

Advances in technology

P-075 **Role of MR imaging in Gaucher disease**

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Introduction: Gaucher disease is a genetically inherited disorder and is the most common lysosomal storage disease. The body is unable to produce an enzyme (glucocerebrosidase) that is required to break down glucocerebroside. It results in the accumulation of this lipid compound in the lysosomes of macrophages, predominantly in the reticuloendothelial system. These abnormal cells are termed Gaucher cells. Consequences of this abnormal storage cause hepatomegaly, splenomegaly, anaemia, thrombocytopenia, and bone problems - bone crises, acute/chronic pain and Avascular Necrosis (AVN). It can also affect the lungs, brain and impair growth. Magnetic Resonance Imaging (MRI) provides a non ionizing imaging technique that can assess bone marrow abnormalities, AVN, liver/spleen volumes, provide Bone Marrow Burden (BMB) scores and Quantitative Chemical Shift Imaging (QCSI) that measures displacement of fatty marrow by Gaucher cells.

Methods: Examination of the MR imaging of several case studies of patients diagnosed and treated with Gaucher disease. Systematic review of the relevant medical literature has been employed to support the role of MR imaging in this disease as well as to include future MR imaging techniques that could prove useful in the management of these patients e.g. MR Spectroscopy (MRS) and Diffusion Tensor Imaging (DTI).

Results/ Discussion: MRI is an extremely useful imaging modality for the management of patients with Gaucher disease. It can monitor the responses of Enzyme Replacement Therapy (ERT) and Substrate Replacement Therapy (SRT). Demand for MR scanning in this cohort of patients will inevitably increase as mounting investment in treatment strategies are being investigated with multicentre Randomised Control Trials (RCT's).

P-076 **Imaging the augmented breast**

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Research suggests there are growing numbers of women having breast augmentation in the UK and the impact on the NHSBSP will continue to rise in the future (Colville 2003, McIntosh 2008).

Mammography is still the most cost effective method of detecting breast cancer at an early stage even for women with augmented breasts. Evidence suggests that implants can prevent visualisation of breast tissue and can cause changes which could hinder cancer diagnosis (McIntosh 2008). A modified technique was developed by Eklund (1988) which when compared to the standard view showed marked improvement in compression, additional breast tissue and improved image detail. Our aim was to evaluate Radiographer adherence to departmental protocols when imaging women with augmented breasts in the screening setting and to evaluate technique. A retrospective review of image sets taken before and after additional training was undertaken. Before training in 50% of cases there was no attempt to carry out the modified view (increasing to 60% after training) and in only 63% of occasions was there an increase in visible breast tissue (increasing to 100% after training).

Departmental protocol on imaging women with breast implants is based on guidance from the NHSBSP (2002) and RCR (2003) and should be followed. Despite this the protocol was not being adhered to and there was only a 10% increase in the use of the modified view even after training. As this is the case it could be concluded that there needs to be national guidelines on imaging women with augmented breasts.

P-077 **Six year longitudinal study of pressure force in screening mammography**

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Aims/Objectives: Our previous research identified applied pressure in mammography is more heavily influenced by practitioners than clients. With pressure variability in mind, this retrospective longitudinal study (6 years) assessed 3 consecutive screening attendances, to determine how pressure varied within and between practitioners and clients.

Content: Consecutive screening mammography with retrospective selection of 500 clients, commencing at 50 years old. One centre using GE DMR+ analogue mammography machine. Recorded data included: practitioners, applied pressure, breast thickness, BI-RADS density, dose estimations. Exclusion criteria: previous breast surgery, previous /ongoing interventions including assessment, implants and volume change.

Relevance /Impact: To assess if pressure application has any dependence on the practitioner rather than the client.

Outcomes: pressure variations over 3 screens were noted for the same client. Amount of pressure applied highly dependent upon the practitioner. 3 practitioner compressor groups were demonstrated - high (mean 126N), intermediate (mean 89N) and low (mean 67N). Same client: when the same practitioner performed the 3 screens, pressure variation was low (-40N to +25N); when practitioners from different compressor groups performed 3 screens variations were higher (-20N to +100N). Retrospective dose analysis demonstrate mean reductions of 0.07mGy (MLO), 0.05mGy(CC) from an image taken by low compressors compared to an image taken by high compressors.

Discussion: The amount of pressure used seems highly dependent upon practitioner rather than client factors. Implications for radiation dose and image quality consistency. It may also affect client experience re-attendance over sequential attendances.

P-078 The use of vacora biopsy in the NHSBSP

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Aims/Objectives: The aim of NHSBSP is to ensure accurate diagnosis at the earliest detectable stage whilst minimising the number of women for open biopsy for benign disease and maximising the number of women with cancer with a non-operative diagnosis of malignancy. As such, the requirement for diagnosis on first biopsy is high. The use of larger gauge needles and vacuum assistance for the assessment of suspicious lesions enables prompt diagnosis and can obliterate the requirement for open biopsy.

Content: Our service utilises various biopsy devices; namely the Mammotome®, Vacora® and Achieve® systems. The use of Vacora® is a relatively new introduction to our service. The device is used in conjunction with other biopsy products and is not considered to be a replacement. An introduction to the device and the training that is to be considered if introducing this technique to your service follows.

Relevance/Impact: This will aid to highlight good practice and identify training requirements for staff new to this technique.

Results: The system is intended for diagnostic sampling of breast tissue and is not used for therapeutic excision. It is excellent for calcification evaluation and is a simple procedure which is carried out during the assessment clinic appointment. It achieves highly accurate diagnostic results with the advantages over traditional 14g core biopsy being its ability to target vague diffuse areas. The patient's acceptance of the procedure remains high in our service.

Discussion: The Vacora® breast biopsy under stereotactic guidance is used in this department with increasing regularity and is now becoming the procedure of choice for first line investigation for an increasing number of breast lesions. It may also affect client experience re-attendance over sequential attendances as women find higher pressures more uncomfortable.

P-079 Optimising paddle and detector pressures and footprints in mammography

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Introduction: The breast is compressed during mammography between a fixed detector plate and a moveable compression plate. Ideally these should exert a uniform pressure on the breast. This study compares different detector positions relative to the breast to determine which give the most balanced surface pressures and contact areas (footprints).

Method: A breast phantom of similar compression characteristics to female breast was mounted on a rigid torso. Positioning (CC projection only) was in line with recommended practice. A flexible multi-sensor pressure mat was wrapped around the phantom so that breast/detector and breast/paddle pressure readings could be taken simultaneously. Readings were taken using Hologic Selenia and Selenia Dimensions mammography units, each with two different paddles, at 60N, 80N and 100N and at five vertical detector positions (-2cm, -1cm, 0, +1cm and +2cm) relative to the infra-mammary fold (IMF).

Discussion: For each of the conditions, paddle and detector footprints and pressures were extracted and the relative pressures from paddle and detector and relative indices of footprint and pressure for paddle and detector were calculated. A detector position of +1cm or +2cm gave the best pressure and footprint balance (approximately 50:50). At baseline (detector at IMF), higher pressures were from the paddle. A detector position below the IMF gave the worst balance (approaching 100% of pressure from the paddle).

Conclusion; For our phantom, optimum footprint and pressure balance is obtained by positioning the detector 1 to 2cm above the infra-mammary fold. This may have implications for clinical practice. A volunteer study is planned.

P-080 **Staff-client interactions within a breast screening assessment clinic**

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Background / Aims: 5-9% of women attending routine mammography have suspicious findings requiring further investigation. Women undergo either low intervention assessment (clinical examination, mammography or ultrasound), or high intervention assessment (breast biopsy). A significant proportion of women will be found to be normal (false positive) and are referred back into the screening programme.

Women with false positive diagnoses are at greater risk of cancer at the next screen, therefore it is essential they are encouraged to attend subsequent screening, but assessment-related psychological distress may contribute to subsequent non-attendance. This study analyses screening re-attendance rates in false positive women.

Method: Retrospective audit (2004-6) of false positive diagnoses, capturing data on: re-attendance rates; eligibility for subsequent screening; no. screening rounds attended; assessment tests.

Results: 228 women referred to assessment (2004-6) were false positive (returned to routine recall). 75% had attended more than one round of screening. Of those eligible for subsequent screening 17.5% (n = 40) did not re-attend (24.6% 2004, 20% 2005, 10.1% 2006), 13.2% non-attender's had received low intervention assessment and with 4.4% having biopsy with stereo taxis and none having ultrasound guided intervention

Conclusion: The number of false-positive women failing to re-attend for screening is greater than published literature, with those undergoing high intervention surprisingly more likely to return. False-positive women are in a higher risk group for cancer and re-engagement with the screening programme is vital. The study centre is therefore undertaking a patient experience evaluation in the assessment clinic to identify strategies for increasing subsequent attendance.

P-081 **Role expansion in mammography: the Australian perspective**

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The main purpose of this study was to investigate the attitudes of BreastScreen Australia radiographers toward mammography screen reading and to determine other areas of interest in role extension.

Method: A questionnaire was sent to radiographers working in BreastScreen Australia programs. Information on demographics, current duties and possible future role extension was collected.

Results: Questionnaires were returned from 253 radiographers. Currently 69% of radiographers working in mammography are over 45 years old, and have been doing mammography for at least 10 years. Radiographers under 30 years old make up less than 7% of the current workforce with part-timers comprising 63%. While being passionate about their role in BreastScreening, the results highlighted that radiographers working in Australia have an interest in role extension with more diversity in mammography being supported by 73% of the respondents. The radiographers indicated they would feel reasonably confident to undertake image interpretation, and a majority (79%) were prepared to undertake extra training and demonstrated that the importance of increased pay for these extra responsibilities (39%) lagged behind the importance of increased enjoyment and interest in mammography (66%).

Conclusion: An estimated 78% response rate indicates that the data obtained is representative. The introduction of flexible roles and responsibilities may give radiographers a better understanding and passion for mammography improving recruitment issues. This is especially important as it is estimated that 30% of BreastScreen Australia staff will retire within the next five years.

P-082 Specimen radiography of wide local excision for breast cancer – what is the gold standard?

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Intra-operative specimen radiography allows the breast surgeon to assess whether a non-palpable lesion has been adequately excised, or if immediate further margin excision is required. Our wide local excision (WLE) specimens are currently imaged in a Faxitron computed-radiography (CR) specimen cabinet with the imaging plate temporarily removed from the cassette. We audited the quality of specimen images obtained using Agfa CR and a Siemens Novation full-field digital (FFD) mammography unit.

15 cases were imaged using both techniques (CR and FFD) between November 2010 and November 2011. Specimen radiographs were assessed by three breast radiology practitioners – a consultant breast radiologist, an advanced breast practitioner and a radiology SpR year 5. We scored the conspicuity of microcalcifications (both within the lesion and in the surrounding tissue) and lesion margins. Scores of 1, 2 or 3 indicated whether FFD images were of lower, equal or higher quality than CR images. A third assessment, collating the first two results, gave an overall appraisal of FFD versus CR. Images were interpreted on a mammography-quality PACS workstation with a single monitor in ideal lighting conditions and optimum windowing.

Results: FFD images were rated better than CR images in 76% of cases, and better or equal in 98% of cases. A particular strength of FFD is better conspicuity of microcalcifications within the excised lesion ($p < 0.0001$, Fisher exact test). Our gold standard for WLE specimen radiography has now shifted from cabinet CR to FFD mammography-acquired DR.

P-083 Breast density measurements in digital mammography: detector stability analysis

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Introduction: For the longitudinal assessment of breast density detector stability is essential. We have thus analysed mean pixel value (MPV) per unit exposure (mAs) from five Full Field Digital Mammography (FFDM) systems over a period of 22 months.

Methods: Daily quality control (QC) data and servicing information were collected from five GE Senographe Essential FFDM units located at a static site and on mobile screening units between

January 2010 and October 2011. The QC data were plotted for each machine as MPV/mAs against time. Linear fits were applied to the data to determine whether the value of MPV/mAs could be regarded as constant over an extended period.

Results: Periods of up to 6 months in which the MPV/mAs data were stable were identified. Consecutive periods of stability were separated by sudden changes in the mean value of MPV/mAs. By comparing the dates of step changes with servicing records every change can be accounted for. Changes were a result of events such as detector replacement or detector recalibration following routine servicing.

Discussion: Our results provide conclusive evidence that the GE Senographe Essential machines are stable over extended periods of time, with the mean value of MPV/mAs only changing in response to machine servicing. Stability allows longitudinal measurements of breast density to be made without the need to image a calibration object alongside the breast. The changes in MPV/mAs can thus be accounted for in the calibration data set.

P-084 Minimising pressure variability in mammography – an exploratory calibration study

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Pressure variations in mammography exist between and within practitioners. Variation may affect client experience, radiation dose and image quality. This research reports on a calibration study to improve consistency.

Automatic readouts of breast thickness accuracy vary between mammography machines. Therefore one machine (Hologic Selenia), serving a symptomatic population, was selected for calibration. 250 randomly selected clients were invited to participate; 235 agreed and 940 compression datasets were recorded (comprising breast thickness, breast density and pressure). Pressure was increased from 50N stepping through 10N aliquots until the practitioner felt pressure was appropriate for imaging; at each pressure increment breast thickness was recorded.

Graphs were generated and equations derived; second order polynomial trendlines were applied to the data using least squares method. No difference existed between breast densities but a difference did exist between 'small paddle' and 'medium/large paddles'. Accordingly data was combined, with the Y axis representing average change in breast tissue thickness from 50N. 4 composite graphs were created. Small paddle: CC $y=0.0944x^2-3.4742x+15.968$ ($R^2=0.9809$); MLO $y=0.0944x^2-3.4742x+15.968$ ($R^2=0.9809$). Medium/large paddle: CC $y=0.1313x^2-4.4331x+19.21$ ($R^2=0.9984$); MLO $y=0.1323x^2-4.575x+19.88$ ($R^2=0.9994$). Graphs were colour coded into 3 segments - low, intermediate and high gradients (<-2 (amber); $-1<>-2$ (green); <-1 (red)). We propose 130/135N could be an appropriate termination pressure using this mammography machine.

Using client compression data we have calibrated a mammography machine to determine its breast compression characteristics. This calibration data could be used to guide practice to minimise pressure variations between practitioners so improving client experience and reducing potential variation in image quality.

P-085 Results of a CT dose audit of new technology scanners

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A review of radiation doses delivered to patients undergoing X-ray CT examinations was undertaken for three newly installed scanners, in addition to one having undergone a major software upgrade and another having undergone optimisation of all thorax protocols. Three of the scanners featured the GE ASiR reconstruction algorithm, claimed by the manufacturer to reduce radiation dose whilst maintaining image quality. Audit questionnaire sheets were completed by radiography staff at each participating site and information was recorded for each procedure, to include patients' height,

weight, examination type, dose-length product (DLP) and scan length. Mean DLP values for each scanner were collated for a range of “standard” procedures carried out on patients of average weight. These values were compared between hospitals, with equivalent results from a similar audit in 2010 and with National Diagnostic Reference Levels (NDRLs) recommended by the NRPB, where available. Standard exposure parameters were inspected to determine whether protocols were optimised and whether changes made since the previous audit correlated with changes in dose. For the majority of procedures, new technology and protocol optimisation were found to have contributed to a significant reduction in patient dose. Many mean DLPs were also found to have fallen from their 2010 values to below the recommended NDRL.

P-086 The impact of tube current variation on lesion detection in the attenuation correction image co-incidentally acquired for myocardial perfusion imaging in SPECT/CT: a phantom based study

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Aim: Assess the impact of tube current (mA) on a readers' ability to accurately localise simulated pulmonary lesions on the attenuation correction (AC) CT image acquired for SPECT/CT myocardial perfusion imaging.

Method: Four mA settings (1, 1.5, 2 and 2.5) were evaluated using the GE Infinia Hawkeye 4. All other CT acquisition parameters remained constant throughout. An anthropomorphic chest phantom containing simulated pulmonary lesions was scanned on each mA setting without any movement of the phantom between scans to produce of a case-matched series of images (27 cases showing 0-4 lesions) suitable for free-response receiver operating characteristic (FROC) analysis. Images were evaluated using our novel web-based ROCView software under controlled conditions. The area under the ROC curve (AUC) index was obtained using jackknifing (JAFROC) methods and Multi-Reader Multi-Case (DBM-MRMC) analysis. A difference in performance would be considered statistically significant at $p < 0.05$. 20 readers of varying CT experience (0-24 years) evaluated 108 images using an ordinal scale to score confidence.

Results: Analysis showed that there was no statistically significant difference in performance between mA settings ($p = 0.826$) according to ANOVA. However, average localisation performance was weaker at 1mA (AUC = 0.714) compared to the three higher dose settings (AUC = 0.736, 1.5mA; AUC = 0.738, 2mA; AUC = 0.733, 2.5mA).

Conclusion: All mA settings allowed similar lesion detection performance. This suggests that lesion visibility is preserved at lower mA /lower dose values; this study could have implications for diagnostic quality CT in terms of dose reduction strategies.

P-087 Lesion detection in the CT attenuation correction image of 5 different low resolution SPECT/CT systems: a multi-centre study

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Aim: Assess lesion detection performance of the CT attenuation correction (AC) image produced for myocardial perfusion imaging of 5 different SPECT/CT systems.

Method: An anthropomorphic chest phantom containing simulated lesions was scanned at 5 centres using the departmental CT AC acquisition. Simulated lesions were not moved between scans; producing case-matched images (26 cases showing 29 simulated lesions) suitable for free-response receiver operating characteristic (FROC) analysis. Images were evaluated using our novel web-based ROCView software. The area under the ROC curve (AUC) index was obtained using jackknifing

(JAFROC) methods and Multi-Reader Multi-Case (DBM-MRMC) analysis. A difference in lesion detection performance would be considered statistically significant at $p < 0.05$. 19 readers of varying CT experience (0-4 years) evaluated 130 images scoring confidence using a continuous rating scale.

Results: Analysis of the AUC index showed a significant difference in lesion detection performance for this sample of readers ($p < 0.005$). Table 1 describes the lesion detection performance of each SPECT/CT system. The first generation system, GE Millennium VG (Hawkeye option), achieved an AUC score representing unreliable capability for lesion detection in this study.

Centre	Scanner	Eff. mAs	CTDI _{vol}	AUC (95% CI)
1	Infinia Hawkeye 4	30.36	3.967	0.754 (0.623-0.844)
2	Infinia Hawkeye 4	24.29	3.173	0.839 (0.765-0.912)
3	Millennium VG (Hawkeye)	57.69	4.600	0.627 (0.494-0.760)
4	Infinia Hawkeye 1	57.69	4.112	0.670 (0.542-0.797)
5	Precedence 16	49.57	3.500	0.873 (0.788-0.957)

Conclusion: For SPECT/CT systems, there is large disparity in the CT system's ability to demonstrate simulated lesions in an anthropomorphic phantom. It can be speculated that the clinical value of these co-incidentally produced CT images is highly variable.

P-088 **The use of contrast enhanced ultra sound (CEUS) for characterization of incidental focal hepatic lesions compared to contrast computed tomography (CT) and contrast magnetic resonance imaging (MRI)**

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Aims: To highlight the importance of using CEUS as the evolving technology for characterization of incidental-focal-hepatic lesions compared to contrast-CT and contrast-MRI.

Content: This is a retrospective literature review comparing CEUS to contrast-CT/MRI for characterization of incidental-focal-hepatic lesions, which was undertaken during the preparation of a Business-Case for CEUS service at an NHS hospital.

Impact: Focal-hepatic-lesions are localized areas of abnormality in the liver. These include benign lesions, such as simple cysts, haemangiomas, adenomas; and malignant lesions, such as metastasis and hepatocellular carcinoma. They are commonly detected in the clinical practice 'incidentally' whilst performing imaging for unrelated clinical scenarios.

Currently, contrast-CT/MRI scans are used for characterization of such lesions. However, there are a number of advantages of using CEUS instead.

Outcomes: Results of this literature review shows significant cost-effectiveness and other advantages of using CEUS compared to contrast-CT/MRI including, higher sensitivity and specificity; reduction of hospital-stay and/or invasive liver biopsies; reduction of waiting-lists; ability to detect small metastasis; avoidance of contrast-induced-nephropathy (CIN), nephrogenic-systemic-fibrosis (NSF) and contrast allergy; avoidance of radiation-induced cancer; and providing real-time teaching and research opportunities.

Discussion: Ultrasound is the gateway for other imaging modalities. Current common practice in the UK is to image patients using baseline-B-mode ultrasound (without contrast) to detect focal liver lesions. If focal liver lesions are detected they then need to be characterized mainly to discriminate between benign and malignant through contrast-CT/MRI. This study outlines the importance of using CEUS for such characterization through highlighting various advantages of using CEUS.

P-089 **CT as an alternative to the skeletal survey in patients with multiple myeloma**

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Key learning Points: To examine at the benefits of computed tomography (CT) skeletal survey in patients with multiple myeloma.

Description : The role of radiology in the assessment and monitoring of patients with multiple myeloma is to demonstrate evidence of the lytic lesions, the location and their extent. Conventional radiographs have limitations as 10-20% of patients may have normal results due to the under diagnosis of lytic disease and radiographs are limited in the assessment of response to treatment. CT has increased sensitivity and an ability to characterise trabecular anatomy in difficult areas such as scapulae, ribs and sternum. It also allows differentiation between benign and pathological compression fractures, and is superior in estimating fracture risk.

Other advantages of CT include

- Demonstration of unsuspected associated pathology such as lung disease, soft tissue and visceral masses and identifying suitable biopsy sites.
- Detection of small osteolytic lesions
- Multiplanar reconstructions.
- Excellent for radiotherapy planning and surgical intervention.
- Shorter examination time than skeletal survey.
- No repositioning of the patient therefore increased patient comfort.

Although CT was previously associated with increased radiation dose the effective radiation dose can be comparable with conventional radiography depending on the exposure parameters selected

Conclusion: We aim with case studies and examples of scanning techniques to demonstrate that whole body low dose multi detector CT is a viable alternative to the skeletal survey in patients with multiple myeloma.

P-090 **Radiographer led arthrograms**

*Lisa Brindle, Rebecca Leahy;
RBH*

Arthrograms have been carried out solely by Radiologists for a number of years. Due to waiting list issues and the time constraints on Radiologists we were approached with regard to carrying out Radiographer led Arthrograms.

We applied to do the Advanced Medical Imaging course at Salford University and with Radiologist guidance we were trained how to carry out the Arthrogram procedure. We found we were the only Radiographers in the country to officially carry out this procedure. We had to create our own new technique/ procedure documents along with all the relevant PGD's for the drugs administered.

We now run our own Arthrogram lists . This has a huge impact on the service that is provided within the Radiology department and has dramatically reduced waiting lists and also added further patient groups for steroid injections which would normally have been carried out in theatre.

P-091 **Improvements made to the process in carrying out patient dose audits**

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This project set out to automate and simplify the process of conducting Patient Dose Audits, in addition to correcting the calculated Entrance Surface Doses for individual patients based on age/exam type.

Included will be a brief history of how PDA's were carried out, the current process involving many steps and hours, methods we have used to improve the results, process and the final report, and the future of this service.

The improvements made to this service will have a major impact on the quality of the data used. Correcting ESD's based on patient age and/or exam type will vastly improve the accuracy of the reported data. RIS data is also used instead of hand written dose audit sheets; impossible data is

excluded along with data that doesn't conform to set parameters. Automation will increase the quality of the output of the report both visually and in terms of the data presented. In addition to the reduction of costs, automation also ensures mistakes are not made by using inaccurate or incorrect data.

The outcome is a reduction in time/cost spent producing reports and an increase in the quality of both the data and report.

To evolve in the future it is hoped that this process can be linked or expanded to include a dose engine to calculate an effective dose for individual patients based on exposure factors and patient size/age. It is also hoped that data will be collected straight from DICOM data, again increasing its accuracy.

P-092 Does new CT generation mean eco-friendly radiation?

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Aim: Audit patient radiation doses from the new Toshiba Aquilion PRIME CT scanner against national diagnostic reference levels (DRLs) and national average multi-slice CT doses.

Method: Patient radiation dose for five CT examinations (Head, Thorax, HRCT, Abdo/Pelvis, Thorax/Abdo/Pelvis) was measured by recording the Dose Length product (DLP) from 90 randomly selected patients. An average DLP radiation dose for each examination was calculated. Data was collected in April 2011 and again in November 2011 following use of certain radiation protection settings and increasing image slice acquisition in three of the five CT examinations.

Results: In April 2011 DLP in 56% of all CT examinations were within national DRLs; average DLP were within national DRLs in three CT examinations including CT Head (850 DLP), Thorax (370 DLP), and Thorax/Abdo/Pelvis (730 DLP). CT Head, Abdo/Pelvis and HRCT DLP (850, 590 and 240 respectively) exceeded national average multi-slice CT DLP (830, 530 and 140 respectively). In November 2011 DLP in 79% of all CT examinations were within national DRLs; average DLP were within national DRLs in four CT examinations including CT Head (860 DLP), Thorax (180 DLP), Abdo/Pelvis (520 DLP), and Thorax/Abdo/Pelvis (450 DLP). CT Head and HRCT DLP (860 and 330 respectively) exceeded national average multi-slice CT DLP (830 and 140 respectively).

Conclusion: Majority of patient radiation doses for the new CT scanner were within national DRLs however some CT examinations reported higher than national average doses. Becoming more experienced in using new software settings can reduce patient doses.

P-093 Reducing radiation dose in CT colonography

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Aim: To audit the radiation dose of CT Colonography (CTC) at a district general hospital.

Relevance: The use of CTC for the detection of bowel cancer is increasing in the UK. This is partly due to the introduction of the bowel cancer screening program. As the use of CTC becomes more widespread, particularly in asymptomatic patients, radiologists must ensure that radiation doses are kept as low as reasonably practicable.

Standard: The mean effective dose of CTC should not exceed the CTC dose range in the literature (4.0-13.2 mSv).

Methods: Dose-length products of 70 patients undergoing CTC were recorded from two CT scanners: a 64 slice scanner and a 128 slice scanner. Effective dose was calculated using transfer factors.

Results: The overall mean effective dose was 16.7 mSv. The mean effective doses from the 64 and 128 slice scanners were 12.0 mSv and 19.9 mSv respectively. Outcomes: A review of CTC protocols identified that the 64 slice scanner used a fixed CTC protocol. The 128 slice scanner used a dose modulation system that adjusted tube current to acquire high quality images at the expense of dose. We therefore implemented a low dose protocol for this scanner. A re-audit of 76 patients undergoing CTC on this scanner found that mean effective dose decreased to 12.3 mSv.

Discussion: Keeping CTC dose as low as reasonably practicable is vitally important. In order to achieve this, dedicated low dose CTC protocols should be used and dose audits need to be performed on a regular basis.

P-094 **Radiological investigations and ionising radiation: how aware are we?**

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Aims/Objectives: To assess Foundation Doctors' awareness of ionising radiation from common radiological investigations.

Content: 60 Foundation Doctors (FD) completed a questionnaire designed to test their knowledge on radiation doses associated with common diagnostic imaging procedures; they were also asked to specify the certainty of their answers. Other questions focussed on identifying which investigations emit ionising radiation. The trainees received no prior tutorials/lectures on this subject.

Relevance/Impact: The increasing use of diagnostic imaging studies has given rise to growing fears over the risks associated with high levels of radiation exposures. Many studies have also raised concerns over the limited awareness of these risks amongst medical students and referring doctors.

Outcomes: With regards to radiation doses, 49% of all questions were correctly answered. Over half (54%) of trainees had guessed these correct answers. 28% underestimated the doses of radiation associated with these investigations. 12% and 15% of FD believed that CT scans and abdominal radiographs respectively do not involve radiation; 25% believed that angiograms do not involve radiation. 10% believed MRI involves the use of radiation. 25% of trainees correctly identified the risk (1 in 2000) of inducing a fatal cancer from an abdominal CT.

Discussion: Since FD are responsible for organising and requesting various diagnostic imaging studies, it is crucial they are aware of radiation exposures associated with these investigations. This study highlights poor awareness of radiation doses and potential risks of ionising radiation amongst FD and hence emphasises the need to educate current and future referring doctors.

P-095 **Dose reduction in CT pulmonary angiography - a district hospital experience**

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Aims/Objectives: To present the results of the introduction of dose-reducing techniques in CT pulmonary angiography (CTPA) in a district hospital setting.

Content: The protocol for CTPA was recently changed in our institution. As the number of CTPAs requested has rapidly increased in recent years so has concern about radiation dose to patients. Based on recent literature findings the decision was made to reduce the imaged scan range in an effort to reduce dose whilst trying to maintain diagnostic quality. A further dose-reducing technique (iterative reconstruction) was introduced a few months later. The effect on dose at each step is presented.

Relevance/Impact: Our experience with these dose-saving techniques will be presented along with an analysis of the data. This information will be of relevance to all those involved in the delivery of a CT service.

Outcomes: Comparison of patient dose levels before and after the introduction of the reduced scan range technique showed a significant reduction in patient dose ($p < 0.0001$). The introduction of an iterative reconstruction technique further significantly reduced the dose ($p < 0.0001$).

Discussion: The phased introduction of two dose-reduction techniques over the space of just a few months has delivered significant dose savings. First, a reduction in scan range resulted in a 20% dose saving. The use of a new iterative reconstruction technique resulted in a further 30% dose saving. No perceived reduction in diagnostic quality was observed.

P-096 **Weight bearing lumbar spine X-rays: PA or AP, a dose comparison**

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Aims: To conduct a pilot study investigating a potential patient radiation dose reduction by imaging weight-bearing lumbar spines PA (SID =180cm) compared to AP (SID =115cm).

Content: Patient size, kV and image density were kept constant in the study. AEDs were used to control the mAs. Dose data was collected and compared from patients undergoing plain film, weight-bearing lumbar spine imaging, PA and AP. Data collected for imaging in the lateral position at the two SIDs was also compared. Three different rooms were used in the study. The data was analysed using one tailed T-test.

Outcomes: Significant reduction in dose was found in all 6 comparisons, with the exception of one. The PA radiographs were shown to have a significant reduction in dose of 56% compared to the AP radiographs. The dose associated with the lateral images at different SIDs was also significantly reduced (48%). When diagnostic image quality was assessed by comparing magnification and unsharpness, no significant difference was found.

Discussion: Theoretically, increasing the SID and changing the orientation of patients when imaging the lumbar spine should reduce the dose to the patient and their radiosensitive organs, but may also affect image quality adversely. Facing the image receptor allows the patient to hold onto the wallstand and may help reduce movement artefact. The findings of this study support these theoretical assumptions and comply with the principles of ALARP. The authors of this study believe the new acquisition parameters described should be adopted when imaging the erect lumbar spine.

P-097 **Investigation of exposure condition and safety parameters used in clinical ultrasound**

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Purpose: Ultrasound is a safe diagnostic tool used routinely in hospitals worldwide; however, with advancement of technology there is an increase in machine output which might proportionally increase the thermal and mechanical effects in tissue. Hence, the safety committee of the British Medical Ultrasound Society (BMUS) emphasized the importance of monitoring output levels of ultrasound equipment during normal clinical ultrasound scanning. The purpose of this study is to evaluate the acoustic output indices (AOI) at the Department of Radiology, King Abdul-Aziz University (KAU), Jeddah- Saudi Arabia and compare the current practice with these safety guidelines.

Methods: All Sonographers working in the Department of Radiology at King Abdul-Aziz University Hospital, Jeddah, Saudi Arabia were asked to fill out a questionnaire for every patient scan completed between June 2 nd and June 23rd , 2011. The data collected consisted of type and duration of scan, ultrasound machine parameters, settings and output indices (mechanical and thermal).

Results: A total of 408 scans were conducted during the chosen period on 10 different ultrasound machines all by Philips. Scan types were: abdominal, obstetrics, pelvic, transvaginal, and small parts. The scan time ranged from 2 to 36 min for all scan types. The maximum thermal index (TI) and mechanical index (MI) recorded was 1.3 and 1.5 respectively.

Conclusion: All scans performed during this period comply with the safety guidelines set by BMUS with regards to TI and MI limits. However, restricted scan time was exceeded during 2(1.5%) Obstetric scans (35 min with TI = 1.2).

P-098 **An audit of the quality of CT pulmonary angiogram studies at a busy teaching hospital**

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Imperial College Healthcare Trust

Aims: Pulmonary embolism (PE) is a common acute cardiovascular presentation which results in significant morbidity and mortality. CTPA is the investigation of choice in patients with a high clinical

suspicion of PE. Radiologists should be aware of the multiple factors affecting CTPA quality which impact upon accurate evaluation and implementation of measures to overcome poor quality studies.

Content: Review of imaging and reports of 114 patients who had CTPA. Scan quality assessed by: Automatic or manual trigger and location of trigger placement (standard 100% in pulmonary trunk) Mean pulmonary trunk density (standard 100% > 250 Hounsfield Units).

Overall optimality grading taking into account breathing artefact and opacification of each case by two observer review based upon literature standards of grade 0-4 on the level to which PE can be excluded (0 is unable to exclude, 4 is to subsegmental; grade 2 or less is suboptimal)

Outcomes: 18% of CTPAs positive with alternate diagnoses in 56% (in line with RCR guidelines).

13% manually triggered and 18% of triggers in incorrect locations.

29.8% suboptimal contrast opacification (below 250HU)

34% were grade 2 or less (suboptimal) in optimality grading

Reporter agreement in only half these cases.

Discussion: Radiologists should interrogate scan quality and should document this in the report.

Methods to improve scan quality include radiographer education regarding trigger locations and patient breathing instructions. The use of varied contrast volumes, time delays, saline chasers, test boluses and scanning direction in improving opacification are also discussed.

P-099 **Cost-effectiveness in radiologist reporting: are radiologists more efficient when they work longer hours?**

William Hedqes; Shah Khan;

East Lancashire Hospitals NHS Trust

Aim: Assess measure workload in a UK radiology department and compare the productivities and cost-effectiveness of consultants working different numbers of PAs in a large radiology department. to see whether those working longer hours are more cost-efficient.

Content: Reporting data from electronic records for 14 consultants working different numbers of PA during the period April 2010 - March 2011. These were then converted into relative value unit (RVU) scores using the Pitman-Jones RVU system. Crude and net workloads were calculated for each consultant by dividing their RVU score by the number of PAs they were paid for and how many they spent reporting.

Relevance: Increasing workloads, combined with current austerity measures are putting UK radiology departments under considerable stress. Although PACS and voice recognition software have allowed radiologists to increase productivity it may not be enough and we need to look at the most efficient ways to manage radiology departments as well.

Outcomes: It was found that there was statistically significant variation in productivity between consultants working different numbers of PAs ($p < 0.05$). Consultants working 12 PAs were significantly more productive than other consultants, working a mean of 6490 RVUs per PA per year compared to 4722 RVU/PA/year for those working 10 PAs. It was found that there was statistically significant variation in productivity between consultants working 12 PAs than those on fewer PAs ($p < 0.05$).

Discussion: Whilst UK consultants are highly cost-effective, those working 12 PAs per week are more so than those working fewer PAs. The reasons for this are unclear but many of the Consultants on 12 PAs were senior and experienced and may be quicker with higher turnover. However, and further research is needed to identify why this is the case. An UK specific RVU system would make productivity analysis more accurate.

P-100 **Reporting workloads in of reporting radiographers and sonographers: an exploratory study: cost effectiveness compared to consultant radiologist**

William Hedqes; Shah Khan,

East Lancashire Hospitals NHS Trust

Aims: To accurately measure the workload of radiographers and sonographers for the first time in the UK and compare them to that of consultant radiologists in a DGH.

Content: Reporting data for sonographers, reporting radiographers and consultant radiologists at a large DGH was taken from electronic records during the period April 2010 - March 2011. These were converted into an RVU score using an adapted version of the Pitman-Jones RVU system. Reporting workload was calculated by dividing the total group RVU scores by the number of PAs worked by each group.

Relevance: Non-medical reporting staff play a significant role in dealing with increasing radiology workloads in the UK with radiologists. Although accuracy of this reporting has been previously measured, actual workload levels of sonographers and reporting radiographers have never been measured. It is important to do this so that we can improve cost-effectiveness and fully recognise the contribution of these valuable members of staff.

Outcomes: There were 9 sonographers working 80.5 PA/week, 2 reporting radiographers worked 10 PA/week, and 14 consultant radiologists working 158.21 PA/week during the period April 2010 - March 2011. Sonographer workload amounted to 1,955.9 RVU per PA per year (RVU/PA/year). Radiographer workload was to 4,277 RVU/PA/year. Crude consultant radiologist workload was 4,106 RVU/PA/year, but they spend 42.49% of their time on non-reporting activities, giving a net score of 7,140 RVU/PA/year.

Discussion: RVUs can be used to measure reporting workload for non-medical reporting staff. This can then be compared to radiologist workloads. Reporting radiographer workloads are similar to those of consultant radiologists, but workload of sonographers appears to be lower. This may be due to a variety of factors and requires further work to analyse fully. The reporting radiographers and sonographers make a valuable and significant contribution dealing with the increasing radiology workload. However, radiologists are more productive.

P-101 **An audit of the utility and accuracy of ultrasound imaging in the diagnosis of acute appendicitis in a district general hospital paediatric population**

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Aims: Appendicectomy is one of the most common paediatric emergency operations. Prompt accurate diagnosis has a significant beneficial impact and can not only improve diagnostic accuracy but also detect other pathology. Ultrasound scanning (USS) in acute appendicitis is useful particularly in children where the diagnosis can often be more challenging and where radiation protection is a more important consideration. An audit looking at the use of the ultrasound and its diagnostic accuracy was performed.

Content: Appendicectomy specimens in one year aged 0-16 years were analysed and evaluation of relevant imaging performed together with histological correlation. Targets for standards of Negative appendicectomy rates (<6%), sensitivity (80%) and specificity (94%) together with negative and positive predictive values (PPV - 95% and NPV - 90%) based on literature review.

Outcomes: Total 118 included patients.

20.3% negative appendicectomy rate (higher than literature standard of 6%)

23.8% had USS

Sensitivity = 26.8% (i.e. probability that US detected appendicitis when present)

Specificity = 100% (i.e. probability that USS was negative when appendicitis not present)

NPV = 39.1% (i.e. proportion of patients with negative USS correctly diagnosed)

PPV = 100%

Discussion: USS is currently under utilised in the diagnosis of acute appendicitis in this population. Significantly lower than expected sensitivity and NPV rates obtained compared with literature standards. Potential reasons for this are discussed including high false negative rate in early case and

the importance of not ignoring ancillary findings e.g. localised free fluid in this population as well as optimising scanning technique.

P-102 Leadership qualities framework: can you improve over time?

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Purpose: This paper is part of a wider, CORIPS funded case study, which explored the leadership function of 6 consultant radiographers in the UK. This paper explores the change in leadership capabilities demonstrated by the repeated LQF, as a result of involvement in the study, executive coaching provided and an increased awareness of, reflection on, and analysis of the leadership function.

Methods: A longitudinal case study was used as a framework for this study. A range of data collection methods were used to triangulate data and increase validity, including an objective leadership measure (the Leadership Qualities Framework (LQF)) which was undertaken prior to any interventions and at the end of the study.

Results: The study found that there was clear evidence of change over time. The qualitative data highlights the impact of specific interventions on those changes, in the opinion of the consultants involved.

Conclusion: The results clearly demonstrate that leadership function can be impacted on over time and offers suggestions as to which specific interventions resulted in a measured change, which could impact on future development planning for advanced and consultant practitioners.

Service delivery

P-103 Should surgeons be responsible for acute ultrasound list? Our experience in a tertiary centre

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Background: In our centre a daily ultrasound list dedicated to acute surgical patients has been implemented to facilitate patient turnover. On-call surgical teams are responsible for patient booking and preparation. We systemically reviewed our service and aimed to introduce changes for further improvement.

Method: We prospectively studied the appropriateness of requests and patient preparation for the dedicated ultrasound list for a 3-week period in January 2010. A trust-wide ultrasound patient preparation guideline was subsequently introduced and junior doctors ultrasound teaching sessions were introduced. We re-audited this service in the following year.

Results: In 2010, inadequate preparation occurred in 21 scans out of 91 patients. 'Full bladder' was not achieved in 58% of scans where it was required. Similarly, 12% of patients did not accomplish 'Nil-by-mouth' when required. Three ultrasound scans were inappropriately requested. Following the guideline introduction and junior doctor education, an improvement in patient ultrasound preparation was observed in our re-audit of 115 patients, with only 36% and 5.6% of patients not achieving 'full bladder' and 'Nil-by-mouth' respectively. There remained 4 inappropriate ultrasound requests.

Conclusion: Our new service has been highly valued amongst surgeons. With appropriate guideline and education, satisfactory standards of service provision can be accomplished especially in a busy tertiary centre where ultrasound demand is high. Similar working model is applicable to other hospitals in the UK to manage the increasing radiology demand

P-104 Omitting neck ultrasound in lung cancer – making best use of a department of radiology or an opportunity lost?

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