepancy meetings have been almost universally adopted by radiology department in the UK. We carry out a meeting every month as a part of clinical governance to support best practice and to contribute to improved patient safety. We have added what we call "Golden Spot" award which we award to a reporter every month who have spotted something unusual or hidden findings which had a potential to be missed. This way, its an appreciation to the said reporter and also success story which keeps us motivated in our job.

**Purpose**: Safety in healthcare has traditionally focused on avoiding harm by learning from error. This approach may miss opportunities to learn from excellent practice. Excellence in healthcare is highly prevalent, but there is no formal system to capture it. We tend to regard excellence as something to gratefully accept, rather than something to study and understand.

**Summary**: I proudly present some of our "golden spots" from a year of Discrepancy meeting at our hospital. Being a junior trainee, it added a great deal of educational value to my reporting. All modalities have been included. 2 out of 7 Cases I chose for this presentation are as below: Incidental left lower lobe mass picked up on prelim abdominal plain film from a pyelogram serious.

*1. Adrian Brady, (2012) Discrepancy and Error in Radiology: Concepts, Causes and Consequences. Ulster Med J 2012, 81(1):3-9 2. Steven Marc Friedman, (2013) Clinical impact of diagnostic imaging discrepancy by radiology trainees in an urban teaching hospital emergency department. International Journal of Emergency Medicine*

### p209 Introduction to interventional radiology: A study session for multi-disciplinary students

Rachel Ranson; Denise Hitchmough; Jennifer Wall

*Royal Liverpool University Hospital*

**Background**: Practice Education Facilitators in the hospital Trust work with the Universities to facilitate multi-disciplinary student educational opportunities while on placement. They found student's knowledge of Interventional Radiology (IR) to be limited and requested a 3 hour tutorial be provided by IR staff. The aim was to develop students' awareness of IR and assist placement preparation.

**Purpose**: To demonstrate the variety of educational methods possible for students. By providing students with basic knowledge, they can maximise their learning experience on placement. This may be used by other Trusts as a way to assist in education, developing the future of the professions.

**Summary**: The aim of the study session was to give multidisciplinary students a basic understanding of Interventional Radiology including the team, procedures and legal requirements//policies in place. An informative PowerPoint presentation and interactive practical session were planned and presented to students, to engage and educate them in the services provided by IR. An overview of the Radiology department was given, including the history of Radiology and education on the imaging pathways used prior to IR procedures. Radiation regulations and common IR procedures were other topics covered. 80+ students attended from backgrounds of Radiography, Nursing, Physiotherapy and Student Associate Physician, developing an insight into IR, the procedures performed and patient preparation required. This study experience prepared them for a placement and enabled them to cascade their learning to others, thus improving patient care and future educational experiences. After feedback, the session will be presented again.

p210 **The student diagnostic radiographer and the obese patient: Quantifying attitudes and predictors in the UK**

Paul Miller; Stacey Bryant; Charles Sloane; Peter Phillips

*University of Cumbria*

**Background**: Obesity is putting increasing pressure on radiology departments across the UK, and the staff within them (Woods, Miller & Sloane, 2016). Despite this, very little is known about the attitudes of student radiographers toward obese patients, and the factors that influence these attitudes.

**Method**: An online self-report questionnaire, based upon the abbreviated Fat Phobia Scale (Bacon, Scheltema & Robinson, 2001), was administered. Alongside attitudes towards obesity, a range of potential sociodemographic predictors of weight-bias were measured: year of study, total amount of workplace training/experience to date, additional/previous healthcare experience, and weight-oriented self-perception. N=180 undergraduate radiography students, training and studying in the North West of England, were invited to participate. N=108 completed the instrument (F = 84, M = 24); the average age of participants was 25.58 years (SD = 8.00).

**Results**: Provisional results indicate that attitudes towards overweight people were strongly skewed towards the negative across the full sample. While participants who saw themselves as overweight or very overweight held less broadly negative views than those who did not, there was no significant "softening" of negative attitudes with greater age, education or workplace experience in radiography or other healthcare areas.

**Conclusion**: The highlighted relationship between attitudes to obesity and self-image is in line with extant psychological literature. The generally negative attitudes of the students, however, and the fact that neither undergraduate education nor NHS clinical experience seems to ameliorate them in any substantial way, indicates that both domains may need to address this issue in the future.

*Bacon JG, Scheltema KE, Robinson BE (2001) Fat phobia scale revisited: the short form. Int J Obes Relat Metab Disord 25: 252–257. Woods AL, Miller PK, Sloane C (2016) Patient obesity and the practical experience of the plain radiography professional: On everyday ethics, patient positioning and infelicitous equipment. Radiography 22(2): 118-123.*

p211 **Degree classification: Does the calculation model affect the award?**

Noreen Sinclair; Chris Wright; Gail Edwards; Peter Keane

*London South Bank University*

Universities have the freedom to define their own calculation model to define the degree classification awarded. The output profile features as a key metric in ranking tables, yet this conceptually could be affected by the calculation method and provide a source of inequality.

The scores from Level 5 & 6 modules from a group of final year students (n=50) was selected. Four different (A,B,C,D) models were applied to the same data to calculate the final degree score and subsequent award classification and analysed based on raw scores and rounded values. All four models appear to deliver similar calculated scores (Mean: A=62.9%: B=65.7%: C=64.8%: D=62.7%) however there is a distinct impact on the degree classification profiles. The proportion of students achieving First or Upper Second class awards for models A to D are 72%, 80%, 74%, 70% respectively. If rounding is applied this changes to 72%, 82%, 78%, 70%. Additional application of discretion at classification boundaries may further positively impact the results. Calculation models have minimal impact on lower class awards.

The results demonstrate that the calculation model has an effect on the degree classification awarded. In particular, models B and C produce more favourable outcomes. Universities using these models may benefit from an improved contribution to ranking performance.

*1. Burgess, R. (2007) Beyond the honours degree classification: Burgess Group Final Report, Universities UK*

p212 **The role of the consultant radiographer in diagnostic imaging services in the United Kingdom and barriers to their practice**

Jack Williams; Vicki Pickering

*Directorate of Medical Imaging and Radiotherapy, University of Liverpool*

**Purpose and Aim:** Consultant radiographers were introduced into practice after the Department of Health released the 'Advance Letter PAM(PTA) 2/2001' in 2001. After 15 years of development the role is still in its relative infancy with 102 consultants currently registered with the Society of Radiographers. This review aims to assess the role of consultant radiographers in clinical practice, the barriers to their practice and improvements to the role that could ensure its future at the forefront of radiography.

**Method**: The study consisted of a literature review that was designed to examine the role of the consultant radiographer with respect to the four core functions of consultant level practice. Searches of the literature were conducted to gather evidence related to the aims, the literature was appraised for quality and this was considered were possible when extracting evidence and forming conclusions.

**Results**: The consultant radiographer has been a beneficial addition to the radiography workforce. Waiting times for services and delays in image reporting have been reduced, service delivery has improved and radiologists' workloads have been eased. Consultant radiographers have faced many barriers during their development however a few persist, these continue to be challenged as the consultant radiographer role grows in numbers and strength.

**Conclusions**: The guidelines produced in 2001 by the Department of Health are rarely adhered to in practice and may need to be revised. There is no formal education or training pathway which would provide potential consultant radiographers with clear targets of educational attainment and knowledge to aim for.*1. Department of Health (2001) Advance Letter PAM(PTA) 2/2001. Available at: http://webarchive.nationalarchives.gov.uk/20130107105354/http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_4011004.pdf (Accessed: 11 September 2016). 2. Harris, R. and Patterson, A. (2015a) 'Exploring the research domain of consultant practice: Perceptions and opinions of consultant radiographers', Radiography, 22(1), pp. 12-20. doi: 10.1016/j.radi.2015.03.002. 3. Kelly, J., Hogg, P. and Henwood, S. (2008a) 'The role of a consultant breast radiographer: A description and a reflection', Radiography, 14(1), pp. e2-e10. doi: 10.1016/j.radi.2008.10.003. 4. Lawson, S. (2008) 'Case study: Solitary intra-cystic papilloma - Advances in consultant radiographic practitioner led ultrasound guided mammotome excisional biopsy', Radiography, 14(1), pp. e79-e81. doi: 10.1016/j.radi.2008.09.005. 5. Price, R.C. and Edwards, H.M. (2008) 'Harnessing competence and confidence: Dimensions in education and development for advanced and consultant practice', Radiography, 14(1), pp. e65-e70. doi: 10.1016/j.radi.2008.11.005. 6. Rees, Z. (2014) 'Consultant breast radiographers: Where are we now? An evaluation of the current role of the consultant breast radiographer', Radiography, 20(1), pp. 121-125. doi: 10.1016/j.radi.2013.12.005.*

p213 **Building capacity: An evaluation of the use of non-traditional placements in diagnostic radiography education**

Emma Hyde; Susan Errett

*University of Derby*

**Background**: Students studying to become a diagnostic radiographer are required to undertake clinical placements in order to gain the practical skills necessary to become a registered health care professional. This totals approximately 50% of their programme1. Recent changes in technology (such as the move to digital radiography), changes to staffing levels and shift patterns, alongside increasing demand for placements, has made placement capacity a growing issue for Higher Education Institutions (HEIs)2,3,4. As part of a range of strategies designed to address capacity issues, a number of new placements in care settings, and with private, voluntary and independent providers (PVIs), were rolled out to students at one UK HEI. The care placements were expected to have the added advantage of embedding care & compassion, a key area of concern since the Francis enquiry5.

**Purpose**: To share findings of research into student radiographer's experiences of placements in a care setting, where there is no diagnostic imaging activity, and student radiographers experience of placements in private, voluntary and independent imaging settings. The research found the care and PVI placements generally went well for most students. However, it was clear that further guidance was required to support both students and clinical staff working in the placement settings, to ensure that all available learning opportunities in both settings were maximised.

**Summary**: The display will include images of students on placement (with permission)

*1. College of Radiographers . Quality Standards for Practice Placements. London: The College of Radiographers. 2012. Available at: https://www.sor.org/learning/document-library/quality-standards-practice-placements 2. St John-Matthews, J., Woodley, J., Dumall, K., Bailey, A. & Mills, K. (2015) Longer hours and shorter weeks. Imaging & Therapy Practice. November 2015 3. Sloane, C. (2010) Applying theory to practice. Imaging & Therapy Practice. August 2010 4. Nightingale, J. Radiography education funding - crisis or opportunity? Radiography 22 (2016) 105-106 5. Francis, R. Report of the Mid Staffordshire NHS Foundation Trust Public Inquiry 2013. Available at: http://www.midstaffspublicinquiry.com/report*

p214 **Returning to the register: A bespoke return to practice programme for diagnostic radiographers**

Emma Hyde; Sue Errett

*University of Derby*

Diagnostic Radiography is currently listed as a shortage occupation by the UK government, with vacancy rates across the UK at between 15-20% 1,2. This shortage has led to renewed interest in encouraging qualified radiographers whose registration with the HCPC has lapsed, to return to the profession 3. Guidance and support to help radiographers return to practice is available from both the regulatory body (HCPC) and professional body (Society of Radiographers) 4,5. However, recent changes in technology, such as the move to digital radiography, and changes to the role of the diagnostic radiographer, such as image commenting, have anecdotally been barriers to returnees.

The CoR approved 'Return to Practice in Diagnostic Radiography' programme at one UK university provides a structured way for returnees to meet the Health and Care Professions Council (HCPC) return to practice requirements. The programme is designed to support returnees to re-establish clinical competency in a range of radiographic techniques and diagnostic imaging procedures within their scope of practice. The programme includes scheduled learning and teaching activities, simulation in the clinical skills suite and problem based scenarios. Guided independent study is utilised to support individual learning needs identified in a 'gaps analysis' exercise. Placement learning provides the opportunity for returnees to apply underpinning theory into current clinical practice, and demonstrate professional and radiographic skills.

This poster will share the experience of successfully supporting the two cohorts of return to practice learners through the programme.

*1. Shortage occupation list (2015). Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/423800/shortage_occupation_list_april_2015.pdf 2. Vacancy rates (2015) Society of Radiographers. Available at: https://www.sor.org/learning/document-library/diagnostic-radiography-uk-workforce-report-2014/5-vacancy-rate 3. Helping allied health professionals return to practice. Health Education England. Available at: https://www.hee.nhs.uk/hee-your-area/east-midlands/our-work/attracting-developing-our-workforce/allied-health-professionals/helping-allied-health-professionals-return 4. Returning to practice (Health & Care Professions Council). Available at: http://www.hpc-uk.org/registrants/readmission/ 5. Return to practice (College of Radiographers). Available at: https://www.sor.org/career-progression/return-practice*

p215 **A method for integrating preliminary clinical evaluation education into an undergraduate diagnostic radiography programme**

James Harcus; Denise Foulkes; Pauline Reeves

*Sheffield Hallam University*

**Background** Preliminary clinical evaluations (PCEs) remain a vision by the College of Radiographers[1] but have not been widely integrated into practice[2]. Reasons for this include reluctance from practitioners themselves due to issues cited as lack of education and confidence[3,4]

**Method** Within a final year undergraduate diagnostic radiography programme a new method of developing image interpretation and PCE writing skills was trialled. Over several months, each week an image bank was released to students on a topic related to a keynote lecture. Students were encouraged to undertake the 'test' in their own time by considering if the images were abnormal and required them to write a PCE. Small group tutorials were then conducted to review the images and discuss the relevant points and discussion on how a PCE could be constructed. This allowed the student to calculate their own accuracy and appraise their own PCE's. A survey was then conducted to gain feedback regarding the method.

**Results** Students found the method of teaching very useful to their own personal development and increased confidence in writing PCE's. It was seen as a potential way of assessing accuracy of image interpretation and in developing other skills such as anatomy and medical terminology and was suggested to be useful in all levels of radiography education.

**Conclusion** This approach appears an effective way of developing confidence in writing PCEs as well as assessing accuracy. It is proposed that it will be integrated throughout the programme as a way of monitoring progression towards qualification and beyond.

*1. Society and College of Radiographers. (2013) Preliminary clinical evaluation and clinical reporting by radiographers: policy and practice guidance. Society and College of Radiographers, London 2. Snaith, B. and Hardy, M. (2008) Radiographer abnormality detection schemes in the trauma environment - an assessment of current practice. Radiography. 14(4), 277-81 3. Lancaster, A. and Hardy, M. (2012) An investigation into the opportunities and barriers to participation in a radiographer comment scheme, in a multi-centre NHS trust. Radiography. 18(2), 105-8 4. Wright, C. and Reeves, P. (2016) Image interpretation performance: a longitudinal study from novice to professional. Radiography (online).*

p216 **An investigation into first year diagnostic radiography students' preparedness to deal with ill service users in two UK universities**

Emma Hyde [1]; Ruth Strudwick [2]

[1]*University of Derby;* [2]*University of Suffolk*

Transition to university level study is known to be a difficult adjustment for some students1,2,3. Transition to a work based learning opportunity such as clinical placement can be really hard4-9. Key components that influence a successful transition to placement can be grouped into two main areas:

1. Practicalities - transport, accommodation, uniforms, work patterns, child care issues, etc.

2. Socialization into the profession. At the same time as dealing with these issues, radiography students are also starting to work with very ill service users - usually for the first time. They may work with very ill service users in areas such as intensive care, coronary care, neonatal units, and resuscitation rooms.

This poster will present research that was undertaken at two UK universities to investigate the preparedness of first year students to deal with very ill service users. The research took a qualitative approach, using focus groups at both universities to collect data. The data was audio-recorded and transcribed, and then analysed using a thematic approach. The poster will discuss the issues which were identified by participants in the study, and make recommendations for curriculum development to support future students.

*1. Thomas, L. What Works? Student retention & success. 2012. Available online at: www.heacademy.ac.uk 2. Quality Assurance Agency (2012) UK Quality Code for Higher Education Part B: Assuring and enhancing academic quality. Chapter B3: Learning and Teaching. Available from: http://www.qaa.ac.uk/Publications 3. College of Radiographers (2013) Improving the retention of the radiotherapy workforce – the role of practice placements in student attrition from pre-registration programmes in England. London: The College of Radiographers, 2013. Available from: http://www.sor.org/learning/document-library/improving-retention-radiotherapy-workforce-role-practice-placements-student-attrition-pre 4. Hyde E. (2013) Managing student expectations: what do prospective student radiographers expect from their programme of study at one university? Imaging & Therapy Practice April, 2013 5. Hyde E. (2015) A critical evaluation of student radiographers' experience of the transition from the classroom to their first clinical placement. Radiography 2015, 21(3), 242-247 6. Strudwick RM, Harvey-Lloyd J.M. (2012) Ready or not? How prepared are diagnostic radiography students for their first practice placements. A small scale study in one university. Imaging & Therapy Practice December, 2012 7. Andrew N, McGuiness C, Reid G, Corcoran T. (2009) Greater than the sum of its parts: Transition into the first year of undergraduate nursing. Nurse Education in Practice 2009, 9, 13-21 8. Mackintosh C. (2006) Caring: The socialisation of pre-registration student nurses: A longitudinal qualitative descriptive study. International J Nurs. Stud. 2006, 43, 953-962 9. Leducq M, Walsh P, Hinsliff-Smith K, McGarry J. (2012) A key transition for student nurses: The first placement experience. Nurse Education Today 2012, 32, 779-781*

p217 **A review of culture for raising concerns in diagnostic imaging**

Alexandra Partner, *University of Derby*

**Background** Whistleblowing and raising concerns has been in the public eye since the release of the Francis report into the major failings at the Mid Staffordshire NHS Foundation Trust. Whilst many major reports have outlined how the failings came about and what changes need to be made, there is still little known about the state of care, confidence levels of staff to report concerns and what factors contribute to this in diagnostic imaging.

**Methods** A literature review of the culture for raising concerns in diagnostic imaging was undertaken. A review of literature written about diagnostic imaging's culture, leadership, education and what can be learnt from large scale reports was considered. Where there is a lack of reliable, published literature in radiography, sources from across health care have been used. Results Themes coming through are that a culture of blame or the fear of punishment even if this is not actually the case still exists in some cases. There is a lack of national learning from errors in diagnostic radiography and a failure to share this across the profession. Although there is a focus on improving quality of care there is a lack of an evidence base in radiography.

There is little published in UK Radiography on the culture around raising concerns, learning from mistakes and staff confidence levels in doing this. It is unknown how much goes un-reported in Radiography, what clinical radiographers feel about whistleblowing, self-reporting and raising concerns about others

*Francis, Sir R (2013). The Mid Staffordshire NHS Foundation Trust Public Inquiry Final Report. Available online at http://webarchive.nationalarchives.gov.uk/20150407084003/http://www.midstaffspublicinquiry.com/report accessed 24/10/2016 at 14:20 Keogh, B (2013) Review into the quality of care and treatment provided by 14 hospital trusts in England: overview report. NHS. Available online at http://www.nhs.uk/nhsengland/bruce-keogh-review/documents/outcomes/keogh-review-final-report.pdf accessed 24/10/2016 at 13:50 Morgan, S (2015). Radiography students in hospitals tell stories that make me want to weep. The Guardian. Available online at: https://www.theguardian.com/healthcare-network/views-from-the-nhs-frontline/2015/jul/27/radiography-students-hospitals-stories-make-me-weep accessed 08/10/2016 Society and College of Radiographers (2013a) The joint response of the Society of Radiographers and the College of Radiographers to the Final Report of the Independent Inquiry into care provided by Mid Staffordshire NHS Foundation Trust. Available online at https://www.sor.org/learning/document-library/joint-response-society-radiographers-and-college-radiographers-final-report-independent-inquiry-care accessed 24/10/2016 at 14:50*

p218 **Teaching radiology to medical students: Evaluating the methods and mindset**

Chandu Wickramarachchi [1]; Rameesha Anwar [2]

[1]*Royal Berkshire NHS Foundation Trust;* [2]*University of Southampton Medical School*

**Background** Radiology teaching for medical students can often unfortunately be perceived as relatively "dry" when compared to clinical specialties which may involve more apparent narrative variety in patient cases. The literature studying this area of medical education remains limited. This study aims to find areas of potential practical improvement from which Radiology teaching can be made more engaging and effective at medical school. It also aims to find the topics of Radiology which seniors and students perceive to be important areas of knowledge for practising junior doctors.

**Methods** Data collection was carried out using a standard questionnaire (image attached below) targeted at three demographic groups: "Students" (including medical students and Foundation Year 1 & 2 doctors); "Trainee Radiologists"; and "Consultant Radiologists". This was distributed through a district general hospital and a teaching hospital in the UK with results to be collected over a period of 4 months.

**Results** The quantitative data collection is currently still in progress; preliminary results show a variety in response patterns from all stages of training. Responses appear to be aligned with personal style as well as professional experience, yet a few themes manifest themselves as generally popular: e.g. using visual overlays for presenting key features on imaging and using cases to illustrate the core knowledge base.

**Conclusion**: Overall, it appears that utilising the visual nature of Radiology can increase its appeal to students, as well as the effectiveness of the teaching. Case-based discussions, especially of some key clinical emergencies, should also supplement the factual background.

*1. Courtier J, Webb EM, Phelps AS, Naeger DM. Assessing the learning potential of an interactive digital game versus an interactive-style didactic lecture: the continued importance of didactic teaching in medical student education. Pediatr Radiol. 2016;46(13):1787-1796. 2. Hilmes MA, Hyatt E, Penrod CH, Fleming AE, Singh SP. Radiology in Medical Education: A Pediatric Radiology Elective as a Template for Other Radiology Courses. J Am Coll Radiol. 2016;13(3):320-5. 3. Marom A, Tarrasch R. On behalf of tradition: An analysis of medical student and physician beliefs on how anatomy should be taught. Clin Anat. 2015;28(8):980-4.*

p219 **Student led/peer teaching in healthcare education: The use of innovative pedagogies and journal clubs to enhance research skills of undergraduate radiography students**

Aoife Doyle

*NHS Lothian*

Healthcare education is continually evolving to meet the expectations of students, patients, government demands and professional policies. Radiography Education is no different, with the aforementioned factors and the significant rate of change in technology and social advancements impacting on what is required of radiography education and the profession today (1)(4).

The requirement for a healthcare service underpinned in evidence, is a key example of how patient and government requirements impact on healthcare education. In order for the National Health Service to be underpinned in evidence based practice (EBP), so too is the need for an education system which facilitates the learning of skills required to be an evidence based practitioner (7)(8) Journal Clubs are a form of peer assisted learning when facilitated by students and have been used in medical education for years to promote critical thinking, confidence and improve research skills, key skills necessary in the delivery of EBP and research utilisation (2)(8)(5).

Whilst there is a wealth of knowledge on journal clubs perceived benefits in other health care disciplines such as nursing, pharmacy, medicine and radiation therapy (3)(6)(9) there is paucity of literature in radiography profession and education. The lack of research skills in the radiography profession has been reported in literature as an inhibitor to EBP.

The following paper will look at the potential use of journal clubs and peer assisted learning to improve research skills in radiography students and the subsequent need for this.

*1.CASTILLO, J., CARUANA, C.J. and WAINWRIGHT, D., 2011. The changing concept of competence and categorisation of learning outcomes in Europe: Implications for the design of higher education radiography curricula at the European level. Radiography, 17(3), pp. 230-234. 2. COCHRANE, A. L., 1972. Effectiveness and efficiency: Random reflections on health services. London: Nuffield Provincial Hospital Trust. 3. DONOHOE, K.L. et al., 2016. Evaluation of student-led journal clubs. Currents in Pharmacy Teaching and Learning, 8(2), pp. 173-177. 4. MALAMATENIOU, C., 2009. Radiography and research: A United Kingdom perspective. European Journal of Radiography, 1(1), pp. 2-6. 5. MELNYK, M.M., and FINEOUT-OVERHOLT, E., 2015. Evidence Based Practice in Nursing & Healthcare –A Guide to Best Practice. 3rd ed. Philadelphia, PA: Wolters Kluwer Health. 6. MILINKOVIC, D., FIELD, N. and AGUSTIN, C.B., 2008. Evaluation of a journal club designed to enhance the professional development of radiation therapists. Radiography, 14(2), pp. 120-127. 7. NIXON, S., 1999. Undergraduate research: theory or practice? Radiography, 5(4), pp. 237-249. 8. PAGER, S., HOLDEN, L. and GOLENKO, X. 2012. Motivators, enablers, and barriers to building allied health research capacity. Journal of Multidisciplinary Healthcare, 5, pp. 53–59. 9. WILSON, M. et al., 2015. Striving for evidence-based practice innovations through a hybrid model journal club: A pilot study. Nurse education today, 35(5), pp. 657-662.*

p220 **Use of RIPLS questionnaire to evaluate medical imaging and medical students inter professional experience**

Julie Mills; Demelza Green; Rob Meertens; Sam Pollard

*University of Exeter*

**Background** Interprofessional education is intended to enable healthcare students to gain a better working understanding of how other professions work in order to provide high quality patient care. The RIPLS Readiness for Interprofessional Learning Scale is designed to enable educators to evaluate how the students perceive other professions both before and after an inter professional learning experience and to evaluate if the students value the experience as a positive one going forward in their careers.

**Purpose** To disseminate information on how to use RIPLS when evaluating an interprofessional education intervention.

**Summary** An evaluation of using the RIPLS Readiness for Interprofessional Learning Scale (RIPLS) to determine the inter professional educational experience of Stage 2 medical imaging students and Stage 1 medical students in a medical school

*1. Parsell G1, Bligh (1999) The development of a questionnaire to assess the readiness of health care students for interprofessional learning (RIPLS). J. Med Educ. Feb; 33(2):95-100.*

p221 **The role of interprofessionalism in optimising patient care within imaging departments**

Alexandra V Stokes ; Vicki J Pickering

*Directorate f Medical Imaging and Radiotherapy, University of Liverpool*

**Introduction** This critical review is focussed on Interprofessional practice within Imaging and its role in optimising patient care. It considers the implications of both functional and dysfunctional Interprofessional team-working between two or more health professionals from different disciplines working within imaging departments. The importance of Interprofessional working was first highlighted in 1942. Successive governments since the 1970s have published papers on the topic and in the mid 1980s Interprofessional Collaboration was seen as a means of optimising patient care.

**Aims**: To evaluate:

1. the importance of collaboration and communication and their effect on patient care

2. the barriers to Interprofessional learning (IPL) 3. the promotion and development of IPL

**Method**: Three health and medical databases were used to access information relevant to the review and historical papers from the 1980s and 1940s were included in the search. Using topical keywords and terms facilitated a rigorous exclusive/inclusive policy adding to the data credibility and review quality.

**Results** There is evidence that effective Interprofessional Collaboration within Imaging departments increases the quality of patient care by reducing diagnostic tests and maximising strengths and skills of the workforce. However, evidence also shows that whilst radiographers work well together, they can appear closed and guarded when working with other professionals creating a barrier to patient-centred care. Tribalism can hinder Interprofessional collaboration and is present when different professions each have their own occupational culture. This is evident when radiographers work well within their specific profession, but appear to be closed and guarded when liaising with doctors and nurses.

*Beveridge, W. (1942) Social Insurance and allied Services. HM Stationery Office, London. Available at: onlinelibrary.wiley.com/doi/10.1111/j1467-8500.1943.tb02384.x/abstract Day, J. Interprofessional working:an essential guide for health and social care professionals. 2nd ed. Cengage Learning EMEA, Hampshire:2013 Stewart, M., Brown, J.B., Donner, A., McWhinney, I.R., Oates, J., Weston, W.W., Jordan, J. (2000). The Impact of patient-centred care on outcomes. The Journal of Family Practice, 49(9), pp. 796-804 Strudwick, R.M., Day, J. (2004) Interprofessional working in diagnostic radiography. Journal of Radiography 20:235-240Â*

p222 **Emotional intelligence, students and curricula: The mystery of the missing EI**

Sarah Lewis [1]; Stuart MacKay [2]; Jonathon McNulty [3]; Peter White [4]

[1]*The University of Sydney, Australia;* [2]*The University of Liverpool;* [3]*University College Dublin;* [4]*Hong Kong Polytechnic University*

**Background**: EI has been promoted as a predictor of leadership, patient satisfaction and suitability for health professional roles however it is a complex concept and the acquisition of EI is challenging to document1. Within this presentation, we explore EI through the student life-cycle and explore options for improved research. Methods: Using the trait EI questionnaire (TEIQue-SF)2, 274 students from radiography Bachelor programs in Australia, Hong Kong, United Kingdom and Ireland completed the surveys at 6 times points throughout their 3 years of study. The data generated Global EI scores and 4 factors of well-being, emotionality, self-control and sociability. Inferential statistics were used to compare to curricula, students' ethnicity/culture and clinical experience.

**Results**: Students' Global EI is significantly below qualified radiographers (p≤0.01) upon entry into the courses and comparable to that of the general population of the respective countries3. As students moved through their 3 year curricula, no significant

changes in Global EI scores were seen. There were no significant differences for age and gender but a significant difference for students' culture ($p<0.01$)4.

**Discussion**: Why student EI remains significantly lower at graduation than qualified counterparts remains a mystery. Discussion about the value of embedded clinical placement and reflective learning in essential to understanding EI improvement alongside the role of interventional training to prepare students for emotionally challenging roles. The early practitioner years may also hold answers to the acquisition of EI and we discuss this notion in relation to other health professions and the methods of EI measures they measure.

*1. Goleman D, Mckee A, Boyatzis RE. Primal Leadership: Realizing the Power of Emotional Intelligence. Harvard Business School Press, Boston, 2002. 2. Petrides KV. Technical Manual for the Trait Emotional Intelligence Questionnaires (TEIQue) 2009; (1st Edition 4th Printing). London: London Psychometric Laboratory. 3. Mackay SJ, White P, McNulty JP, Lane S, Lewis SJ. A benchmarking and comparative analysis of emotional intelligence in student and qualified radiographers: an international study. Journal of Medical Radiation Sciences 2015; 62: 246–252. 4. Mackay, S, de Galvão e Brito Medeiros, A, Lewis, S, McNulty, J, White, P, Lane, S, Emotional Intelligence development in radiography curricula: Results of an international longitudinal study. Journal of Medical Imaging and Radiation Sciences (In press), 2017*

p223 **How to tackle common on call scans: An aide memoire**

Mubeen Chaudhry

*North Cumbria University Hospitals Trust*

The radiology on-call is a prospect which fills many junior trainees with dread and indeed some more senior colleagues! The on-call has demonstrated an exponential increase in workload over the years and this does not appear to be abating any time soon. I would like to present a short aide memoire for commonly performed studies whilst on call, thereby, enabling the radiologist to have a structure in mind and feel that an overall thorough 'satisfaction of search' has been performed. The end goal of this is to enable identification of pathology in an accurate and prompt manner. CT Brain -- 3 Bs. Bleed -- intra- or extra-axial. Blockage/Blurring -- a stroke may be manifest as a dense MCA sign due to an underlying thrombus or possibly loss of the insular ribbon resulting in a degree of 'blurring' at this level. More established infarcts would take on a CSF density appearance. Break -- fracture in the skull vault. CT Cervical spine -- ABCS Alignment of the spine. Bones -- fractures or dislocation. Cartilage/ligament assessment. Soft tissue assessment. CT Abdomen/Pelvis -- 6 Fs Free air -- pneumoperitoneum. Free fluid Fat stranding Fat wall -- bowel wall thickening indicative of colitis. Filling defect -- assessment of vasculature to determine thrombus leading to ischaemic change. Fractures -- particularly vital in the case of trauma patients. CTPA -- ABC Aortic dissection -- Important life-threating abnormality can be diagnosed on CTPA! Big heart/Big vessels -- cardiomegaly / pulmonary artery

p224 **Audit of patient consent to oncology clinical trials prior to imaging**

Theresa Taylor Emberton

*The Christie Hospital Nhs Foundation Trust*

**Background**: The principle of informed consent taking place before embarking upon any research related procedures is a basic tenet of clinical research. There is an extensive evidence base to support this concept. The purpose of this audit was to determine compliance with this principle and to examine whether consent was annotated in an accurate and timely fashion on the electronic patient record.

**Method** All imaging performed specifically for clinical trial screening during September 2016 was reviewed and the following recorded:

- Relevant clinical trial.
- Date of imaging and time of arrival.
- There were 90 patients.

Using the electronic patient record (CWP), the date of consent was obtained for each patient and checked against the paper consent forms.

**Results**

- Date of consent on CWP only present in 70% of patients.
- 16% of patients were imaged on the same day as consenting.
- Of these; 8 patients consented prior to imaging,
- 3 patients were imaged before consenting.
- 3 patients had no record of time of consent but are unlikely to have consented before imaging.

**Conclusion** Procedure to ensure consent to a clinical trial occurs prior to screening procedures is in need of improvement. Patient consent to clinical trial not recorded accurately or consistently which is essential to enable appropriate care by non-research staff.

We should not presume consent has been taken.
Patients should be asked if they have signed consent for the clinical trial before being imaged.
Implemented recommendations and result of re-audit in early 2017 will be presented.

p225 **An audit of Naso-Gastric tubes (NGTs): Are we getting it right?**

Katherine Sharkey; Leah Fenning

*St Helens and Knowsley NHS Trust*

**Introduction**: Although easily preventable, incorrectly placed NGTs are a significant problem that results in thousands of deaths each year (NPSA, 2011). Are radiographers doing enough to prevent this?

**Method**: A retrospective audit was completed over six months evaluating NGT X-ray requests. Each request was evaluated to see if it stated whether an aspirate had been obtained. The corresponding images were also evaluated to look at the position of the NGT tip and the orientation of the detector as these factors are largely dependent upon technique i.e. windowing, exposure factors.

**Findings**: * Only 43.3 % of requests stated that an aspirate could not be obtained and/ or was too high. * 96.1% concluded that the tip of the NGT was in the stomach/past the diaphragm and 3.9% were in the lung. * Only 60.5% of chest X-rays were performed using the detector portrait vs. 39.5% landscape.

**Conclusion and recommendations**: Many chest X-ray requests do not state whether an aspirate has been obtained. An aspirate level should be documented on the request and if not, the ward should be contacted to ensure that this has been attempted. All chest X-rays should be performed portrait as this increases the chance of including the tip, increasing the accuracy of diagnosis and preventing further repeats. Furthermore, annotating the image with the measurement of the NGT at the nose allows extra confirmation of the position and is also beneficial when comparing images. A further recommendation is that radiographers could remove NGTs in the department.

*National Patient Safety Agency (NPSA) National Health Service (NHS). (2011) Reducing the harm caused by misplaced nasogastric feeding tubes in adults, children and infants. http://www.npsa.nhs.uk/corporate/news/reducing-the-harm-caused-by-misplaced-nasogastric-feeding-tubes-in-adults-children-and-infants/ (Accessed: 6th December 2016)*

p226 **Development of image interpretation skills -- a follow-up study of Singapore diagnostic radiographers**

Yi Xiang Tay [1]; Chris Wright [2]

[1]*Singapore General Hospital;* [2]*London South Bank University*

**Background**: The notion that a trained radiographer has the ability to interpret images is well demonstrated in literature and this has a positive impact on patient's management. Published evidence suggests that image interpretation performance decreases unless education is regularly consolidated. However, no study of this type has been carried out in local context. This study is a one year follow up of previous research in benchmarking radiographers' image interpretation skills in a local flagship tertiary hospital.

**Method** Unknown to the participants the study used the same randomised RadBench® image test bank, containing 30 blind double reported appendicular musculoskeletal images, with a 50% prevalence of abnormality. The same in-house RADS trained radiographers (n=7) who participated in the 2016 study were recruited again in addition to non-RADS radiographers (n=23) who had no additional image interpretation training.

**Results** The total population delivered a similar accuracy 2016v2017 however display a significant increase in sensitivity and decreased specificity. The RADS group significantly improved accuracy, mean increasing from 70 to 86% driven by a significant increase in specificity however a slight decrease in sensitivity. The non-RADS accuracy decreased slightly however demonstrated a significant increase in sensitivity and significant decrease in specificity. 57% of the RADS trained group delivered accuracy >90% and proved ready to participate in abnormality detection systems compared to 4% of the non-RADS group.

**Conclusion** This study demonstrated that continued development is required, not only in abnormality spotting but even more importantly the ability to differentiate normal variants. This will benefit the profession as a whole, as we seek to develop models of advanced radiographer practice in Singapore. RADS offers the basis of a preceptorship programme to scaffold new graduates beyond binary decision making and on towards competence in image interpretation with the ability to provide reliable preliminary clinical evaluation.

*Tay, Y. X. and Wright, C. (2016) Image interpretation performance of diagnostic radiographers. 6th June 2016, UKRC 2016*

p227 **Benchmarking image interpretation performance: A multicentre undergraduate study**

Tatsuhito Akimoto [1]; Chris Wright [2]; Pauline Reeves [1]

[1]*Sheffield Hallam University;* [2]*London South Bank University*

**Aim**: The SCoR (2013) policy expects radiographers to be able to make reliable decisions on the images they produce. Image interpretation has been integrated into all undergraduate degree programmes. Therefore this project aimed to benchmark and compare PCE competencies of undergraduate diagnostic radiography students from different universities.

**Methods**: All 21 Universities in England & Wales delivering diagnostic radiography education were invited to participate; 9 agreed. Final year students (n=87) at the point of graduation participated. The test contained 30 blind double reported MSK images with equal prevalence of normal and abnormal.

**Results**: Accuracy ranged from 56 to 87%; mean 73.4, SD 8.01. Sensitivity ranged from 47 to 100%; mean 79.6, SD 10.78. Specificity ranged from 20 to 100%; mean 67.1, SD 16.42. A weak correlation in accuracy by university was demonstrated (r2=0.266) highlighting the wide range of graduate performance. One-way ANOVA (with PostHoc Tukey) highlighted a statistically significant difference in Specificity (F (8, 78) = 3.40, p = 0.002) at University A (CI: -47.4/-4.5).

**Conclusion**: This project is the first to benchmark and compare PCE competencies of radiography students from multiple universities. Whilst image interpretation is now a routine part of undergraduate degree education, the capability of graduates varies and few appear to be able to meet a 'reliable' standard, highlighting the need for further training prior to participation in abnormality signalling systems. A follow-up study is recommended to increase reliability.

p228 **Image interpretation: Test the candidate not the test**

Kirstie Wilby [1]; Chris Wright [2]

[1]*Sheffield Hallam University;* [2]*London South Bank University*

Image interpretation tests are core to radiography and radiology education to provide a measure of competence. Each training organisation designs its own tests. Does test bank design affect image interpretation results accuracy? Final year radiography students (n=23), took part in two RadBench® image interpretation tests to evaluate their accuracy scores. Each test was subjectively of equal difficulty and contained 30 images, with a fifty percent incidence of abnormality, chosen from a blind double reported database. Item response theory (IRT) was used to determine test difficulty, question difficulty and discrimination. Weaker students should be more likely to get the more difficult questions wrong.

Test A: range 77-97%, mean 90%. Test B: range 73-93%, mean 85.2%. Paired samples T-Test (t=3.746) was significant (0.001) at 95% significance level. Mean test difficulty via IRT was 0.90 v 0.86. Neither test was 100% discriminating; Test A had 2 non-discriminating questions, Test B had 6. Test bank design can be subjective and impact the result of image interpretation accuracy, confirmed by IRT. Assessment via multiple test banks is recommended within undergraduate modules in order to average out performance.

A discriminating National test, as utilised for the FRCR Part 1, could provide benchmark performance and equality in assessment for all radiography candidates.

*Chong Ho Yu (2013) A Simple Guide to the Item Response Theory (IRT) and Rasch Modeling. http//:www.creative-wisdom.com Society & College of Radiographers (2013). Preliminary Clinical Evaluation and Clinical Reporting by Radiographers: Policy and Practice Guidance [Internet] (2013) Available from: file:///C:/Users/PJaneC/Downloads/book_export_html_9197.pdf The Royal College of Radiologists (2016) Final FRCR Part B Examination. https://www.rcr.ac.uk/clinical-radiology/examinations/final-frcr-part-b-examination-0 Wright,C. & Reeves,P. (2016) Radbench: Developing Image Interpretation Skills. Radiography. P1-6 . http:// dx.doi.org/10.1016/j.radi.2015.12.010 Wright,C. & Reeves,P. (2016) Image Interpretation Performance: A Longitudinal Study from Novice to Professional. Radiography. D-16-00053R2*

p229 **Conversations about death**

Lorraine Whyte

*Beatson West of Scotland Cancer Centre*

We are all going to die, yet we find it so difficult to talk about. When people we love die we never really know what to say or what to do. Would they like to be buried, cremated or sent into outer space? Can we afford to do any of these things? Do we know how much the average funeral costs? Do our patients know? How can we gently encourage them to have these conversations at home? Can we ever get over our feeling of discomfort when it comes to conversations about death? One way to tackle this issue was by hosting a Death Café, which is a straightforward and open discussion about death. It has no agenda and like life, a Death Cafe has a start, middle and an end (1). This was arranged for staff at the Beatson. Method and Materials: In order to host the Death café a facilitator, people who want to discuss death, a relaxing venue and some refreshments were required. Minimal direction was given and participants' comments were recorded and then transcribed.

Results: The subject of death may have been uncomfortable, but the provision of refreshments, a relatively healthy group of participants, and a safe, relaxing space appeared to generate vast quantities of data. We merely created a space to discuss death without expectations. Conclusion and Discussion: When people we love are terminally ill they may leave instructions, but many people don't, in which case we still don't know what to do. We don't know because we don't discuss it. Western society has tried to normalise death, and undertakers do their utmost to make corpses look alive. They embalm them and put make-up on them. We talked, we laughed, we had conversations about death and we will have them at home with our loved ones as a result of this.

*1) www.deathcafe.com*

p230 **MRI safety awareness among cardiology team members: A quality improvement project**

Aisling Fagan; Firas Yassin

*Peterborough City Hospital*

**Background**: 50-75% of patients with a pacemaker will need an MRI scan at some stage in their life[1]. 2.4 million MRI scans took place in the UK in 2013, with a 12% yearly increase between 2003-2013[2]. MRI-conditional pacemakers have recently been developed in order to deal with this demand. A Portuguese study demonstrated that 15% of cardiologists were not aware that CMR does not involve ionising radiation, and only 39% correctly answered questions on MR contraindications[3]. Awareness of the contraindications is essential for patient selection. This will be increasingly important with the development of cardiac MRI.

**Methods**: This project was performed in a cardiology department with a catchment area of 500,000 people. The participants included consultants, junior doctors, and specialist nurses. A pre-education questionnaire and quiz was performed. A single-page infographic (image A) was created to explain the basics of MRI physics and the risks of MRI. This formed the basis of an interactive education session. The questionnaire was repeated after the session.

**Results**: Self-reported confidence with MRI scans increased from 4.3/10 to 8/10. 30% more medical devices were correctly categorised as MRI safe/unsafe after the session (54% to 84%). The average number of MRI side effects identified was 4, an increase from 2.2.

**Conclusion**: MRI safety awareness is essential for clinicians requesting scans. A simple infographic can be an accessible resource, both for reference and education. We plan to distribute the infographic throughout the cardiology wards and clinics. There is scope to create infographics on other specialist topics also.

*1. Kalin R, Stanton MS. Current clinical issues for MRI scanning of pacemaker and defibrillator patients. Pacing and Clinical Electrophysiology. 2005 Apr;28(4):326–8. 2. NHS England Analytical Services. www.england.nhs.uk. NHS Imaging and Radiodiagnostic activity; 2015 Aug 06 [cited 2016 Dec 16]. Available from: https://www.england.nhs.uk/statistics/wp-content/uploads/sites/2/2013/04/KH12-release-2013-14.pdf. 3. Ferreira AM, Bettencourt N, Matos P, Oliveira L, Almeida AG. Familiarity and perceptions of Portuguese cardiologists concerning cardiac magnetic resonance and cardiac computed tomography: The extent of the task ahead. Revista Portuguesa de Cardiologia (English Edition). 2013 Jul;32(7-8):601–8.*

p231 **An analysis of bibliometric data exploring factors influencing research-capacity amongst UK radiographers**

Ugochi Agwa

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**Background**: Radiographer-research is generally described as "emergent(1)" but registrants are expected/encouraged to contribute to the professional knowledge-base(6). Yet, reportedly radiographers trail behind analogous professions and/or participate in positions of lower-prominence(4).

Pre-existing studies argue, radiographers are "apathetic(7)". However, labelling everyone as ambivalent, "button-pushers(3)" seems a gross-simplification of a multifaceted issue; especially as current evidence tends to err towards the anecdotal, subjective or again, as compared to similar professions(2)(3)(5).

Considering this, the SCoR periodically issues a Research Strategy(6), recognising the necessity to embed/improve research-capacity across all levels of the profession.
**Aim**: To seek factors characteristically influencing research-capacity amongst UK-based, HCPC-registered radiographers.

**Method**: A purposeful sample of 5 years' bibliometric data from the journal 'Radiography.' A critical and thematic analysis followed based on current peer-reviewed journals and grey literature.

**Results**: Of 374 eligible articles and 143 research-active authors (published 2+ articles), collaborations prominently featured (74.9%) across 19 international partnerships. UK-registrants were principal investigator(s) in 49.20% of cases and registrants affiliated with the journal/publisher generally published more than non-affiliates. Preferred topic-areas included 'Education & Research' and 'Technical Practice.' Males published more than females (M=5.13/F=3.45). Average length of practice equalled 22.93 years. Outputs mostly originated from HEIs (62.07%), but contributions varied (mean=10.05/std.deviation=±17.09);

modestly correlating high-REF scoring HEIs (r=0.330); however, regional workforce ratio(s) proved the strongest indicator (r=0.601).

**Conclusion**: No "one-size-fits all" approach to research-capacity applies, as findings suggest multiple variables affect capacity/activeness. Many seem contingent on extrinsic factors e.g. regional locale, organisational type and culture/support. Personal/professional influences included career status, length of qualification and gender.
The SCoR may benefit from refinement; mindful of the dynamics influencing the heterogeneity of the current workforce. Recommendations are that future strategies/studies may benefit from more specific targetting.

*1. Chan, S. and Gunderman, R.B. (2005) 'Emerging strategic themes for guiding change in academic Radiology departments', Radiology, 236(2), pp. 430–440. doi: 10.1148/radiol.2362040587. 2. Golenko, X., Pager, S. and Holden, L. (2012) 'A thematic analysis of the role of the organisation in building allied health research capacity: A senior managers' perspective', BMC Health Services Research, 12(1), p. 276. doi: 10.1186/1472-6963-12-276. 3. Hafslund, B., Clare, J., Graverholt, B. and Wammen Nortvedt, M. (2008) 'Evidence-based radiography', 14(4), pp. 343–348. doi: http://dx.doi.org/10.1016/j.radi.2008.01.003. 4. Harris, R. and Paterson, A. (2016) 'Exploring the research domain of consultant practice: Perceptions and opinions of consultant radiographers', Radiography, 22(1), pp. 12–20. doi: 10.1016/j.radi.2015.03.002. 5. Segrott, J., McIvor, M. and Green, B. (2006) 'Challenges and strategies in developing nursing research capacity: A review of the literature', International Journal of Nursing Studies, 43(5), pp. 637–651. doi: 10.1016/j.ijnurstu.2005.07.011. 6. Society of Radiographers (2016) 2016-2021 Research Strategy. Available at: http://www.sor.org/learning/document-library/research-strategy-2016-2021/2016-2021-research-strategy (Accessed: 6 March 2016). 7. Yielder, J. and Davis, M. (2009) 'Where radiographers fear to tread: Resistance and apathy in radiography practice', Radiography, 15(4), pp. 345–350. doi: 10.1016/j.radi.2009.07.002.*

## p232 **A phantom study to assess the effect of lesion size and overlying tissue thickness on manual compression strain sonoelastography measurements**

Terence Jones [1]; Bilal Salman [2]; Victoria Sherwood [2]; Charles Hutchinson [1]

[1]*University of Warwick;* [2]*University Hospitals Coventry and Warwickshire NHS Trust*

**Background**: Sonoelastography can differentiate tissues based on differences in stiffness. Manual compression strain sonoelastography measures relative tissue stiffness by calculating differences in tissue deformation following an external force - stiffer tissues deform less than soft tissues. Although this technique is qualitative, strain elastography remains widespread. We tested whether the qualitative stiffness measurements were affected by the size of the lesion and the depth of overlying tissues using an ultrasound phantom.

**Methods**: A phantom comprising two layers of gelatine and agar was constructed to simulate different tissues [1]. Multiple stiffness measurements were taken by two raters by applying intermittent compression to the surface of the phantom with a GE Logiq E9 ultrasound scanner using a 9MHz linear array transducer. Multiple relative stiffness measurements were made by each rater at different points. The phantom was then inverted and measurements repeated.
One-way ANOVA with post tests was used to compare the effect of tissue type, depth and lesion thickness on relative stiffness.

**Results**: Mean relative stiffness within agar (2.4+/-0.67) was significantly lower than gelatine (4.2+/-1.2; $p<0.001$). Relative stiffness was generally significantly higher within deep segments than corresponding superficial segments ($p<0.01$), but there was no difference between thin and thick lesions. There was a high degree of inter-rater reliability (intraclass correlation coefficient 0.90, 95% CI 0.80-0.95, $p<0.001$).

**Conclusion**: Manual compression elastography can differentiate tissues of different stiffness with high inter-rater reliability, but is affected by thickness of overlying tissues which may have implications ins scanning obese/lean subjects.

*1. Blechinger J, Madsen E, Frank G. Tissue-mimicking gelatin-agar gels for use in magnetic resonance imaging phantoms. Medical physics. 1988;15(4):629.*

## p233 **Research involving ionising radiation - governance and local arrangements to get the green light**

Andrea Shemilt

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Approval for healthcare research is obtained through IRAS [1], with this portal accessing the relevant approving bodies. The application is reviewed by the HRA [2], incorporating ethics review. It's submitted to the competent authority, if relevant, and the NHS Trust sites involved, to obtain Organisation Confirmation of Capacity and Capability (previously known as NHS Permission). What are the key points on radiation to get right in your application? What are the legislative and policy requirements relating to research involving ionising radiation? Who is responsible to check what? Although many over-arching elements of radiation review are carried out by the HRA, there are still some radiation issues that need to be assessed, arranged and confirmed at a local level. This poster highlights good practice to create a smooth set-up of the radiation component of the research and continue with safe systems of research imaging management in place.

*1. Integrated Research Application System https://www.myresearchproject.org.uk/ 2. http://www.hra.nhs.uk/about-the-hra/our-plans-and-projects/assessment-approval/*

p234 **Facilitating research amongst radiographers through information literacy workshops**

Emily Hurt; Alison Mcloughlin

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**Background:** The Society and College of Radiographers aims to '...Expand UK radiography research capacity through development of skilled and motivated research-active members of the profession'. Despite having a strong research profile within our trust, allied health professionals are under-represented across the organisation's research activity. Library Services and Research and Innovation, working together, secured funding to run a research project enabling radiographers to develop knowledge and skills across research and information literacy.

**Method:** Data was collected retrospectively on research activity and library usage in the 12 months prior to the study. Participants were recruited and completed the Information Literacy Self Efficacy Scale -- ILSES (Kurbanoglu et al). Participants were then asked to select workshop topics from a list of 16 provided by the research team, and the top 6 were developed and delivered over a 7-month period (ongoing). Participants will then re- complete the ILSES, and an analysis of results will be carried out in conjunction with the data collected on workshop attendance.

**Results:** Results are currently unavailable as the final workshop will be delivered on the 10th of February 2017. Results will be available for presentation at the conference. Evaluative material around the sessions will also be collated.

**Conclusion:** As well as presenting the research and results, this presentation will explain the design and delivery of workshops tailored to radiographers to increase research capability and capacity. It will also discuss the barriers and facilitators to this important work in NHS environments.

*1. Society and College of Radiographers (2015) 2016-2021 society and college of radiographers research strategy 2. Kurbanoglu, S. S., Akkoyunlu B. & Umay A. (2006). Developing the information literacy self-efficacy scale. Journal of Documentation, 62 (6), pp.730-743.*

p235 **An investigation into pain flare in patients undergoing radiotherapy for bone metastases**

Rebecca Goldfinch [1]; Nick White [2]

*[1]Royal Wolverhampton NHS Trust; [2]Birmingam City University*

**Aims**: External Beam Radiotherapy (EBRT) is a recognised intervention for symptomatic pain relief from bone metastases. Pain flare is a reported EBRT toxicity, reported in 16-41% of steroid-naïve patients. This study aimed to determine incidence and duration of pain flare amongst patients within one Oncology Centre, comparing findings with previous studies.

**Methods**: Patients receiving EBRT for bone metastases were recruited to a prospective cohort study. Patients recorded baseline pain scores and completed a daily pain and analgesia diary during EBRT and for 14 days thereafter. Pain flare was defined as a two-point pain scale increase or 25% increase in analgesia intake, with a return to baseline.

**Results**: Of the thirty-two participants, 21 (66%) completed the diary. Nine (43%) patients experienced pain flare, the median duration being 3.2days. Of the evaluable patients, 57% (12) were male and 43% (9) were female. The median age was 72.5 years, (range 40-83). The common primary sites of disease were Breast (29%), Prostate (33%) and Multiple Myeloma (9%) with other sites making up the remaining 29%. The most frequent EBRT site was the spine (62%), with other sites of treatment including pelvis (24%) and extremities (14%). EBRT regimes were restricted to 20Gy in 5 treatments, received by 33% (7) of patients and 8Gy in 1 treatment, received by 67% (14). Of these two regimes, pain flare was reported by 29% and 50% respectively.

**Conclusion**: Pain flare is a common toxicity of EBRT for bone metastases. Taking the small sample size into consideration, the incidence and duration of pain flare in patients within this single-centre study are comparable with those found in international studies.

*1. Chow, E., Ling, A., Davis, L., Panzarella, T. and Danjoux, C. (2005). Pain flare following external beam radiotherapy and meaningful change in pain scores in the treatment of bone metastases. Radiotherapy and Oncology 75, pp. 64-69 2. Hird, A., Chow, E., Zhang, L., Wong, R., Jackson, W., Sinclair, E., Danjoux, C., Tsao, M., Barnes, E.and Loblaw, A. (2009a). Determining the incidence of pain flare following palliative radiotherapy for symptomatic bone metastases: results from three Canadian cancer centres. International Journal of Oncology, Biology, Physics 75(1), pp. 193-197. 3. Loblaw, D.A., Jackson, W., Kirkbride, P., Panzarella, T., Smith, K., Aslanidis, J. and Warde, P. (2007). Pain flare in patients with bone metastases after palliative radiotherapy – a nested randomized control trial. Support Care Cancer 15, pp. 451-455 4. Gomez-Iturriaga, A., Cacicedo, J., Navarro, A., Morillo, V., Willisch, P., Carvajal, C., Hortelano, E., Lopez-Guerra, J. L., Illescas, A., Casquero, F., Del Hoyo, O., Ciervide, R., Irasarri, A., Pijoan, J. I. and Bilbao, P. (2015). Incidence of pain flare following palliative radiotherapy for symptomatic bone metastases: multicentre prospective observational study. BMC Palliative Care 14;48.*

p236 **Dementia and the law in frontline radiography: The practical experiences of junior clinicians in the UK**

Lisa Booth; Paul Miller; Adam Spacey

*University of Cumbria*

**Background**: Informed consent remains the cornerstone of ethical and lawful clinical practice. However, for consent to be valid, the patient must be given sufficient information, give their consent freely and they must be competent. The Mental Capacity Act (MCA) provides guidance on how practitioners might proceed with procedures where a patient might lack competence, for example with patients who have Dementia, though it is recognised that many health practitioners do not apply the MCA in practice. Given the increase in the numbers of individuals suffering from Dementia, and the problems related to gaining consent within this group, this study aims to determine how radiographers apply the guidance of the MCA to their practice when caring for patients who have Dementia.

**Method**: In line with the orthodox methods of Interpretative Phenomenological Analysis (IPA), six junior radiographers (mean experience = 3.5 years) were interviewed. All interviews were semi-structured, conducted and recorded in a place of the participant's convenience, and transcribed verbatim. The mean interview duration was 40 minutes.

**Results**: Though an on-going study, currently three superordinate themes emerge from the data; Presumed lack of capacity; lack of explanation; and compliance versus consent. Preliminary analysis reveals that the MCA is not routinely applied in general radiographic practice and that this practice is therefore at times unethical, and perhaps even unlawful.

**Conclusions**: Though limited in scale these preliminary findings suggest a need for better education, training on how to apply the MCA during radiographic procedures and a basis for further investigation.

p237 **Functional connectivity in Alzheimer's disease and vascular dementia**

Paula Harman [1]; Christine Law [2]; Farhad Huwez [3]; Sweni Shah [1]; Aarti Sharma [1]; Annalu KvºhnÂ [4]; Richard Aspinall [5]; Iris Grunwald[1]

[1]*Anglia Ruskin University and Southend University Hospital NHS Foundation Trust;* [2]*Stanford University;* [3]*Southend University Hospital NHS Foundation Trust;* [4]*University of Massachusetts Medical School, USA;* [5]*Anglia Ruskin University*

**Purpose**: Alzheimer's disease (AD) and vascular dementia (VD) make up a large proportion of patients that attend memory clinics. Differentiating between AD and VD is challenging; there are mixed kinds of dementia and disease progression and treatment differs. The aim of our study is to see if resting state fMRI (RS-fMRI) can differentiate between AD and VD and can potentially serve as a biomarker. To the best of our knowledge this is the first study that compares resting state functional connectivity in AD and VD in routine clinical setting.

**Method**: This is part of a prospective, observational study. Confirmed AD and VD patients (no mixed type) undergo a neuropsychological battery of tests and a RS-fMRI as part of routine clinical care. Individual measures of the default mode network are used to evaluate differences in functional connectivity between the two groups, which are then correlated to scores of global cognition and episodic memory performance.

**Results**: Preliminary results show some characteristic differences in connectivity between AD and VD. The two groups differed specifically regarding the default mode network.

**Conclusion**: Data is still limited as there are only few patients that present with a clear diagnosis of AD or VD and not mixed type, however early results are supportive that there are characteristic differences in connectivity between AD and VD. Further research is likely to improve ability to appropriately classify new subjects and ultimately allow RS-fMRI as a biomarker.

p238 **Intraorbital foreign body detection and localisation by radiographers**

Paul Lockwood [1]; Lisa Pittock [1]; Claire Lockwood [2]; Christopher Jeffery [1]; Keith Piper [1]

[1]*Canterbury Christ Church University;* [2]*Kings College Hospital NHS Foundation Trust*

Background: Since the report by Kelly et al (1986), there has been controversy regarding the potential harm from metallic foreign bodies in the orbital anatomy and the necessity of screening patients prior to magnetic resonance imaging (MRI) procedures. Current SoR and BAMAR, IR(ME)R 2000 and MHRA guidelines recommend investigation to exclude an intra orbital foreign body (IOFB) prior to imaging.

Purpose: The aim of this poster is to enable conference participants to review a preliminary multi-reader multi-case observer performance study to establish if a short course of learning would increase radiographers' performance in IOFB detection and localisation on pre-MRI orbital computed radiographs. Fifteen radiographers from five hospitals participated, each participant reviewed a pre- and post-training image bank (30 cases) to identify the presence or absence of IOFBs.

The intended learning outcomes for readers by the end of this poster should be able to:

1. Understand the clinical risk to patients in MRI from IOFBs.

2. Describe the impact of a short course of training to educate radiographers in IOFB image interpretation.

3. Begin to evaluate the level of radiographer competence in IOFB localisation and detection.

4. To start to reflect afterwards of the various role extension areas available for radiographers to support service delivery and patient safety.

*1. Kelly W M, Paglen P G, Pearson J A, San Diego A G, Soloman M A. (1986). Ferromagnetism of intraocular foreign body causes unilateral blindness after MR study. American Journal of Neuroradiology ; Mar-Apr;7(2):243-5. 2. Society and College of Radiographers and the British Association of Magnetic Resonance Radiographers (2013). Safety in Magnetic Resonance Imaging. London: The Society and College of Radiographers. 3. Great Britain. Ionising Radiation (Medical Exposure) Regulations 2000 (IRMER) (2012). Schedule 1. London: Department of Health. 4. Medicines and Healthcare products Regulatory Agency (MHRA) (2007). Device Bulletin Safety Guidelines for Magnetic Resonance Imaging Equipment in Clinical Use DB2007 (03) . 5. Bailey W, Robinson L. (2007). Screening for intra-orbital metallic foreign bodies prior to MRI: Review of the evidence. Radiography. Feb 28;13(1):72-80.*

## p239 **Reporting radiographer's performance in CT head reporting in a clinical environment**

Paul Lockwood; Keith Piper

*Canterbury Christ Church University*

**Background**: The number of head injured patients attending district general hospitals has been estimated by the United Kingdom (UK) Acquired Brain Injury Forum during 2011-2012 to be around 353,059 UK patients. (around 558 per 100,000 of the population each year). This represents a 33.5% increase in the last ten years (10-20,000 per year) of admissions for severe traumatic brain injuries.

**Purpose**: The aim of this poster is to enable conference participants to review a preliminary small scale study of multiple reader (reporting radiographers (RR) and consultant radiologists (CR) and multiple case (30 cases) assessing the diagnostic performance in clinical practice of computer tomography (CT) head interpretation. Eight observers from six southern National Health Service (NHS) trusts were invited to participate.

The intended learning outcomes for readers by the end of this poster should be able to:

1. Understand the clinical demand to train radiographers as part of a skills mix workforce to report CT head examinations.

2. Describe the process of assessing radiographer's ability using a range of conditions, reporting environments, and variety of statistical methods

3. Begin to evaluate the level of reporting radiographer competence in CT head reporting. To start to reflect afterwards of the various advanced practice roles available for radiographers to support service delivery

Summary: A0 portrait style, with subheadings (background, method, results, tables, conclusion), tables broken down to individual results to reflect variance of readers performance, and mean overall results for the cohort using alternative free response receiver operating characteristic (AFROC) methodology was applied.

*1. United Kingdom Acquired Brain Injury Forum. Life after Brain Injury: A Way Forward- Evidence Base; 2012. Available at: http://www.ukabif.org.uk/uploads/UKABIF/Life_After_Brain_Injury.pdf*

## p240 **Reporting radiographer's performance in CT head reporting in an academic and clinical environment**

Paul Lockwood

*Canterbury Christ Church University*

**Background**: Demand for Computed Tomography (CT) examinations in English National Health Service (NHS) Trusts between March 2015 and February 2016 including the waiting list of planned tests, and unscheduled tests. The CT demand between April 2013 to March 2014 at 5.2 million. Demonstrating a 10% increase from the previous year, a 43.1% rise over five years, and 160% growth over a decade.

**Purpose** : The aim of this poster is to enable conference participants to understand the factors that are involved in testing the abilities of radiographers undertaking a postgraduate certificate in reporting CT heads. The intended learning outcomes for readers by the end of this poster should be able to:

1. Understand the evidence and clinical requirement to train radiographer's as part of a skills mix workforce to report CT head examinations.
2. Describe the process of assessing radiographer's ability using a range of conditions, reporting environments, and variety of statistical methods 3. Begin to gain an appreciation of the type of common errors in CT head reporting
4. Begin to evaluate that there is a requirement for a range of disease prevalence in assessment that will reflect clinical practice
5. To start to reflect afterwards of the various advanced practice roles available for radiographers to support service delivery
Summary A0 portrait style, with subheadings (background, method, results, tables, conclusion), tables broken down to individual results to show progression of ability, and mean overall results for the cohort using standard statistical models.

*1. NHS England. February (2016) Statistical Report: Waiting times and activity for diagnostic tests and procedures. January 2006 to February 2016. April 2. NHS England (2016). Monthly Diagnostics Commissioner February 2016. April 3.Great Britain (2014) NHS Imaging and Radiodiagnostic activity 2013/2014. Leeds: NHS England Analytical Services (Operations) 4. Royal College of Radiologists (2014) Clinical Radiology UK Workforce Census Report 2012*

p241 **Patient dementia and clinical interaction in frontline diagnostic radiography: Mapping the practical experiences of junior clinicians in the UK**

Paul Miller; Lisa Booth; Adam Spacey

*University of Cumbria*

**Background**: A rapidly ageing UK population and a corollary increase in the numbers of individuals suffering from dementia syndromes is causing a range of structural problems for healthcare services, and practice-oriented problems for frontline clinical staff (Kasteridis et al., 2016). A number of studies in the broader field of allied healthcare has recently emerged pertaining to the nuanced problems that will increasingly emerge as an output of working with patients with dementia, and the equally nuanced solutions that a practitioner might (or might not) find, especially around interpersonal communication (Het, Verkaik, Mistiaen, van Meijel, & Francke, 2015; Nazarko, 2015; Webb & Dening, 2016). Within this corpus, it is reported that junior practitioners of all orders are in a particular position of disadvantage (Baillie, Cox, & Merritt, 2012; Tullo, Young, & Lee, 2016), working with an ever-increasing number of patients with dementia, but without having yet accrued the levels of direct professional experience conventionally thought to be key to developing "expertise" in professional performance (Yielder, 2006). No research has to date, however, directly addressed this broad matter within the radiological professions.

**Method**: Extended semi-structured interviews with six junior diagnostic radiographers in the UK (mean experience = 3.5 years) were analysed using Interpretative Phenomenological Analysis (IPA).

**Results**: Three superordinate themes were identified: 1. Confidence, experience and education. 2. Practical and technological constraints on effective practice. 3. Complexities of carer input. Participants' lack of confidence around their knowledge of dementia, and regular treatment of the condition as a 'generic' thing in practice, sometimes damaged clinical interaction, particularly when the participant was feeling institutional time pressures. Education for new professionals was seen as lacking in both quantity and context-relevance, with implications for professional confidence and legal ethical practice. Carers/family were viewed as both a positive and negative force within an examination, and technological advances in radiography were taken to be clinically advantageous, but also sometimes actively detrimental to the effective interpersonal care of patients with dementia.

**Conclusions**: Although necessarily limited in scale and classical

*1. Baillie, L., Cox, J., & Merritt, J. (2012). Caring for older people with dementia in hospital part one: Challenges. Nursing Older People, 24, 33-37. doi:10.7748/nop2012.10.24.8.33.c9312 2. Het, H. I., Verkaik, R., Mistiaen, P., van Meijel, B., & Francke, A. L. (2015). The effectiveness of interventions in supporting self-management of informal caregivers of people with dementia; a systematic meta review. BMC Geriatrics, 15, 147-147. doi:10.1186/s12877-015-0145-6 3. Kasteridis, P., Mason, A., Goddard, M., Jacobs, R., Santos, R., Rodriguez-Sanchez, B., & McGonigal, G. (2016). Risk of care home placement following acute hospital admission: Effects of a pay-for-performance scheme for dementia. Plos One, 11, e0155850-e0155850. doi:10.1371/journal.pone.0155850 4. Nazarko, L. (2015). Hearing the voice of the person with dementia. British Journal of Healthcare Assistants, 9, 222. doi:10.12968/bjha.2015.9.5.222 5. Tullo, E. S., Young, T. J., & Lee, R. P. (2016). Medical students' views about person-centred communication in dementia care. Dementia, doi:10.1177/1471301216651981 6. Webb, R., & Dening, K. H. (2016). In whose best interests? A case study of a family affected by dementia. British Journal of Community Nursing, 21, 300-304. doi:10.12968/bjcn.2016.21.6.300 7. Yielder, J. (2006). Towards an integrated model of expertise in medical imaging. Journal of Diagnostic Radiography and Imaging, 6, 1-11. doi:10.1017/S1460472806000010*

p242 **Team roles in MRI**

Darren Hudson

*InHealth Group, London*

**Background**: Team working and collaboration in healthcare is essential for ensuring patient safety, as well as supporting delivery of efficient and effective services. It is of no lesser value in the MRI setting when staff are often working in small, isolated teams, sometimes just in pairs on a remote mobile unit.

**Method**: As part of the review of the in-house MRI training programme, classroom based contact time was doubled to allow inclusion of sessions around team roles, service efficiency and patient experience. This was in order to provide more breadth in content around ancillary topics that support delivery of MRI services, team working being central to many aspects. During the introduction session on team roles, participants are asked to complete a Belbin Self-Perception Inventory, which is a behavioural test used to measure preference for the nine indentified team roles. Team roles are indentified as 'a tendency to behave, contribute and interrelate with others in a particular way'. The nine roles being; resource investigator, teamworker, co-ordinator, plant, monitor evaluator, specialist, shaper, implementer and completer finisher.

**Results**: Of the nine roles assessed, the top three preferences seen amongst many of the MRI Radiographers were; Completer Finishers, Specialists and Team Workers.

**Conclusion**: These were interesting and help support some of the key attributes needed amongst this professional group -- detailed knowledge and understanding of anatomy and physical principles, ability to interact and work with colleagues to deliver a service, and ensure an imaging examination is complete to a diagnostic standard from start to

p243 **Lymphoma: The great masquerader**

Elisabeth O'Dwyer; Ciara O'Brien; William Torreggiani

*Tallaght Hospital, Dublin*

This pictorial review will describe the pearls and pitfalls which radiologist encounters when interpreting these cases.

Demonstrate the varied locations and appearances of classic extranodal sites of lymphoma

**Background**: Lymphoma, a malignancy arising from lymphocytes or lymphoblasts, accounts for approximately 4 % of all cancers. Typically thought of as a disease of the lymph nodes however approximately 40% present as extranodal disease.

Primary extranodal lymphoma is a great mimicker often appearing like other neoplastic, infections or inflammatory conditions. This leads to a wide and varied radiological features, with lymphoma often being an under considered differential.

Through the increased availability of multimodality imaging including CT, MRI and PET/CT, the diagnosis of extranodal lymphoma has been greatly advanced. This pictorial review will describe the typical and atypical imaging characteristics, seen in cases of common sites of extranodal lymphoma, including CNS, pulmonary, testicular and osseous lymphoma. We will offer a potential diagnostic algorithm to aid diagnosis.

**Conclusion**: Lymphoma is a relatively common but often under considered diagnosis due to the wide spectrum of multimodality imaging characteristics. Although a tissue diagnosis will be required, it is important to consider extranodal lymphoma in the presence of certain radiological features to ensure a quick and timely diagnosis.

*1.Chua, S. (2009) 'Imaging features of primary extranodal lymphomas', Clinical radiology., 64(6), pp. 574–88. 2.Guermazi, A. (2003) 'Extranodal lymphoplasmacytoid lymphoma: Spectrum of disease', European radiology., 13(4), pp. 771–9.*

## d001 Radiation awareness amongst junior doctors, re-audit.

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**Background** Recent literature suggests that junior doctors' knowledge of ionising radiation is inadequate. Advances in technology and availability have led to of these investigations being readily requested. Exposure is associated with adverse risks especially malignancy, therefore in accordance with IR(ME)R, clinicians should be aware of radiation doses and their legal responsibility as referrers, to insure no unnecessary exposures. The first audit cycle demonstrated limited knowledge. Understanding of the fundamentals of imaging techniques was limited, with >70% requesting more teaching. The action plan included teaching sessions focussing on radiation awareness and using i-Refer to request imaging responsibly.

**Method** A prospective study of all foundation doctors attending teaching at Royal Oldham Hospital was conducted. A questionnaire regarding knowledge of radiation doses, ALARA and guidelines was circulated to all foundation 1 doctors.

**Results** Overall, results of the re-audit were very promising. Of the 25 responses received 96% agreed that CT TAP had the highest radiation dose, 72% correctly estimated the risk of inducing a malignancy (compared to 43% and 49% from first cycle), and 72% correctly estimated the relative dose of radiation compared to 0% form the first cycle. 95% and 98% understood IR(ME)R regulations and how to use i-refer to request responsibly, a dramatic improvement from 1% and 0% respectively from the cycle one.

**Conclusion** Structured and dedicated teaching sessions has shown to improve the knowledge of the junior doctors; this has the potential to help to reduce inappropriate imaging requests and unnecessary radiation exposures.

*1. Royal College of Radiologists. Making the best use of clinical radiology 2. Soye, J. A., and A. Paterson. "A survey of awareness of radiation dose among health professionals in Northern Ireland." The British journal of radiology (2014). 3. The General Medical Council, Good Medical Practice (2006) 4. The Ionising Radiation (Medical Exposure) (Amendment) Regulations 2011.*

## d002 Derriford Hospital foundation doctors' knowledge of ionising radiation legislation and exposure

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**Introduction** Studies have revealed a lack of appreciation among referrers regarding ionising radiation exposure.[1] Furthermore, foundation doctors are commonly being asked by seniors to request radiology without fully understanding the clinical indications. Referrers have a legal obligation to comply with IR(ME)R (2000).[2] Many trusts bundle radiation training into `induction e-learning`, which may get overlooked by new trainees. This audit assesses foundation trainees` knowledge of radiation and suggests changes to employers/trusts learning provision.

**Method**

*Target*

1. 100% of foundation doctors should have knowledge towards radiation legislation.
2. 90% of foundation doctors should have appropriate knowledge of common/important radiation doses.[3]

*Data Collection*

•Questionnaire distributed to foundation doctors in PHNT.

*Initiation of Change*

•Teaching to foundation doctors on IRMER and iRefer.

*Re-audit Data Collection*

Questionnaire re-distributed to foundation doctors after intervention.

**Results** There were 24 responses to the first questionnaire. 12 were aware of legislation regarding radiation; 9 were able to name IR(ME)R. None were aware of referral guidelines. 21 admitted being asked to request radiology from seniors without full understanding. 17 felt that they did not have adequate teaching regarding referrals.

Following a teaching intervention, there were 23 responses to the re-audit questionnaire. 23 were aware of government legislation; 22 named IR(ME)R. 23 were aware of iRefer. There was significant improvement in knowledge of common plain film and CT ionising radiation doses. 3 stated they haven`t received adequate radiology referral teaching.

**Conclusion** Induction mandatory e-learning alone is not sufficient in ensuring adequate junior doctor knowledge of radiation legislation. Additional workshops significantly improve understanding of ionising radiation and appropriate referral, which is essential for patient safety within referring teams.

*1. Shiralkar, S., Rennie, A., Snow, M., Galland, M.B., Lewis, M.H., and Gower-Thomas, K. (2003) Doctors` knowledge of radiation exposure: questionnaire study. BMJ **327**, 371—372. 2. The Ionising Radiation (Medical Exposure) (Amendment) Regulations 2011. http://www.legislation.gov.uk/uksi/2011/1567/contents/made (Accessed April 2017). 3. RCR AuditLive - Foundation Doctors` Knowledge of Radiation Legislation and Exposure. London. 2011. https://www.rcr.ac.uk/audit/foundation-doctors%E2%80%99-knowledge-radiation-legislation-and-exposure (Accessed April 2017).*

d003 **Dose audit in plain radiography for paediatric imaging: a multi-centre study**

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[1]*King's College Hospital NHS Foundation Trust;* [2]*Whittington Hospital NHS*

**Background**: There are currently no National Paediatric Diagnostic Reference Levels (DRLs) for plain radiography paediatric imaging studies in the UK. A multi-centre study was performed to establish and compare Local DRLs between three NHS hospitals.

**Methods:** Data from 3 hospitals was collected for n=62,167 paediatric patients (<17 years old). Data was collected from the Radiology Information Service (RIS) for two sites and a Dose Management System (DMS) for the other. Dose Area Product (DAP) values were analysed for each age group (0,1,5,10 and 15 year olds) using SPSS v.22 for the most frequent examinations (>10 studies per age group). Exposure parameters including kV and mAs were also analysed where available.

**Results:** From the data obtained from RIS 29% did not include a unit for the DAP value; this were excluded from the final analysis. As expected this was not an issue with data obtained from the DMS. In each age group the median DAP varied from 1.4 to 7.1 cGycm2 for chest; 2.9-8.0 cGycm2 for wrist; 3.7-6.2 cGycm2 for ankle; 2.3-5.1 cGycm2 for knee and 3.1-10.1 cGycm2 for elbow.

**Conclusions:** The DMS not only provided the data in a more time efficient manner but it was of a superior quality when compared to that obtained from the RIS. National DRLs will be easier to establish across all radiology examinations as more sites across the NHS adopt DMSs. This data will now be compared to values published in literature. Although a mixture of Computed Radiography (CR) and Digital Radiography (DR) systems and vendors are operated across the three sites this audit has demonstrated a need for optimisation and harmonisation.

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d004 **Establishing a comprehensive and automated imaging dose registry for radiotherapy**

Andrew Reilly ; Aisling Haughey ; Bernadette McCafferty

*North West Cancer Centre*

**Background**: Radiotherapy centres are encouraged to actively manage concomitant imaging doses(2). An imaging dose registry has been developed to comprehensively and automatically capture both treatment and pre-treatment radiotherapy imaging exposures.

**Methods**: The registry is orientated around a Conquest DICOM archive of Radiation Dose Structured Report (RDSR) objects. Conquest forwards the objects to the open-source OpenREM system(1). which parses and stores the relevant dose information. A script extracts patient height and weight from the ARIA oncology management system (OMS) and stores these in OpenREM. A new data-warehousing layer presents the OpenREM data in a denormalised form suitable for exploration by data analytics tools. RDSR objects are automatically sent to the dose registry by the radiotherapy CT scanner and a script runs daily that extracts linac treatment exposure information from the ARIA OMS and generates RDSR objects which are forwarded to the registry. This includes information about kV and MV planar imaging and kV CBCT scans.

**Results**: Operators consider the registry the definitive record of imaging exposures and regularly consult it as part of technique audit and development. It is also used during multi-disciplinary peer review to consider whether imaging practices remain clinically appropriate. Opportunities for optimising CBCT protocols have been identified by detecting via the registry where significant dose modulation has been performed by the CT scanner during pre-treatment imaging. Pre-treatment exposures were consistent with local and national DRLs. **Conclusion**: The effectiveness of strategies for radiotherapy imaging optimisation can be explored by considering dose information alongside image evaluation.

*1. McDonagh E. (2014). http://openrem.org 2. National Radiotherapy Implementation Group. (2012). Image Guided Radiotherapy (IGRT) Guidance for implementation and use.*

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d005 **Comparison of a size-adjusted versus a standard-size approach for dosimetric calculations**

An Dedulle [1]; Niki Fitousi [1]; Hilde Bosmans [2]

[1]*Qaelum NV;* [2]*University Leuven, Belgium*

**Background** Effective dose (E) is currently used as the only common dosimetric index between modalities, until organ doses are available. Even though it is meant for populations, several tools use phantoms of various sizes to evaluate E for different body habitus. This study investigates the differences between standard-size and size-adjusted dosimetry for chest radiography.

**Method** A set of 233 adult chest posterior-anterior examinations was used. The examination parameters and patient information were extracted from the dose management platform DOSE (Qaelum NV, Belgium). The E was estimated with two methodologies. First, calculated by DOSE, that uses a standard-size conversion factor. Secondly, simulations were executed with PCXMC (STUK, Finland), which scales its phantom to match patient's weight and height, using the corresponding examination parameters. This provided size-adjusted dose, which was compared to the standard-size results.

**Results** The patients' Body Mass Index (BMI) ranged from 13 to 44 (median 26). Differences in E (%$D_E$) between DOSE and PCXMC ranged from -22% to 90% (median 15%). The correlation between %$D_E$ and BMI was $r^2$=0.73. Underestimations for the underweight and overestimations for the overweight and obese patients were observed. For 88% of the patients with normal BMI (18.5-25), %$D_E$ was within ±15% and for 67% it was even within ±10%.

**Conclusion** A standard-size conversion factor towards effective dose works well for the normal size patients, but results in underestimations for the underweight and overestimations for the overweight and obese patients. These dose differences could be a trigger for a more personalized approach in dosimetry.

*Martin, C. J. (2007) Effective dose: how should it be applied to medical exposures? The British Journal of Radiology, 80, 639-647 Yanch, J. C.; Behrman, R. H.; Hendricks, M. J. & McCall, J. H. (2009) Increased Radiation Dose to Overweight and Obese Patients from Radiographic Examinations. Radiology, 252, 128-139*

d006 **Effective dose and effective risk of projection radiography procedures in obese patients compared with normal-weight patients.**

Saeed Alqahtani [1]; Richard Welbourn [2]; Karen Knapp [3]; Jude Meakin [3]; Rachel Palfrey [3]; Susan Rimes [2]; Katharine Thomson [2],

*[2]Musgrove Park Hospital; [3]University of Exeter*

**Background**: The radiation dose to obese patients in projection radiography is not well documented as for computed tomography and interventional radiography. This study aimed to estimate the effective dose and the effective risk of projection radiography procedures conducted for obese patients with a comparison to normal weight patients.

**Materials and methods**: Dose of area product (DAP) from four projection radiography procedures; abdomen, lumbar spine, chest and pelvis, that were conducted for obese patients, have been used along with DAP figures from normal patients based on the national diagnostic reference level 2010 review, to estimate the absorbed dose and effective dose for obese and normal weight patients using Monte Carlo software, PCXMC 2. The effective risk was estimated, for males and females from 20 years age and above, based on the organ absorbed dose and the cancer risk figures from the report of the health protection agency.

**Result**: Obese patients in this cohort are receiving higher effective doses in the four studied procedures compared to the normal weight patients. The effective dose increases percentage in obese patients compared to normal adult ranged between 25% for the chest to 160% for abdomen imaging. The lifetime cancer risk is increased for obese patients, with increases up to 152% especially in the abdomen and lumbar spine radiograph.

**Conclusion**: Obese patients are receiving high effective doses compared to normal weight patients and hence more cancer cases among obese patients to occur as a result of ionising radiation doses relating to projection radiography examinations.

d007 **Nottingham University Hospitals. Standardising PA chest exposures via DoseWatch**

Nicholas Wong ; Elliott Simpson

*Nottingham University Hospital*

Showing how Nottingham University Hospital radiographers worked together with their Medical Physics Team on the dose optimisation of PA chest X-rays. DoseWatch is a dose monitoring programme which pulls detailed data directly from compatible X-ray equipment for each exposure. This is part of the Imaging Excellence Programme. We have set up medical exposures committee which meets monthly. These meetings discuss the obstacles which have become apparent with the implication and the management of the DoseWatch programme and how to overcome them. The first step for the PA chest examination was to standardise the exposures across both sites using the data from DoseWatch programme. Our medical physics team were able to search the DoseWatch programme using the exam codes entered into CRIS (e.g. XCHES). We then found that the exam code would be used for several local codes depending on the X-ray equipment (e.g. chest, XR chest, XCHES). The data showed that the rooms which were used for PA chests (one on each site) used different exposure parameters. One favouring 90kvp (no grid) the other 125kvp (with grid). Exploring the average DAP of the rooms shows that the dose to the patients is largely the same, and well below NRDLs

d008 **Exploring patient dose optimisation in Computed Tomography (CT) scanning**

Victoria Major [1]; Sean Ryan [2]; Teresa Letchford [1]; Desiree O'Leary [2]

*[1]Paul Strickland Scanner Centre; [2]University of Hertfordshire*

**Background**: There are concerns about radiation dose to patients from CT due to its increased use and its larger contribution to radiation exposure than other imaging modalities, this makes the optimisation of CT protocols paramount[1]. This study explored optimisation of patient dose during CT scanning by UK Radiographers. Objectives included investigating knowledge of CT parameters, identifying educational needs and examining collaborative working.

**Method**: Ethical approval was granted for this mixed method cross-sectional study through survey methodology using an adapted existing questionnaire. Participants were recruited with the support of Society of Radiographers via a link to the

participant information leaflet. The questionnaire contained quantitative and qualitative questions, 40 protocol questions could be scored and compared with the previous study[2].

**Results**: UK radiographers fared slightly better when the questions on exposure parameters were scored and compared to previously published data from a European cohort, with a mean score of 30.93/40 compared to 28.00/40 from the previous study. 98% of respondents felt that further education on optimisation of CT parameters would be beneficial. Through thematic analysis four main themes were identified indicating how additional education could be delivered, these were; 'further education to Masters' level', 'regular continuing professional CT focused updates', 'training from manufacturers/application specialists' and 'standardised training at undergraduate level'. Only 9% of respondents indicated that a multi-disciplinary team set protocols.

**Conclusions**: UK radiographers have reasonable knowledge of exposure parameters but they feel that further training/education will empower them to optimise patient doses effectively. Collaborative working is required to fully optimise protocols.

*1. Chell, I. DH Expert Working Party Response to: Committee on Medical Aspects of Radiation in the Environment (COMARE) 16th Report Patient radiation dose issues resulting from the use of CT in the UK. Department of Health (UK); 2016 May. 2. Foley, SJ, Evanoff MG, Rainford LA. A questionnaire survey reviewing radiologists and clinical specialist radiographers knowledge of CT exposure parameters. Insights into imaging. 2013 Oct 1;4(5):637-46.*

d009 **Optimisation of paediatric CT dose and image quality**

Rebecca Gillen [1]; Nick Weir [2]; Mark Worrall [3]

*[2]NHS Lothian; [3]NHS Tayside*

**Background** CT is in general a relatively high dose imaging modality and, since younger patients are more radiosensitive, it is especially important to fully optimise paediatric CT protocols. The primary aim of this project was to assess the suitability of imaging protocols on a new CT scanner at the Royal Hospital for Sick Children (RHSC) compared to the CT scanner currently in clinical use. We also reviewed the imaging protocols to identify any aspects which could potentially be optimised to improve image quality and/or reduce radiation dose.

**Method** Head and chest scans were performed on three anthropomorphic phantoms (CIRS ATOM dosimetry phantoms) representing a 1 year old, a 5 year old and a 10 year old. The phantoms were scanned on both CT scanners installed at RHSC; the Siemens Sensation 64 which is in current clinical use, and the GE Discovery 670 which was installed more recently. The radiation dose associated with scanning the different sizes of phantom was recorded in terms of dose-length product (DLP). Image quality was assessed in terms of the Signal to Noise Ratio (SNR) in regions of interest. Imaging protocol settings were also compared for different age ranges and between the two scanners. In order to evaluate the reliability of using the phantoms to predict patient doses, a retrospective patient dose audit using data from 2016 was also carried out on the Siemens Sensation 64.

**Results** Phantom data demonstrated that paediatric head and chest scans on the GE Discovery 670 provided

*1. Doses from Computed Tomography (CT) Examinations in the UK – 2011 Review, PHE-CRCE-013 (2014), P C Shrimpton, M C Hillier, S Meeson and S J Golding 2. Radiation Risks from Medical X-ray Examinations as a Function of the Age and Sex of the Patient, HPA-CRCE-028 (2011) BF Wall, R Haylock, JTM Jansen, MC Hillier, D Hart and PC Shrimpton 3. National survey of doses from CT in the UK: 2003, British Journal of Radiology, Vol 79 (2006) P C Shrimpton, M C Hillier, M A Lewis and M Dunn 4. Benchmarking paediatric CT practices throughout Scotland - Presentation given at the IPEM Optimisation in Paediatric Imaging Conference, 2016, M Worrall*

d010 **Reducing administered activity in myocardial perfusion SPECT by 40% using LEGP collimators and resolution recovery (RR)**

Ian Armstrong ; Kim Saint; Heather Williams; Patricia Chilra; Stuart Bartley; Christine Tonge; Parthiban Arumugam

*Central Manchester University Hospitals*

**Background** In 2016, our department performed 1199 myocardial perfusion SPECT (MPS) studies with median administered activity of 346 MBq, resulting in a radiation dose (stress + rest) of 5.2 mSv. This clinical evaluation follows our multi-vendor phantom study, which indicated patient dose can be significantly reduced by moving from LEHR to LEGP collimators, in combination with RR.

**Methodology** 45 MPS scans were performed on a GE Infinia with LEHR then LEGP collimators. Patients received tetrofosmin using our BMI-based protocol. Counts in the myocardium were matched between LEHR and LEGP images. Summed scores were extracted from a normal database comparison using Corridor 4DM. Functional data (EDV, ESV and LVEF) were obtained using Cedars Sinai QGS.

**Results** Image quality was comparable for each collimator. No significant differences were observed for the summed scores. On average EDV, ESV and LVEF were 16%, 26% and -3.1 percentage points different ($P < 0.01$) in the LEGP images, respectively. The LVEF difference showed an inverse relation with the ESV. This is likely to be due to differences in pixel in size.

**Conclusion** Use of LEGP collimators and RR is a simple and highly accessible method for attaining significant radiation dose reductions for MPS, which will facilitate a widespread reduction to population radiation dose. This enables a 40% reduction in administered activity in the LEGP images, leading to a radiation dose for a two-day stress-rest protocol of between 3 and 4 mSv. Furthermore the reduced Tc-99m usage will increase resilience against anticipated cost increases of radioisotope supply.

d011 **Effect of tube angulation on peak skin dose during interventional procedures**

Niki Fitousi ; Frank Rogge ; Filippo Miniati ; Jurgen Jacobs

*Qaelum NV, Leuven, Belgium*

**Background** Interventional procedures involve the risk of excess use of radiation. Peak Skin Dose (PSD) is the quantity of concern as it is directly linked to skin injuries. This study focusses on quantifying the reduction in PSD when changing the tube primary and secondary angle during the procedure.

**Method** The study was performed on 1588 cardiac procedures from nine interventional rooms (3x Philips AlluraXPer, 6x Siemens Axiom Artis), in four hospitals of two different countries. For the data analysis and PSD calculation, the dose management platform DOSE (Qaelum NV, Belgium) was used. DOSE calculates the dose distribution on the patient's skin and performs a complete angle and table analysis, allowing for the computation of different angle combinations for each procedure.

**Results** By using different angles in 50% of the irradiation events, the physician can reduce PSD even by 50% compared to Dose at Reference Point (DoseRP). This trend was observed in almost all devices. It was also noticed that in several cases the tube angles remain constant during the whole procedure. For them, as expected, the ratio of PSD to DoseRP is close to unity.

**Conclusion** A significant reduction of PSD is observed when changing properly the tube angles, to avoid constant irradiation of the same area. Unquestionably, this is not always feasible and moreover, other parameters also influence PSD. By using an advanced dose management system, the operating physician can identify techniques that require corrective actions to ensure patient safety, especially when high skin doses could be expected.

*1. Balter, S, Hopewell, JW, Miller, DL, et al. (2010) Fluoroscopically guided interventional procedures: A review of radiation effects on patients` skin and hair. Radiology **254**(2), 326-341. 2. Pasciak, AS, Bourgeois, AC, Jones, AK. (2014) C-arm rotation as a method for reducing peak skin dose in interventional cardiology. Open Heart **1**, 1-8. 3. Pasciak, AS, Jones, AK. (2011) Does "spreading" skin dose by rotating the C-arm during an intervention work? J. Vasc. Interv. Radiol. **22**(4), 443-452. 4. Stecker, MS, Balter, S, Towbin, RB, et al. (2009) Guidelines for patient radiation dose management. J. Vasc. Interv. Radiol. **20**, S263-S273.*

d012 **Reducing radiation the lens of the eye in routine CT head imaging- re-audit**

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**Background** CT head examinations may result in significant and unnecessary irradiation to the lens of the eye, a highly radio-sensitive tissue; thus increasing the likelihood of accelerated cataract formation. Standard CT head examinations expose the lens to approximately 25-103mGy. The International Commission on Radiological Protection estimates opacity formation with doses as low as 0.5Gy. With CT examinations readily available and patients often having multiple exposures over a lifetime, the need for radiation awareness and safe practice is paramount. First cycle demonstrated lens exclusion in only 38% of studies in the under 65s, where mobility issues or confusion/ dementia are likely to be less prevalent. The commonest cause for lens inclusion was mal-positioning; therefore a poster demonstrating effective positioning techniques to avoid the lens was placed in the radiology department.

**Re- audit method** A retrospective trust wide audit of all CT head scans was undertaken over a one week period in September 2016. CT scans were viewed in sagittal section to best visualise lens inclusion.

**Results** A total of 328 scans were analysed. 154 were under the age of 65, 55% of studies in this group excluded the lens of the eye (38% first cycle). Demonstrating a 17% decrease in lens inclusion in the under 65s following introduction of the poster.

**Conclusion** This is a modest improvement which has demonstrated the need for continued training, as well as highlighting the importance of improving image acquisition to reduce unnecessary radiation to the eye and potential cataract formation with multiple exposures.

*1.D. D Hart, B F Wall, M C Hillier and P C Shimptorn (2008) Frequency and Collective Dose for Medical and Dental X-ray Examinations in the UK, HPA-CRCE-012E 2, . Heaney, C. A. J. Norvill, (2006) A Comparison of reduction in CT dose through the use of gantry angulations or bismuth shields, Australasian Physics & Engineering Sciences in Medicine Volume 29, Issue 2 , pp 172-178 3.*

d013 **Evaluation of absorbed dose and protocols during brain computed tomography scans in a Nigerian tertiary hospital**

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*[1]Usmanu Danfodiyo University Sokoto; [2]University of Nigeria Nsukka; [3]university of Maiduguri Teaching Hospital*

Computed tomography (CT) scan of the brain is the commonest CT examination performed and had been recognized to deliver a very high radiation dose to the patients. This study was aimed at evaluating the radiation dose from routine brain CT scan and to compare the dose from the protocols for brain CT. The ex-post-facto design was adopted. All the records of brain CT scan from September 2011 to August 2015, acquired with a 16 slice CT machine (Phillips Brilliance Medical System, MX8000) in the Radiology Department of University of Maiduguri Teaching Hospital (UMTH) were evaluated. Ethical approval was obtained from the Ethical Committee of UMTH. The weighted CT dose index (CTDIW), volume CT dose index (CTDIVOL) and dose length product (DLP) values were recorded for each of the examination. Results showed that the two main protocols used were axial

and helical scan modes. The mean CTDIvol and DLP values were 76.6 mGy and 1285.8 mGy*cm for axial and 103 mGy and 1903 mGy*cm for helical scan modes respectively. There was a significant difference ($p < 0.05$) between the CTDIvol and DLP values of axial and helical scan modes. Conclusion: the study found higher radiation dose in helical than axial scan modes. This study, therefore, recommends the use of axial scan mode for routine brain CT scan, to reduce radiation dose, except where speed is desirable such as in unconscious patients, uncooperative patients and when automatic injector pump is to be used.

d014 **Worldwide patterns and trends in Diagnostic Reference Levels (DRL) for common adult Computed Tomography (CT) examinations**

Jia Jun Ng ; Siew Teng Boon ; Joanne Janice Chia ; Li Jun Lim ; Galileo Bengo ; Yushuang Zheng

*Sengkang Health*

**Background**: In the last two decades, there has been extensive interest in DRL and various publications to set up institutional and national DRL. In this poster, we will look at DRL articles that feature three most common adult computed tomography (CT) examinations; head, chest and abdomen pelvis and observe if the CT DRL values decrease with time as a result of advancement in technology.

**Method**: An online search for articles on CT DRLs through the University of Sydney library search engine was conducted. Search terms such as "diagnostic reference levels" and "computed tomography" were used. Relevant articles were collected and analysed.

**Results**: Eighteen articles representing 18 different countries were collected and analysed. The two indicators of CT DRL, Computed Tomography Dose Index (CTDI) and Dose Length Product (DLP) on the head, chest, and abdomen pelvis were tabulated. The results did not indicate a downward trend of radiation dose to patient with time, other than CT head.

**Conclusion**: While advancement of CT imaging has been rampant in the last three decades, CT DRL values over time in the different countries do not reflect a reduction in radiation dose. The average weight of the different populations does not seem to be a major factor that affects CT DRL. The availability of technology and CT radiographers practice may have played more influencing roles.

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