For office use only Grant ID: **138**

THE COLLEGE OF RADIOGRAPHERS
INDUSTRY PARTNERSHIP SCHEME
SUPPORTING RADIOGRAPHY RESEARCH

College of Radiographers Industrial Partnership Research Grants
Final Report

1. Principal Investigator	K Flintham
2. Project Title	**A pilot study to compare supine and erect pelvis radiographs – assessment of impact on radiation dose and diagnostic markers (SEPRAIDD)**
3. Amount of Grant	£4,725.83

4. Did you spend the money as indicated in your proposal (if not why)?

Yes. Additionally we managed to secure the input of a PhD student (K Alzyoud) at the University of Salford to undertake some of the additional phantom work and analysis to extend the content of this phase.

5. Did you reach your intended project outcomes (if not why)?

Yes

6. What are your significant findings?

Anteroposterior body thickness increases significantly when a patient is measured erect rather than supine. Such change is evident across the patient spectrum and is not limited to individuals with an increased body mass index.

When relative changes in soft tissue thickness were studied in a phantom experiment it was noted that the increased body thickness reduces contrast-noise and signal-noise ratios, influenced by changes in kVp. Visual grading analysis also confirmed that image quality was decreased with the increase in soft tissue thickness and kVp.

These findings were evaluated in a patient cohort and were replicated with the change in anatomical shape on standing resulted in reduced visual image quality and increased patient radiation dose.

In conclusion, the techniques used for supine pelvic imaging are not directly transferrable to the erect position and personalised imaging strategies are required to perform optimised examinations.

7. Have you submitted the work for publication (if so where)?

Yes:

ECR, 2018, Poster presentation, Impact of fat thickness on AP pelvis radiography image quality and effective dose, http://dx.doi.org/10.1594/ecr2018/C-0425

Radiography, 2018(3), Optimum Positioning for Anteroposterior Pelvis Radiography: A Literature Review, https://doi.org/10.1016/j.jmir.2018.04.025

Radiography (In Press), Impact of body part thickness on AP pelvis radiographic image quality and effective dose, https://doi.org/10.1016/j.radi.2018.09.001

Secondary analysis of phase 3 imaging to be published

8. Have you presented the work at a national/international event (if so where)?

Yes:

UKRCO, 2018, 'Are we fatter when flatter? A prospective cohort study exploring technique change in pelvic radiography'

ISRRT 2018.Developing Evidence Based Practice: Experiences from the SEPRAIDD Project

To also be disseminated at ASMIRT 2019.

9. Please provide an executive summary of your work (two sides of A4 maximum)
N.B. If you already have a draft or final version of the proposed publication can you please attach.

This study was a clinical-academic collaboration which considered whether pelvic radiography could be undertaken in the erect position and to examine whether there are any differences in diagnostic markers, image appearances and radiation dose, including whether there were any barriers to its introduction.

The research was approved by the South Yorkshire Research Ethics Committee and the Health Research Authority with sponsorship provided by the NHS Trust partner.

During the initial phase of the study we recruited 108 patients attending for non-acute pelvis radiography to undergo measurements of their body shape and body-mass index (BMI) prior to imaging. These measures were obtained in both a supine and standing orientation with body circumference and thickness obtained at the levels of the lower costal margin, iliac crest and greater trochanter. There was little change in body circumference at the three levels (-1.44% to 3.30% change dependent on level and BMI). However, body thickness demonstrated a marked change between the supine and erect positioning with increases ranging from 13.03% to 24.11%, dependent upon BMI and level of measurement.

In phase two of the study an anthropomorphic phantom was utilised and imaging undertaken with direct digital radiograph. Additional fat (catering lard) was then placed in a container above the phantom in a variety of different thicknesses (up to 15cm in 1cm increments) and imaging repeated to simulate increased BMI of the phantom. In total, 144 images were obtained for exposures from 70kV to 110 kV in 5kV incremental steps across the range of differing fat thicknesses. Contrast-Noise Ratio (CNR) and Signal-Noise Ratio (SNR) were calculated for each image and six experienced observers used relative visual grading to assess overall image quality (IQ). The results demonstrated that CNR and SNR decreased with increasing fat thickness and increasing kVp. IQ also reduced as fat thickness and kVp increased. However, the effective dose (E) also increased with fat thickness, with higher fat thicknesses producing a proportionately higher dose at lower kVp values. Normal radiographic practice is to increase kVp as body habitus increases in order to minimise patient dose, however this has demonstrated that this will reduce overall image quality and a clinical judgment must be made between these two factors.

An appropriate imaging protocol was developed from the anthropomorphic phantom experiment work. This supported the final phase of the study which involved the recruitment, with informed consent, of 60 patients referred for non-acute radiography to undergo imaging of the pelvis in both supine and erect positioning. Image acquisition order (erect or supine) was randomised. Secondary analysis of the images to assess clinical measures and image quality is planned as a supplementary phase.

The majority of patients who expressed a preference in type of image acquisition selected erect positioning as the favourable option (n=42/47, 13 no preference stated).

In conclusion, the study has demonstrated that patient body shape changes between the erect and supine positioning, regardless of the patient's BMI. An increase in body thickness reduces the overall image quality with objective measures such as CNR and SNR ratios showing reduction in values and subjective measures (visual grading analysis by experienced observers) confirming the reduction in image quality. Additionally the increased body thickness will result in a higher dose being delivered to the patient. In order to perform erect pelvis imaging consideration will need to be given to ensuring optimal protocols are employed in order to minimise the radiation dose received and ensure that high quality diagnostic images are obtained.