DOSE OPTIMISATION AND MEASUREMENT

p173 Evidence of dose optimisation with a single UK radiology department

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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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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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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**

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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**

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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.

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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**

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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**

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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**

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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.