manufacturer and published guidelines. This included the addition of 0.1mm of copper to all truck examinations. After the first month of use, and further adjustments to settings, a follow up dose audit was undertaken. This showed a significant reduction in DAP values while ensuring diagnostic image quality was maintained. Good agreement was also found with DAP measurements from the other paediatric hospital. Further follow up audits are required for the different X-ray procedures in order to provide a more comprehensive cross site comparison. Once clinical and medical physics staff are satisfied that adequate dose optimisation has been achieved, the exposure factors will be applied across all future paediatric sites. This will ensure a high standard of care and dose optimisation for paediatric patients in Ireland.

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Initial experiences in establishing a 68 Ga-based radiopharmaceutical service in PET/CT

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This study will report on our centre's experience during the installation and validation of a 68 Ge/68 Ga generator and the introduction of 68 Ga-DOTA-TOC imaging to our PET/CT service. Key factors considered in the establishment of the service include shielding and equipment requirements, work practices to ensure occupational exposures are as low as reasonably achievable and quality control procedures. 68 Ga is a short-lived radioisotope (t1/2 67.7 min) that is produced from a 68 Ge/68 Ga generator. 68 Ga decays through positron emission with a mean energy of 836 keV followed by photonic annihilation radiation of 511 keV. The 68 Ga eluate is labelled with DOTA-TOC before being administered to the patient. 68 Ga-DOTA-TOC binds to the surface of neuroendocrine tumours, permitting them to be visualised on PET/CT. The 68Ge/68Ga generator is housed in the existing shielded.

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Challenges encountered when shielding a dual-room sliding gantry CT installation

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Best practice guidelines recommend that a CT scanner be located adjacent to the Emergency Department (ED) or in the Emergency Room. Modern CT technology has evolved in recent years such that it now possible to move a CT scanner between two adjacent rooms and operate the system in either room. One of the main benefits for installing a dual-room sliding gantry CT system in an ED is that it reduces the number of bed transfers critically unstable patients are required to undergo when CT imaging is requested. In addition, it substantially reduces delays resulting from transferring these patients from the ED to the Radiology Department. Many publications exist which outline shielding criteria for rooms in which CT equipment is planned to be installed. The practice of identifying shielding solutions is considered a routine task for those professionals who undertake this work on a regular basis. It is only in the event that regulatory and construction requirements are revised or when new technologies are purchased that this task can be challenging. This presentation outlines the significant shielding challenges encountered when designing the shielding for a sliding gantry CT scanner which can be operated in either a dedicated CT Room or in an adjacent Resuscitation Room within an ED. The solutions to address the difficulties whilst ensuring that the clinical needs and mechanical, electrical and aesthetic aspects of the facility were not compromised are presented. The work also highlights that specific shielding guidelines are required for this new type of installation.

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Relative response of eye dosimeters to variations in scattered X-ray energy spectra encountered in interventional radiology

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The most appropriate operational dose metric for monitoring radiation dose to the eye lens has been identified as the personal and directional dose equivalent at 3 mm depth, Hp(3). Other suggested methods include evaluating Hp(3) through Hp(10) or Hp (0.07), and using conversion factors. There are many uncertainties, however, associated with these dosimetry methods. In particular, the energy response for different dosimetry techniques may vary considerably depending on the incident X-ray energy spectrum. For Thermoluminescent Detectors (TLDs), Optical Stimulated Luminescence Detectors (OSLD) and Electronic Personal Dosimeters (EPD), the deviation of the energy response from unity is reported to vary by a factor of 0.9–2.8 across Hp(0.07) and Hp(10) measurements, with overestimations occurring in the 30-60 kV range. This range coincides with scattered energy spectra encountered in both interventional radiology and cardiology. Establishing how dosimeter energy dependence affects dose measurement accuracy in the clinical setting, whether Hp(3), Hp(0.07) or Hp(10), has received little attention in the literature; however, the effect has been identified as the dominant source of uncertainty in current eye dosimetry methods. Accordingly, this study aims firstly to measure scattered X-ray energy spectra to staff in Interventional Radiology procedures under varied conditions and system settings. Consequently, the dosimetry accuracy of a series of currently available eye dosimeters, including TLDs (100s, 100Hs), OSLD and Electronic Personal dosimeters (EPDs), and a variety of real-time trunk dosimeters will be presented, with energy dependent correction factors established for each dosimeter type, leading to more precise dose measurement.

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Experience of implementing patient dose tracking software in neuro and vascular interventional radiology

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Commercial Dose tracking software, initially installed in 2014, has been used to collect radiation dose metrics from both Neuro-Interventional (Siemens AXIOM Artis dBA) and Vascular Interventional (Philips Allura Xper FD20) Radiology X-ray Systems. The experience of using such software with both systems differs greatly depending on the age of the system and the availability of Radiation Dose Structured Reports (RDSR). The data covers a variety of neuro-interventional and vascular-interventional exam procedures as coded under NIMIS national exam codes. Typical radiation dose metrics include Fluoroscopy Time, Dose Area Product (DAP) and Reference Point Air Kerma (RPAK). More recently the estimation of Peak Skin Dose (PSD) has been added to the suite of dose metrics available within dose tracking software. The aim of this study was to:

- Obtain the distribution of doses per interventional procedure (e.g. Mean, Median, 3rd quartile of Fluoroscopy Time, DAP and RPAK, PSD where available)
- Compare locally determined Dose Reference Levels to published literature
- Compare Peak Skin Dose (PSD) values (where available) with published thresholds for deterministic effects to the skin (e.g. erythema, epilation etc)
- Identify patients who have had single or multiple high dose procedures – for Out-Patient follow-up where appropriate
- Use the collected dose metric data for the optimisation of radiation safety for both patients and staff in an effort to provide continuous improvement within the hospital's radiation safety environment

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Radiotherapy Session 11:25 – 12:55

Benchmarking novel optical fibre sensors for applications in radiation therapy

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Detecting ionising radiation using scintillation light is a long-established technique, yet scintillator-based dosimetry in radiotherapy was not commercially available until recently. Scintillator materials can be organic or inorganic. Organic based scintillator detectors suffer from low light conversion efficiency and Cerenkov light ratio (CLR) coefficient energy dependence. The aim of this study was to characterise novel optical fiber sensors (OFS) based on an inorganic scintillating material for external beam radiotherapy due to the high sensitivity and high light conversion efficiency of inorganic scintillators. The sensor was constructed using a polymethyl methacrylate (PMMA) plastic optical fibre. The core of the PMMA was micro machined to make a cavity with a 700 μm diameter and a 3 mm depth. The cavity was filled with the scintillating material terbium doped gadolinium oxysulphide (Gd2O2S:Tb) and then sealed with an epoxy. The scintillation material fluoresces on exposure to ionising radiation and the resultant emitted fluorescent light is detected using a multi-pixel photon counting module. Essential dosimetric properties were quantified, including the repeatability of the OFS system response, linearity of the output signal with radiation doses and dose rate and dose per pulse (DPP) dependency of the system. Percentage depth dose (PDD) and lateral dose profiles were measured for different field sizes and compared to the commercial W1 plastic scintillator and Monte Carlo simulations using BEAMnrc/DOSXYZnrc codes.

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Using a deep neural network to predict deviations in mean heart dose during the treatment of left-sided deep inspiration breath hold patients

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Purpose We investigated if a deep neural network could be used to predict the change in mean heart dose when a patient's heart deviates from its planned position during radiotherapy treatment. Methods Predictions were made based on parameters available at the time of treatment planning. The dose prescription, deep inspiration breath hold (DIBH) amplitude, heart volume, lung volume, V90% and mean heart dose were used to predict the increase in dose to the heart when a shift towards the treatment field was undertaken. The neural network was kept as simple and institutive as possible with a single hidden layer. The network was trained using of 3 mm, 5 mm and 7 mm shifts in heart positions for 50 patients' giving 150 data points in total. The neural network was tested using random cross-validation to evaluate the model's robustness to new data. Results The optimal neural network found was comprised of a single hidden layer of 30 neurons. Based on twenty train/test splits, 94% of all prediction errors were below 0.2 Gy, 97.3% were below 0.3 Gy and 100% were below 0.5 Gy. The average RMSE and maximum prediction error over all train/test splits was 0.13 Gy and 0.5 Gy respectively. Conclusions Our approach using a deep neural network provides a clinically acceptable estimate of the increase in MHD, without the need for further imaging, contouring or evaluation. The trained neural network gives clinicians the information and tools required to evaluate what shift in heart position would be acceptable and which scenarios require immediate action before treatment commences.

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Dosimetry assessment of patient-specific 3D printable material for HDR surface brachytherapy

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SLRON, Ireland

Purpose: 3D printable material water equivalence was investigated within the range of Iridium-192 source energies. The aim is to validate it for superficial brachytherapy treatments.

Methods and materials: 3D Cheetaflex material (bolus) was examined both in a water tank and with CIRS anthropomorphic phantom, performing an end-to-end test. In water tank, a GafChromic EBT3-V3 film was oriented perpendicular to the source axis obtaining percentage depth dose (PDD) from 7 mm to 30 mm of distance from the source, with and without a bolus 5 mm thick. Two films were oriented parallel to the source at 5 mm and 15 mm of distance and results were compared with TG-43 implemented on Oncentra® Brachy treatment planning system (TPS). A set of CT images of CIRS phantom was acquired and a bolus with 7 trajectories (1 cm inter-distance and 5mm from skin) was created. A new CT set of images with bolus and phantom was imported on TPS where a target was