to implement IQM (iRT Systems GmbH, Germany) for PSD of all volumetric modulated arc therapy (VMAT) and stereotactic plans using locally derived action levels, to improve efficiency of the PSD workflow.

Method: Following system commissioning, small leaf position errors were introduced into a range of treatment plans and resultant IQM signal deviation was assessed. Correlation of IQM signal deviation with changes in plan dose-volume histogram (DVH) metrics was used to derive clinically relevant action levels[1]. These were checked using a retrospective audit of 32 clinical plans delivered on both phantom-based and IQM systems. Finally, a time efficiency audit was performed for a 3-month period.

Results: Strong linear correlation between deviation in IQM signal and DVH metrics was found across a range of sites. Asymmetric action levels of -6.3% and +4.0% were deduced, corresponding to a 5% reduction in planning target volume (PTV) metrics and a 5% increase in organs-at-risk (OAR) metrics respectively. No action levels were exceeded by the audited plans. Automation of the IQM software and reduced setup time contributes to an average monthly time saving of 31 hours.

Conclusion: IQM signal deviation correlates with variation of DVH plan metrics for treatment errors. The IQM is suitable for routine patient specific dosimetry across all tested sites. Implementation of the IQM has dramatically improved efficiency of the PSD workflow.

1. iRT Systems GmbH ed., (2019). *How to determine error tolerances for the IQM System (user training).* Koblenz, Germany.

C5.5 Radiographer IGRT training using "ProKnow contouring accuracy" to enhance online-adaptive workforce skills

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Background: Online-adaptive radiotherapy (OART) may become the new gold-standard for radiotherapy to complex cancers. Current IGRT training programmes do not confer skills in organ at risk (OAR) and target volume contouring or plan evaluation. This study evaluates web-based contouring tasks (ProKnow) in IGRT training; gaining experience with OAR and target volume contouring. ProKnow uses peer-reviewed, expert contours on anonymous CT data-sets, providing Dice scores, which may help to reduce training burden on clinicians.

Method: 10 radiographers undertaking prostate IGRT training completed ProKnow contouring tasks. An anatomy and IGRT overview was delivered for trainees and supplemented by contouring instruction within ProKnow. Trainees contoured 6 CT data-sets (2x prostate, 2x seminal vesicles, 1x bladder and 1x rectum). Mean Dice scores for initial and final contours were compared using paired *t*-tests in Microsoft Excel.

Results: Dice scores significantly increased for the prostate (0.739 vs 0.850, p=0.001), seminal vesicle (0.566 vs 0.794, p=0.007) and for rectum contours (0.720 vs 0.882 p=0.010) from initial to final attempts. All radiographers achieved satisfactory initial bladder OAR contours and therefore initial and final scores matched. The mean Dice score for the bladder was 0.943.

Conclusion: This study shows radiographers significantly improve their contouring accuracy using this self-directed approach, limiting the time burden on training staff. OART capable hardware requires large investments; so OART must be used clinically early in the implementation to justify higher investment. This study indicates integration of ProKnow tasks into radiographer IGRT training builds experience and skills in preparation for radiographer-led OART services.

Proffered papers: Chest

D5.2 Improving diagnoses with AI: Deep learning software for chest xray interpretation

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Background: Chest radiograph reporting at hospitals is challenged by increasing wait times and reporting backlogs due to growing scan volumes. Artificial intelligence (AI) with accurate and rapid chest radiograph reporting capability can help improve efficiency and increase accuracy of initial diagnosis.

Methods: qXR, a deep learning AI system that is trained on 3.5 million chest radiographs with separate detection pipelines for 30 abnormalities. Chest radiographs (n = 1040) from accident & emergency (A&E) (n = 252), general

practitioners' clinic (GP) (n = 265), in-patient admissions (IP) (n = 269) and out-patient centers (OP) (n = 253) were collected prospectively from East Kent NHS Hospital Trust. Two radiologists read each radiograph and provided a report; they then checked on the qXR report and submitted additional comments. Readings of the two radiologists were compared to qXR report for statistical analysis. Inter-reader agreement between radiologists and qXR were tested using Cohen's Kappa coefficient.

Results: Ground truth was established based on the results of radiologist 1's reports, which represented the ground truth. qXR reported each CXR as normal versus abnormal. qXR identified abnormal chest radiographs with a sensitivity of 0.98, specificity of 0.57, positive predictive value of 0.95, negative predictive value of 0.80. Inter-reader agreement (n = 743) between radiologists was 0.66, between qXR and radiologist 1 was 0.61 and between qXR and radiologist 2 was 0.70.

Conclusion qXR can accurately stratify chest radiographs as normal versus abnormal in a hospital setting, potentially reducing reporting backlogs and resulting in early intervention to patients.

D5.3 Factors affecting lung cancer SABR patients participating in a clinical trial

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Background: Clinical trials are essential for the development of radiotherapy treatments and techniques. Lung cancer highly prevalent in the UK and recruitment into eligible clinical trials is crucial; however, trial participation is low (Du et al., 2008; Cancer Research UK, 2021). SABR lung patients are often frail and have other co-morbidities (SABR UK Consortium, 2019). This retrospective service evaluation looked to identify any specific patient demographic factors influencing participation in the current Lung DNA clinical trial.

Method There were 91 eligible trial patients referred for SABR, treated from April 2019 to December 2021. 30 patients participated and 61 patients declined trial participation, demonstrating a recruitment rate of 33%. Seven factors were investigated: age; sex; distance to hospital; transport to hospital; social deprivation; FEV1 and performance status. Statistical analysis was performed to investigate each factor individually using independent-samples t-test and Chi-square test for independence. The interrelation between these factors and participation was investigated using binary logistic regression.

Results: The independent-sample t-tests and Chi-square test for independence showed no statistical significance that any one factor alone affected patient participation. There was no statistical significance in the binary logistic regression 2 (7, N=86) = 4.518, p>0.7.

Conclusion This study showed no statistical relationship between any factors being investigated and participation in the Lung DNA trial. Further investigation into the factors surrounding patient participation in other trials could be used in comparison with this study. Additional research should be done to identify the reasons behind non-participation and to employ strategies to increase participation.

1. Cancer Research UK (2021). Lung cancer statistics. Available at: https://www.cancerresearchuk.org/health-professional/cancer-statistics/statistics-by-cancer-type/lung-cancer#heading-Zero (Accessed: 14 August 2022). 2. Du, W., Mood, D., Gadgeel, S., & Simon, M. S. (2008). An educational video to increase clinical trials enrollment among lung cancer patients. Journal of Thoracic Oncology, 3(1), pp. 23-29. https://doi.org/10.1097/JTO.0b013e31815e8bb2 3. SABR UK Consortium. (2019). Stereotactic Ablative Body Radiotherapy (SABR): A Resource. (Version 6.1). Available at: https://www.sabr.org.uk/wp-content/uploads/2019/04/SABRconsortium-guidelines-2019-v6.1.0.pdf (Accessed 14 August 2022).

D5.4 Nasogastric tube safety improvement

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Background: Feeding through a misplaced nasogastric tube (NGT) is a potentially fatal but avoidable cause of patient harm. Despite classification as a 'Never Event' thirty-one such incidents were reported to the NPSA in 2021 / 20221.

Method: A new process for NGT check x-rays was introduced to prevent feeding via a misplaced NGT caused by misinterpretation of x-rays. The process required:

- requests to include a statement regarding aspirate
- the NGT tip to be demonstrated on all check x-rays and line enhancement software tools to be applied
- radiology to provide formal reports within defined timescales
- reports to be electronically acknowledged by the referrer prior to feeding

NGT check x-rays were routinely reported by radiology during standard working hours; a report was available out-of-hours on request. Compliance was audited six months after implementation.

Results: Only 62% (n=62/100) of referrals included information on aspirate. 93% (n=93/100) of NGT check x-rays included the NGT tip. Line enhancement software tools were used in 94% (n=94/100) of cases. Examinations were reported by radiology within agreed timescales in 97% (n=97/100) of cases but the report was acknowledged by the referring clinician prior to feeding for 32% (n=16/50) of examinations. No NGT Never Events had been reported since implementation. However clinicians had raised concerns regarding out-of-hours reporting delays.

Conclusion: Radiology reporting of NGT check x-rays was implemented to improve patient safety. Further work is required to improve referrer compliance with requirements for stating aspirate on requests and acknowledgement of radiology reports prior to feeding. Availability of out-of-hours reports presents an additional challenge.

1. NHS England 2022, *Provisional publication of never events reported as occurring between 1 April 2021 published and 31 March 2022.* NHS England, London.

D5.5 Reducing never events associated with nasogastric tubes: a radiographer led initiative

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Background: The Healthcare Safety Investigation Branch (2020) examined patient safety issues related to the placement of naso-gastric (NG) tubes. Several recommendations were proposed to reduce associated adverse events; such as, providing a timely report on the position of NG tubes on chest x-rays. Gill et al. (2017) conducted a successful trial of Radiographer reporting of NG tubes. Therefore, the aim of this study was to assess the safe transferability of Radiographer reporting of NG tubes to another trust.

Method: A prospective data analysis was conducted of 508 chest x-rays and reports for NG tube checks over 6-months. Accuracy of Radiographer reports were compared to reference standard Consultant Radiologists. Chest x-rays were also audited for potentially significant (none tube related) chest pathology.

Results: From 508 cases, the accuracy of Radiographer reporting was 98.6% (95% confidence interval [CI]: 97.2 - 99.4), sensitivity 98.9% (95% CI: 93.8 - 100), specificity 98.6% (95% CI: 96.9 - 99.5), positive predictive value 93.5% (95% CI: 86.8 - 97), and negative predictive value 99.8% (95% CI: 98.3 - 100). 7 (1.4%) minor discrepancies and no major discrepancies were identified. 6 cases (1.2%) had potentially significant (extra-tube) findings (4 heart failure, 1 infection and 1 pneumothorax) that had not been imaged before.

Conclusion: Radiographer immediate reporting of NG tubes on chest x-rays provides an accurate reporting service to improve patient safety by reducing the risk of intra-pulmonary feeding. There was a low occurrence of potentially significant (none tube related) chest pathology findings, however it is unclear if these were clinically new findings.

1. Healthcare Safety Investigation Branch. (2020) Placement of nasogastric tubes. Retrieved from: https://www.hsib.org.uk/investigations-and-reports/placement-of-nasogastric-tubes/placement-of-nasogastric-tubes/
2. Roe, G., Harris, K. M., Lambie, H. and Tolan, D. J. M. (2017) Radiographer workforce role expansion to improve patient safety related to nasogastric tube placement for feeding in adults. Clinical Radiology, 72(6), pp.518-e1.

Proffered papers: Pregnancy

E9.1 Hiding in plain sight - a case report on a heterotopic twin pregnancy

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Background: Ruptured ectopic pregnancy (REP) and Ruptured corpus luteal cyst (RCLC) are two of the most frequent acute gynaecological emergencies, presenting with abdominal pain and haemoperitoneum. Heterotopic pregnancy (HP) is where there are multiple gestations (an intrauterine and extra-uterine location, i.e. an ectopic pregnancy). Whilst rare spontaneously (1 in 30,000), due to modern advances HP is now thought to have a common prevalence in those undergoing assisted reproduction techniques (1 in 100).1

Purpose: We present a rare case of a 7 week twin heterotopic pregnancy with normal antenatal scans and diagnostic uncertainty, with an initial diagnosis of RCLC on CT. We utilise this case to explain possible distinguishing imaging features on US and CT between these two conditions; and as an example of the increasing prevalence of HP in those undergoing IVF.