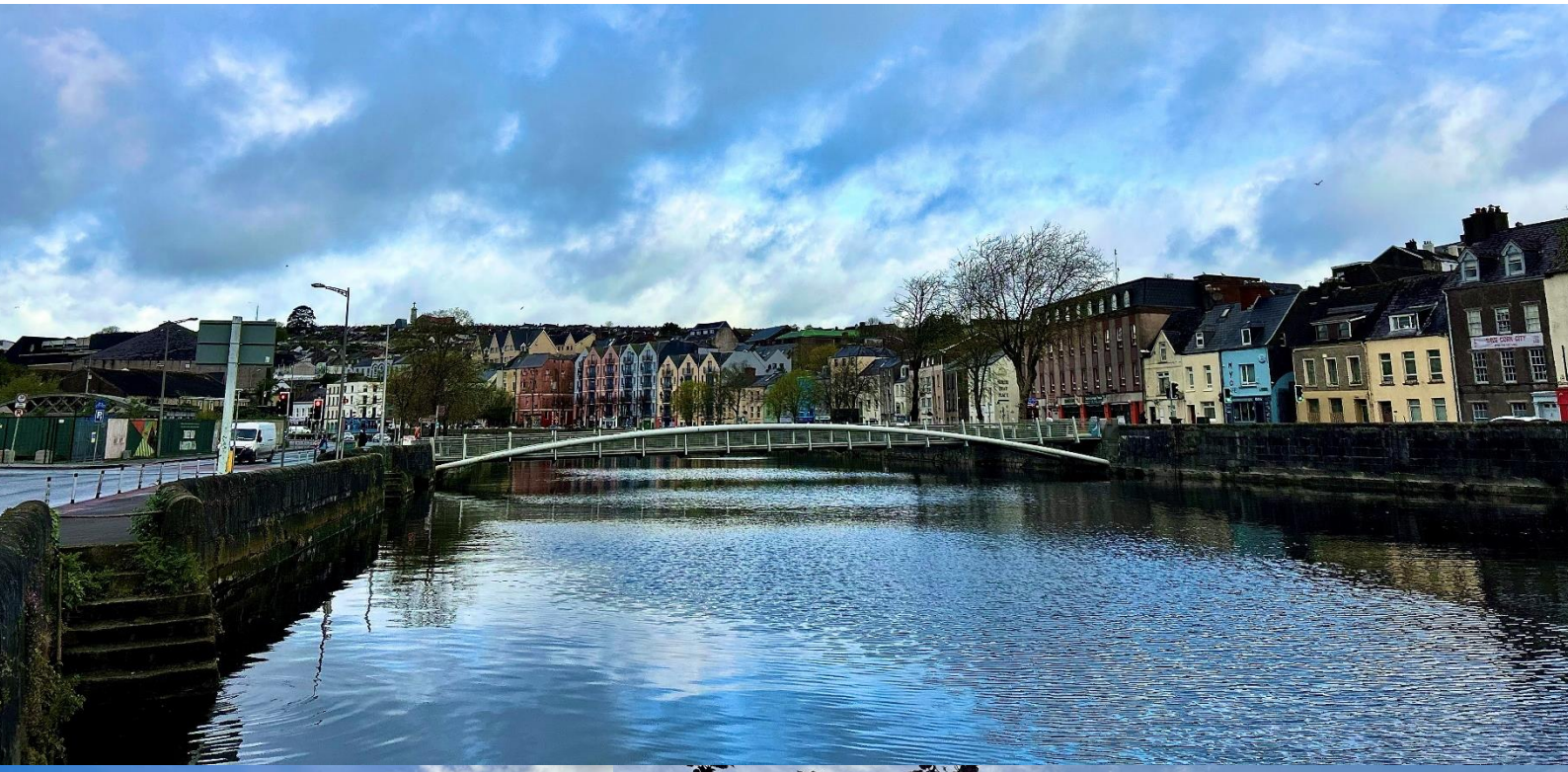
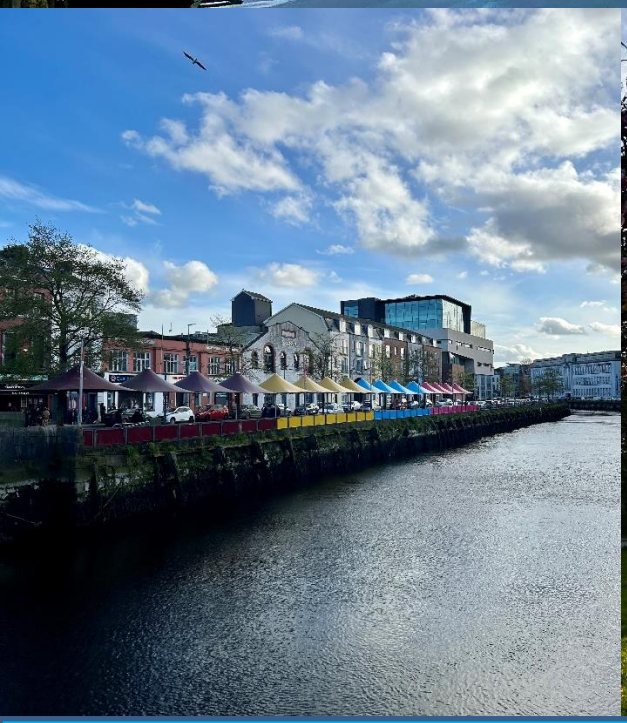
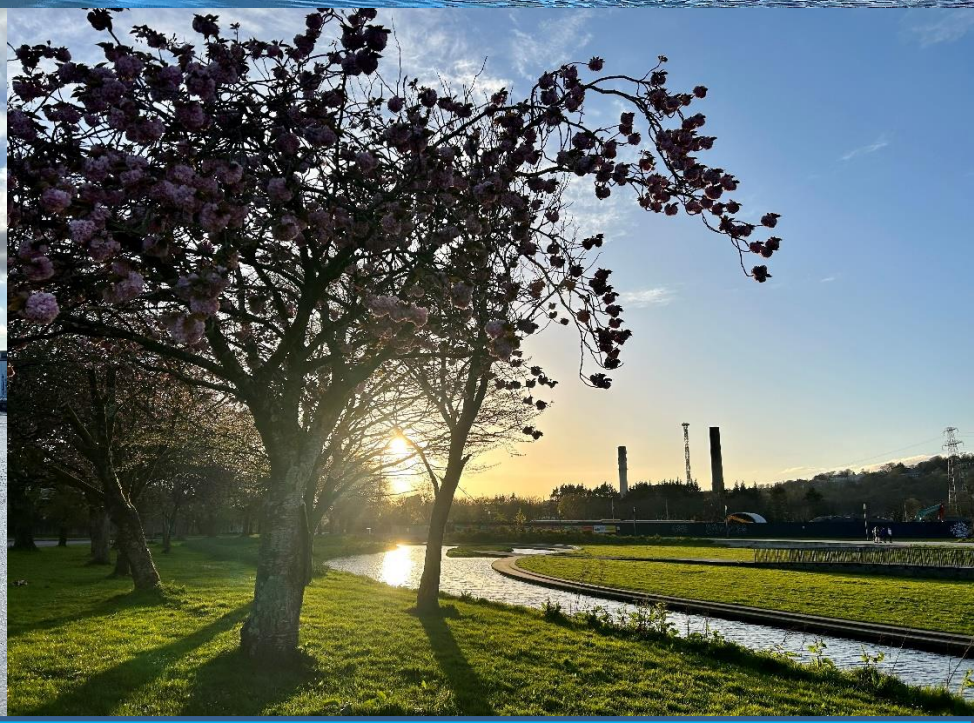
Irish Association of Physicists in Medicine

13th Annual Scientific Meeting Programme







Cork, 19-20 April 2024

PRESIDENT'S WELCOME

Dear delegates,

Welcome to the Irish Association of Physicists in Medicine's Annual Scientific Meeting in Cork!

It is with immense pleasure that I extend a warm welcome to each and every one of you to our 13th ASM. Our annual meeting is an opportunity to share research findings, exchange ideas, connect and drive innovation in medical physics. With such a full, diverse program this year I trust you will all find the meeting impactful and enjoyable.

First and foremost, I would like to extend heartfelt thanks to Dr. Lorna Sweetman and the dedicated members of the organising committee, who have volunteered their time and expertise to ensure the success of this event. Their hard work and dedication have been instrumental in co-ordinating every detail of this meeting, from planning the scientific program to co-ordinating logistics. Without their tireless efforts, the ASM and Workshop would not be possible.

I would also like to express sincere appreciation to our sponsors whose generous support ensures we can run the meeting. Their commitment to advancing medical physics is commendable, and we are grateful for their assistance. Please do take the time to visit their exhibition stands and engage with them.

The contributions of all those who submitted abstracts, and the dedication of the reviewers who meticulously evaluated each submission, has ensured the high quality and relevance of this year's scientific program. My thanks to each of you who contributed. Together with stimulating guest lectures from Dr. Kesminiene, Prof. Moran and Dr. Paradis, this year the program also includes a session on implementing AI in the clinic. On that note, ChatGPT suggested I remind you all of the profound impact our work has on improving patient care and advancing the profession.

As in other years, in additional to the IAPM awards for best presentations, we are delighted to be offering both the Early Stage Research Award (ESRA) and the Xiel Bursary. Special thanks to Xiel for the generous bursary and to Dr. Seán Cournane for overseeing the ESRA award. Best of luck to all candidates!

It is worth noting that this year's ASM is the first time since 2018 that we've had the opportunity to convene outside of Dublin. It's refreshing to swap the virtual platforms for the train platform of the Rebel County and see our community come together in a different location.

Thank you for joining us at this year's Annual Scientific Meeting. I hope you find it fruitful and productive.

Warm regards,

Emer Kenny

IAPM President

ORGANISING COMMITTEE

SARAH BARRY

RUTH BRIDCUT

SHAUNA BURKE

CLARE CORBALLY

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CARLA MAIORINO

GILLIAN POWER

RB EZHILALAN

MICHAEL ROCHE

LORNA SWEETMAN (CHAIR)

ANNA-MAY WOODS

The ASM organising committee would like to thank all who have assisted with the ASM, including abstract reviewers, session chairs, session judges and many others. Your help and time is much appreciated.

SOCIAL MEDIA:

Be part of the IAPM's 13th ASM and Research and Education Workshop by using #iapmasm2024 and #iapmworkshop. Don't forget to follow @theIAPM on X (formerly Twitter)!

GUEST SPEAKERS

Dr. Kelly Paradis is an Associate Professor of Medical Physics and the Associate Chair of Equity and Wellness within the Department of Radiation Oncology at Michigan Medicine. She received her PhD in atomic physics from the University of Michigan in 2010, then went on to complete her medical physics residency at Michigan Medicine before becoming a faculty member in the same department in 2014. Her research interests include re-irradiation, advanced treatment planning, and healthcare workforce equity.

In this talk, Dr. Paradis will present the special medical physics consult workflow used at Michigan Medicine to treat re-irradiation patients. Using several clinical examples, she will highlight the responsibilities of the medical physicist, strategies to ensure consistent analysis, specialized tools needed, and potential hazards in the workflow.

Professor Carmel M Moran, Personal Chair of Translational Ultrasound, University of Edinburgh.

Carmel is currently Professor of Translational Ultrasound based within Medical Physics, Centre for Cardiovascular Science and has been involved in both clinical and preclinical ultrasound studies over the past 30 years.

She undertook a joint Physics and Maths degree at Queen's University Belfast, an MSc in Medical Physics at Aberdeen University and undertook her PhD at the Institute of Cancer Research, University of London. After her PhD, Carmel then moved to University of Edinburgh where she has undertaken ultrasound research over the past 30 years. She was President of the British Medical Ultrasound Society from 2016-2018 and won the IPEM innovation award and outreach award in recent years.

The primary focus of Carmel's research is high frequency ultrasound and ultrasonic contrast agents and their applications in ultrasound diagnosis and therapy. In 2008, with Wellcome Trust funding, she established the preclinical ultrasound imaging facility at the University of Edinburgh, expanding this in 2019 to incorporate a state-of-the art preclinical ultrasound scanner. Using ultrasound imaging, this facility allows the structure and blood flow dynamics of adult, neonates and embryonic hearts, livers and kidneys of small and large animals to be studied in real-time. Carmel's own research focusses on developing and utilising contrast microbubbles for both diagnostic and imaging applications.

Dr Ausrele Kesminiene is a radiation epidemiologist, currently holding a position of Senior Visiting Scientist in the Environment and Lifestyle Epidemiology Branch at the International Agency for Research on Cancer (IARC/WHO).

She received an MD from the Vilnius University in Lithuania and was later trained in epidemiology and radiation biology at the Radiation Effects Research Foundation and Hiroshima University in Hiroshima, Japan. Dr Kesminiene joint IARC in 1997 and became the Head of the Radiation Group in 2009.

Her research interests comprise cancer risks in populations exposed environmentally, occupationally and in medical settings.

She has long experience in coordinating large international networks, including the international cohort study to quantify cancer risks from paediatric CT in 9 European countries (EPI-CT).

Dr Kesminiene served on several international expert committees on Chernobyl and Fukushima accidents, iodine supplementation guidelines, radiation protection of patients, etc.

SPONSORS

The IAPM gratefully acknowledge and extend appreciation to the following companies for their sponsorship of this meeting:

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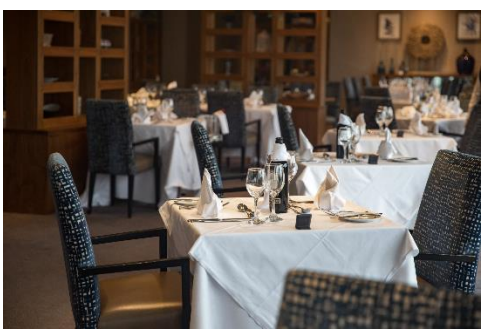
FRIDAY PROGRAMME – FRIDAY, 19TH APRIL 2024

WORKSHOP SESSION:
"DEALING WITH INCIDENTS INVOLVING IONISING RADIATION"
INTERNATIONAL BALLROOM

13:30	Introduction. What is an incident?	
13:50	Coding and classifying incidents 1	*Practical activity*
14:00	Gathering evidence for an investigation	Lorraine Schwanberg, HSE Quality and Patient Safety Incident Management team
14:30	Just culture	Jemma Moore, Royal Cornwall Hospitals NHS Trust
14:45	How to do a root cause analysis	Matthew Dunn, Head of Radiology Physics Nottingham University Hospital
15:15	Break	
15:30	Incident reporting and learning systems in Radiotherapy and Diagnostic Radiology	Paul Davenport, Chief Physicist, St. Luke's Radiation Oncology Network
15:40		Geraldine O'Reilly, Chief Physicist, St. James's Hospital
15:50	Analysis of incidents by the National Radiation Protection Committee	Louise Fahy, HSE National Radiation Protection Committee
16:10	Analysis of significant events reported to HIQA	Kirsten O'Brien, Health Information and Quality Authority
16:30	Coding and classifying incidents 2	*Practical activity*
16:45	Update on the MARLIN project	Colin Kelly, Head of Physics, St James's Centre, SLRON

CONFERENCE RECEPTION AND DINNER – HOTEL LOBBY / ATLANTIC RESTAURANT
PRE-BOOKING ESSENTIAL

19:15	*Drinks reception in the hotel lobby at 19:15*	
19:45	*The annual conference dinner will take place in the Atlantic Restaurant at 19:45.*	

SCIENTIFIC PROGRAMME – SATURDAY, 20TH APRIL 2024

8:00	***Registration – Main Foyer***	

PLENARY SESSION
INTERNATIONAL BALLROOM

8:30	President's Welcome	Dr Emer Kenny
8:40	GUEST LECTURE Cancer risks after CT radiation exposure in childhood and adolescence: results from the European cohort study (EPI-CT)	Dr Ausrele Kesminiene
9:20	GUEST LECTURE Translational Ultrasound: of mice and men	Prof Carmel Moran
	IMPLEMENTING AI IN THE CLINIC – AN IRISH EXPERIENCE	
10:00	Predicting change: Utilizing AI Auto-Segmentation for treatment monitoring in Radiotherapy for H&N Cancer	Ciaran Malone
10:12	Reducing MRI acquisition time using AI reconstruction: assessment of acceleration approaches using objective image quality metrics	Ainur Kazhybekova
10:24	Novel Occupational Exposure Measurement via Passive Tracking	Szymon Borkowski
10:45	***Coffee in the sponsorship area***	

DIAGNOSTIC PARALLEL SESSION
INTERNATIONAL BALLROOM

11:10	Customized Benchmarks for Breast Dose Comparison	Gillian Power
11:22	Reflections on a radionuclide therapy risk assessment - predictions versus reality	Jackie McCavana
11:34	Initial experience of Contrast-to-noise ratio driven exposure control for neuroradiology applications.	Ruth Bridcut
11:46	Examining the quantification accuracy of 18F-fluorodeoxyglucose (FDG) uptake of atherosclerotic plaques in PET/CT imaging using phantom studies	Rebeka Öcsi
11:58	Practical implementation of Harmonisation and Scaling in Digital PET Optimisation	Hannah O'Driscoll
12:10	Investigating the suitability of using the TO PAN phantom in OPG QA	Anna-May Woods

RADIOTHERAPY PARALLEL SESSION

VALENCIA - VENICE

11:10	A Biologically Effective Dose (BED) Calculator for Re-Treatment Evaluation	Eoin Fallon
11:22	Intrafraction motion in surface-guided breast radiotherapy, and its implications on a single PTV margin strategy	Ciaran Malone
11:34	Investigating BED Conversion in Re-irradiation cases using Velocity	Oran McElligott
11:46	A retrospective evaluation of HDR cervical brachytherapy treatments based on the EMBRACE II planning aims	Lisa Rebello
11:58	Implementation of MVision Contour + Guideline Based AI Segmentation (GBS) at Cork University Hospital (CUH)	Michael Roche
12:10	Comparing the setup accuracy of Brainlab Thermoplastic Masks for Head Immobilisation Effectiveness in Stereotactic Radiosurgery	Irish Apale

12:40 ***Lunch in the sponsorship area***

POSTER PRESENTATION SESSION

INTERNATIONAL BALLROOM

AFTERNOON PLENARY SESSION

INTERNATIONAL BALLROOM

13:40	GUEST LECTURE – WIL VAN DER PUTTEN TALK From Night to Day: Progress in Reirradiation Analysis	Dr Kelly Paradis

XIEL BURSARY

Open to IAPM trainee/student member or member with < 2 years' experience. This year's theme: "Advances of science in medical physics that directly benefit the patient pathway".

14:20	An Investigation into the Effect of Ring Snaking in the Varian 3D Interstitial Ring Applicator on Dose to the Clinical Target Volume and Organs at Risk	Amey Bermingham
14:23	Clinical Data Analytics: Characterization and Compensation of Motion Artifacts in Ambulatory Near-Infrared Spectroscopy Measurements (NIRS)	Rayne Pericica
14:26	Inorganic Scintillator-Based Optical Fibre Dosimetry for UHDR Electron Beams on a FLASH-enabled linac	Lucy Griffiths

14:29	Practical implementation of Harmonisation and Scaling in Digital PET Optimisation	Hannah O'Driscoll
14:32	Validation of deformable image registration for dose deformation in head and neck region	Robert Nolan

EARLY STAGE RESEARCH AWARD

14:45	Introduction to the Early Stage Research Award	Dr Seán Cournane
14:50	Young Investigator Grantee 2023	Saoirse Maher
15:05	Announcement of the Early Stage Research Award 2024	Dr Seán Cournane

15:10 ***Coffee in the sponsorship area***

JOINT SESSION

INTERNATIONAL BALLROOM

15:30	Developing a National approach for patients undergoing re-irradiation: A status report by the Re-irradiation Subcommittee of the IAPM RT-SIG	Paul Hill
15:42	Clinical Data Analytics: Characterization and Compensation of Motion Artifacts in Ambulatory Near-Infrared Spectroscopy Measurements (NIRS)	Rayne Pericica
15:54	Python based occupational dosimetry reporting and communication system – PyRP	Darragh McCague
16:06	Driving continuous improvement in an External Services Medical Physics group with the ISO9001:2015 Quality Management System	Michael Rowan
16:18	Developing safety policies for MRI scanning of implanted medical devices	Michael Kelly

AWARD CEREMONY

INTERNATIONAL BALLROOM

16:30	Imaging Equipment Bursary Award (Xiel)	Phil Neale (Xiel)

16:45 ***Close of Meeting***

POSTER PRESENTATION SESSION

An Investigation into the Effect of Ring Snaking in the Varian 3D Interstitial Ring Applicator on Dose to the Clinical Target Volume and Organs at Risk	Amey Bermingham	P1 (Xiel)
ATIA as a Routine Optimisation Tool for Portable X-ray	Michael Brennan	P2
A review of PET/CT DRLs in Digital PET/CT system using dose tracking	Shauna Burke	P3
Scorim - Development of a novel online visualisation platform for facilitating image perception studies	Ronan Coleman	P4
Breast ultrasound imaging performance evaluation and advanced mode optimisation using a breast-specific contrast detail detectability phantom	Seán Cournane	P5
Modelling the relationship between Breast Ultrasound Contrast Detail detectability and slice thickness.	Seán Cournane	P6
Online, modular radiation protection training - changing the world one lecture at a time	Clare Devery	P7
A review of the management options for Extravasation of Radiopharmaceuticals and the evaluation of Massage methods and Compression devices as a potential aid to reduce patient and staff dose	Maria Dooley	P8
Practical and regulatory radiation protection experience in the delivery of Radio-Ligand Lutetium (177Lu) PSMA Therapy doses to patients in Ireland as part of a multi-disciplinary team	Maria Dooley	P9
Quality Assurance Methods of Ireland's First Halcyon Linac	Rhonda Flynn	P10
Initial Evaluation of feasibility of an airport X-ray scanner for lead apron testing	Paddy Gilligan	P11
Inorganic Scintillator-Based Optical Fibre Dosimetry for UHDR Electron Beams on a FLASH-enabled linac	Lucy Griffiths	P12 (Xiel)
Optimisation of Personal Dosimetry for Categorised Workers in Nuclear Medicine	Caroline Lannon	P13

PET Patient Personalisation Method	Eamon Loughman	P14
Automated Nuclear Medicine Quality Assurance image analysis with Python for improved uncertainty analysis	Darragh McCague	P15
Evaluation of Image Quality software for CT AEC performance assessment	Jaine Nolan	P16
Validation of deformable image registration for dose deformation in head and neck region	Robert Nolan	P17 (Xiel)
Practical implementation of Harmonisation and Scaling in Digital PET Optimisation	Hannah O'Driscoll	P18 (Xiel)
Characterisation of Artificial Intelligence based Noise Reduction Software in General X-Ray Systems	Dara Ó'Gallchobhair	P19
Optimisation of Radiation Protection Practices in Incubator Imaging	Dara Ó'Gallchobhair	P20
A Comparative Study of the Imaging Performance of Traditional and Hand-Held Diagnostic Ultrasound Systems.	Claire O'Halloran	P21
Use of ultrasound QA to determine the clinical efficacy of diagnostic ultrasound systems and probes	Jayne O'Neill	P22
Examining the feasibility of adopting a weight based approach for Nuclear Medicine Bone Imaging as part of an optimisation workflow	Luke Oonan	P23
Clinical Data Analytics: Characterization and Compensation of Motion Artifacts in Ambulatory Near-Infrared Spectroscopy Measurements (NIRS)	Rayne Pericica	P24 (Xiel)
A comparison of the dose and image quality obtained on Multi-Slice Computed Tomography with that achieved on three Cone Beam Computed Tomography systems using the QUART EFOMP-ESTRO-IAEA Test Set	Hannah Reilly	P25
A retrospective study on the dose received by paediatric patients during whole spine X-rays in Children's Health Ireland (CHI) using different diagnostic X-ray systems.	Sinéad Ryan	P26
Patient Radiation Safety Video Infographics	Anna-May Woods	P27

ABSTRACTS

PLENARY SESSION

Predicting change: Utilizing AI Auto-Segmentation for treatment monitoring in Radiotherapy for H&N Cancer

Ciaran Malone[*1], Samantha Ryan[1], Jill Nicholson[1]*

1. *St. Luke's Radiation Oncology Network*

Purpose/Objective(s):
Our study aims to assess the feasibility of using raw, uncorrected AI auto-segmentation structures in monitoring and predicting head and neck (H&N) cancer patients' anatomical variation during the course of radiotherapy, thus providing a workflow-efficient and optimal solution for adaptive radiotherapy monitoring.

Materials/Methods:
At the time of submission, 15 radical H&N patients undergoing 70Gy in 35 fractions were investigated. All standard organs at risk and several nodal levels were auto-segmented on each CBCT acquired for image-guided radiation therapy (IGRT) verification. Structure volumes, centre of mass positions and a range of contour comparison metrics were recorded for each imaged fraction. These metrics included average surface distance, Dice similarity coefficient, and average surface overlap at a 1mm threshold. Our goal was to monitor anatomical changes throughout the treatment and identify the metrics most sensitive to these changes.

Results:
Our findings revealed clear early changes in structure volumes for patients who experienced weight loss resulting in a contour change >2cm. In contrast, these significant and early changes were not observed in patients with no notable weight loss (<1cm). Interestingly, structure variation was not a linear process but tended to plateau, indicating a potential 'optimal' time for treatment re-planning. The parotid glands, submandibular glands and Xb nodal levels, as delineated by AI, emerged as a notable indicator of anatomical changes, in some cases resulting in a >60% change in volume.

Conclusion:
In conclusion, our feasibility study demonstrates that raw, uncorrected AI segmentations of anatomical structures in CBCT imaging may serve as a valuable tool in predicting the need for further patient evaluation. More importantly, these segmentations may also assist in determining the most opportune moment for treatment re-planning, thereby enhancing the effectiveness of radiotherapy for H&N cancer patients.

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PLENARY SESSION

Reducing MRI acquisition time using AI reconstruction: assessment of acceleration approaches using objective image quality metrics

Ainur Kazhybekova[*1], Irene Hernandez-Giron[1], Martin Sheridan[2], Aoife Ivory[2], Sean Cournane[1, 3], Ronan Killeen[4], Alan Stone[1,5]*

1. *University College Dublin (UCD), School of Physics*
2. *St Vincent's Private Hospital*
3. *Department of Medical Physics and Clinical Engineering at St Vincent's University Hospital*
4. *Department of Radiology at St Vincent's University Hospital, Department of Radiology at St Vincent's Private Hospital*
5. *Department of Medical Physics and Clinical Engineering at Beaumont Hospital*

Introduction:
Artificial Intelligence (AI)-based MRI reconstructions promise to overcome conventional trade-offs by shortening MRI acquisition times (TA) while maintaining image quality (IQ). However, there is no clear consensus on how to best accelerate MRI acquisition using AI. In this study, objective IQ metrics suited for non-linear image reconstructions are applied to compare strategies for reducing acquisition time using AI.

Methods:
A T2-weighted head protocol was used to image a heterogenous phantom (pineapple) on 1.5T Siemens MAGNETOM Sola. Scans were acquired using a routine acquisition (TA=1min:59sec) which was then accelerated via two methods: increasing Parallel Imaging Factor (PIF, TA=1min:09sec) or reducing Number of Signal Averages (NSA, TA=1min:04sec). Five repeats were performed for each acquisition. Acquired data were first reconstructed using AI (Deep Resolve, Boost=High, Sharp=On), then retrospectively with a clinical standard reconstruction. Structural similarity between standard and AI-reconstructed images was evaluated using Structural Similarity Index Measure (SSIM, Wang2004), which compared reconstructions through images generated from the same input data using retrospective reconstruction. Variability across five repeated SSIM maps for each scan time was assessed by calculating the Coefficient of Variation (CoV).

Results:
SSIM maps indicate less similarity between standard and AI reconstructions when accelerated with PIF compared to NSA-based acceleration approach. Percentage of pineapple area where CoV > 5% is 3.4% for routine acquisition, 17.1% for increased PIF and 2.7% for reduced NSA.

Conclusion:
IQ of AI-reconstructed MR-images depends on the acceleration approach. Less variability is seen in AI-reconstructed images when acceleration is achieved by reducing NSA compared to increasing PIF.

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PLENARY SESSION

Novel Occupational Exposure Measurement via Passive Tracking

Szymon Borkowski[1], Peter Conneely[2], Emerald House[2], Keith Scully[2], Brendan Tuohy[2], Dr. Brian Deegan[1]*

1. *University of Galway*
2. *GUH Galway*

Introduction

It is well documented that Interventionalists face high occupational radiation exposure [1]. Personal dosimetry is one tool, used to mitigate the risks. Poor badge compliance records are often cited by regulators. This in turn creates additional work for medical physicists, who have to perform dose estimation calculations. Calculations are often overestimated, due to assumptions on; exposure time, position, and scatter. This work initially focused on passive location tracking to improve the accuracy of the time-position element of the calculation.

Materials & Methods

An Intel RealSense D455 camera was used to monitor each staff member's position throughout procedures. In addition to a standard RGB, this camera uses infrared point clouds to measure distance.
DoseWise provided timestamps and exposure settings. These were used to correlate staff presence during exposures.
Staff identification and labelling was provided by radiographers.

Results

The proposed method tracks the location of staff relative to the radiation source.
The system demonstrated cm resolution.
The system was not affected by occlusion events.
It was not affected by staff infection control PPE.
It can work in low light conditions.
The data can be outputted for analysis

Conclusion

The system proved that it can be used to accurately and reproducibly track staff position in interventional procedures. Allowing for more accurate dose estimation. Work is ongoing to improve previous scatter measurement to create a one stop solution.

Data can also be utilised to audit safety culture practice. This work shows that low cost passive tracking can be used to improve radiation safety practices in hospitals.

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DIAGNOSTIC SESSION

Customized Benchmarks for Breast Dose Comparison

Gillian Power[*1], Sarah Barry[1], Paola Baldelli[1], Elizabeth Keavey[1], Niall Phelan[1]*

1. *BreastCheck*

There is an Irish regulatory requirement for all practices to determine and review a Local DRL (LDRL) for comparison with the National DRL (NDRL) established by HIQA.

HIQA recommend that the DRLs be displayed in all clinical areas. However, there is large variation in radiation dose to the breast from mammography, primarily dependent on breast size and composition but also on the image acquisition technology. It is therefore equally challenging and inappropriate to use a single dose value as representative of the entire screened population.

In BreastCheck, we use the Qaelum dose management system to calculate and continuously monitor the median value of MGD (mean glandular dose) for all screening images, for real-time comparison with the NDRL. However, this approach is not representative of the variation of breast composition and thickness encountered in the population. We have therefore taken an approach which accounts for the different dose levels at which imaging systems operate and the various breast types encountered, to create appropriate benchmarks against which breast dose can be reasonably compared across the entire population. To do this, we have defined four categories, based on compressed breast thickness range and defined dose benchmarks for each category, for three imaging system types utilised.

By comparing the median values of the relevant breast thicknesses range on each system to the benchmarks, we fulfil the regulatory requirement, but in a more consequential way. This can be easily presented and reviewed on our dose management system.

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DIAGNOSTIC SESSION

Reflections on a radionuclide therapy risk assessment - predictions versus reality

Ann McCann[1], Niamh McArdle[1], Darragh McCague[1], Joshua Nograles[1], Mathilde Colombie[1], Danielle Maguire[1], Jackie McCavana[1]*

1. *St Vincent's University Hospital*

Prior to the introduction of the 177Lu-peptide receptor radionuclide therapy (PRRT) service a comprehensive risk assessment (RA) was performed, encompassing design, operational phase and foreseeable incidents. Doses to staff and members of the public were estimated based on published data and accepted best international practice. Shielding solutions and optimised workflows were incorporated into the design and doses re-assessed. The aim of this work was to assess the efficacy of the revised RA and its outputs.

During treatments occupational exposures were monitored with passive and real-time dosimeters and contact scenarios recorded. After 7 PRRT treatments, Hp(10) and Hp(0.07) were found to be below published data, in most part due to the bespoke shielding solutions and detailed SOPs. While the mean patient dose rates post treatment were comparable to published data, the recorded doses for some staff were well below the dose estimated in the revised RA. This was attributed to differences in the expected and actual contact scenarios, and the use of remote patient monitoring devices. Dose rate post therapy exceeded 25 µSv/hr for two patients.

The RA identified potential complications and incidents, prompting the development of contingency plans, some of which have been utilised to good effect. In addition scenarios occurred that were not originally envisaged or not considered in depth in the RA, such as hotel stay requests, PRRT administration problems, stoma bags, training gaps, signage and communication issues.

In conclusion, the RA led to optimised staff doses but requires updating in light of experiences.

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DIAGNOSTIC SESSION

Initial experience of Contrast-to-noise ratio driven exposure control for neuroradiology applications.

Ruth Bridcut[*1], Ronan Faulkner[1], Áine Matthews[1], Ciara Hutchinson[1], Thomas Heary[1]*

1. *Beaumont Hospital*

The Siemens Artis Icono Fluoroscopy systems at Beaumont Hospital are dedicated to interventional neuroradiology and the National Thrombectomy Service. These systems had a recent software upgrade which enabled implementation of contrast-to-noise ratio (CNR) driven exposure control, marketed as OPTimal Image Quality (OPTIQ®). OPTIQ® modifies six parameters, including detector dose, to maintain a specific image quality (i.e. CNR), rather than the traditional method of maintaining consistent image brightness via detector dose-driven exposure control.

This new exposure control paradigm has been evaluated with respect to image quality, detector dose and patient entrance dose rates. Digital Subtraction Angiography (DSA) image quality tests were performed at a range of PMMA thicknesses with a retrospective comparison of DAP per procedure carried out, before and after OPTIQ was implemented.

While evaluation of additional aspects of OPTIQ is ongoing, an initial evaluation demonstrated the system is performing as expected, i.e. as patient thickness changes over typical head dimensions, image quality was shown to remain constant, while patient entrance dose rates and detector dose varied.

The manufacturer suggests that OPTIQ will reduce patient dose for smaller patients. Our DAP comparison did not show any appreciable dose reduction, but this is not surprising as the head has significant attenuation (mean patient equivalent thickness was estimated as 204 mm) and patient habitus has minimal effect in neuroradiology applications. Future work will also involve the evaluation of OPTIQ® in our new general interventional radiology suite.

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DIAGNOSTIC SESSION

Examining the quantification accuracy of 18F-fluorodeoxyglucose (FDG) uptake of atherosclerotic plaques in PET/CT imaging using phantom studies

Rebeka Öcsi[*1], Sarah Meaney[2], Alan Stone[3], Ann McCann[2], Seán Cournane[2], David Murphy[2]*

1. *St. Vincent's Private Hospital*
2. *St. Vincent's University Hospital*
3. *Beaumont Hospital*

Atherosclerosis is an underlying cause of cardiovascular disease, one of the leading causes of death worldwide. The early detection of atherosclerosis plays a crucial role in the prevention of severe cardiovascular events. One promising method for early detection is PET/CT imaging of the vasculature using the radiotracer 18F-fluorodeoxyglucose (FDG). Although quantification of arterial wall uptake, which captures the metabolic processes within the arterial plaque, is possible using this imaging modality, the impact of reconstruction technique and vessel wall thickness on quantification is unknown. Accordingly, this project investigates the effects of reconstruction protocols and arterial wall thickness on quantification using phantom studies.

Purpose-made aorta phantoms with fillable wall and lumen spaces were 3D printed from resin using stereolithography. The phantoms were scanned with varying activity concentration ratios between the wall and lumen spaces to model uptake in different stages of atherosclerotic inflammation. For image reconstruction, several protocols were selected, each comprising a different set of the following parameters: time-of-flight (TOF) imaging, point spread function (PSF) modelling, FWHM of Gaussian smoothing, matrix size and effective number of iterations. Various quantities, including recovery coefficients (RC), tissue-to-background ratios (TBR) and peak-to-valley ratios (PTV) of line profiles were obtained from the images. Based on the analysis of the obtained metrics, separate reconstruction protocols were recommended for quantitative and qualitative assessment of images. Differences in quantification were identified for different arterial wall thicknesses in some cases, therefore the measurement of arterial wall thickness on CT before quantitative assessment of atherosclerosis in PET was recommended.

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DIAGNOSTIC SESSION

Practical implementation of Harmonisation and Scaling in Digital PET Optimisation

Hannah O'Driscoll[1], Jane Burns[2], Eamon Loughman[1],

1. *Mater Private Hospital*
2. *Mater Misericordiae University Hospital*

PET/CT acquisition and scan optimisation has a renewed importance with the widespread use of EARL harmonisation techniques. These harmonisation efforts allow participation in multicentre dataset collection for quantitative image assessment. Local optimisation of scan protocol may also be facilitated using similar methods. Correlation of local practice to quantitative output requires scaling radiomic features to allow reasonable comparison.[1]

Clinical scans were retrospectively analysed using semi quantitative radiologist visual grading analysis and quantitative radiomic feature analysis. The NEMA image quality phantom was acquired, with the addition of an unfiltered reconstruction, to allow comparison between quality assurance measures and clinical data. Clinical scans were reprocessed to comply with EARL standards 1 and 2, for various bed durations. Central liver region was used for quantitative radiomic feature extraction.

Output metrics from radiomic and radiologist analysis were scaled to allow intercomparison. Trend analysis was performed using fréchet curve analysis. Heat map analysis was used to visualise relationship between radiologist and radiomic features. EARL RC highlighted issues with signal masking present in harmonised images which may impede routine optimisation. Reproducibility of radiomic metrics was poor, however clinical trend remained in overall radiomic analysis.

Harmonisation techniques such as EARL mask signal information in NEMA dataset. Clinical patient image assessment must guide radiomic analysis of phantom and specific patient anatomy features. All pass filter dataset may highlight differences relevant to optimisation in phantom optimisation. Scaling features allows clinical interpretation of abstract mathematical radiomic features. Reproducibility of radiomic features not found, however clinical trend remained in radiomic features.

References

[1] Orlhac F, Eertink JJ, Cottereau AS, Zijlstra JM, Thieblemont C, Meignan M, Boellaard R, Buvat I. A Guide to ComBat Harmonization of Imaging Biomarkers in Multicenter Studies. J Nucl Med. 2022 Feb;63(2):172-179. doi: 10.2967/jnumed.121.262464. Epub 2021 Sep 16. PMID: 34531263; PMCID: PMC8805779.

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DIAGNOSTIC SESSION

Investigating the suitability of using the TO PAN phantom in OPG QA

Anna-May Woods[1], Ronan Coleman*[1]*

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Introduction: From querying physicists involved in dental radiology testing (both in Ireland and abroad), it was discovered that current testing protocols for assessing OPG image quality do not sufficiently characterise the system's performance, particularly aspects of OPG that are unique to the modality. While assessment of spatial resolution and a visual check for uniformity were commonly performed, there was no investigation of the magnification, the extent of the focal trough, the alignment with the "standard jaw" or verification of different "jaw shapes" for commissioning or during regular QA testing of OPG systems.

Method: The TO PAN was acquired to investigate both its suitability in measuring OPG specific parameters as well as examining the utility of those metrics for informing OPG QA. In-house software was developed to automatically process the images and output results for magnification, distortion index and displacement from standard jaw for the input.

Results: Accurate positioning of the test object proved to be a significant challenge which cast doubt over the accuracy of results as there is a lack of guidance and results in the literature to compare to. It was possible to visualise the different trough shapes used by the system which was a preliminary success of this project.

Further work would require building a bank of results across different systems to increase confidence in test procedure and characterise the appearance of a typical focal trough across different manufacturers and systems and how it deviates from the "standard jaw".

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RADIOTHERAPY SESSION

A Biologically Effective Dose (BED) Calculator for Re-Treatment Evaluation

Eoin Fallon[*1], Cathy Fleming*[1]

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In the past decade, radiation therapy has undergone significant advancements that have led to better treatment outcomes than ever before. As a consequence of these improvements, the number of patients returning for re-irradiation has increased. In particular, stereotactic ablative radiation therapy (SABR) to the lung is a common site for re-irradiation. Multiple courses of treatments can often approach organ at risk (OAR) dose limits and the cumulative dose must be assessed.

The biological effect of radiation depends not just on the total physical dose but on the fractionation. With variations in prescribed doses between treatment courses and physical dose gradients across an organ in a given plan, we need a way to combine these doses that reflects their biological impact. BED (Biological Effect Dose) calculations are currently performed by hand, involving a visual inspection of the location of the maximum point doses from each plan. This method is time-consuming, and may be prone to errors. Steep gradients may also mean that the point of maximum combined BED does not necessarily correspond to the max physical dose from either plan.

The aim of this project was to develop a computational method for calculating BED summations in Eclipse. This involved exporting the DICOM dose cube and applying a voxelised radiobiological correction. The newly converted dose cube could then be re-imported back into the treatment planning system for visualisation purposes. Multiple plans could then be summed into an overall BED sum. The maximum BED to the relevant OARs were then compared to hand calculations.

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RADIOTHERAPY SESSION

Intrafraction motion in surface-guided breast radiotherapy, and its implications on a single PTV margin strategy

Ciaran Malone[*1], Samantha Ryan[1], Jill Nicholson[1], Orla McArdle[1], Sinead Brennan[1], Brendan McClean[1], Fran Duane[1]*

1. *St.Luke's Radiation Oncology Network*

Purpose/Objective(s):
To quantify intrafraction motion in surface-guided radiotherapy (SGRT) for breast cancer and considers the need for individualized intrafraction motion measures when calculating Planning Target Volume (PTV) margins.

Materials/Methods:
SGRT was used to assess intrafraction motion in consecutive patients according to (1) region irradiated (whole breast (WB)/chest wall (CW) versus WB/CW + regional lymph nodes) and (2) the use of deep inspiration breathhold (DIBH) versus free-breathing (FB). Intrafraction motion variation was evaluated throughout the treatment course for all cases. Associations between intrafraction motion and patient specific characteristics were explored. The usefulness of individualised intrafraction motion measures for PTV margin determination was considered.

Results:
102 patients undergoing 1360 fractions were included. On a population level, average intrafraction motion was less than 0.4mm and 0.2 degrees for translational and rotational directions, respectively, with 95thpercentiles < 1.2mm and 0.6 degrees. No clinically meaningful differences in intrafraction motion were observed according to region irradiated or the use of DIBH. Consistency in intrafraction motion was noted for all patients throughout the treatment course. No clinically meaningful associations were found between intrafraction motion and patient specific characteristics such as age, seroma volume, PTV volume, and mean body volume.

Conclusion:
Intrafractional deviations with SGRT, using manufacturer-recommended ROIs, are minimal, do not vary substantially for different treatment techniques or patient specific characteristics, and remain constant throughout the treatment course. A universal intrafraction motion measure may be sufficient for calculating PTV margins. Further validation studies are needed to evaluate the impact of ROI size and coverage.

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RADIOTHERAPY SESSION

Investigating BED Conversion in Re-irradiation cases using Velocity

Oran McElligott[*1], Ciaran Malone[1], Colin Kelly[1]*

1. *St. Luke's Radiation Oncology Network*

Aim: To validate and evaluate the benefits and limitations of Velocity's BED conversion tool and incorporate it into a local clinical workflow for re-irradiation cases.

Background: Modern advances in radiotherapy have led to improved survival rates for cancer patients and, therefore, a marked increase in the frequency of re-irradiations. There are many challenges that must be addressed in order to perform accurate dosimetric assessments of re-irradiation patients. Among these is the issue of dose accumulation and, specifically, the estimation of cumulative biological dose to organs-at-risk (OARs). Varian's VelocityTM software offers the ability to convert 3D physical dose distributions into biological dose distributions, expressed in terms of biologically effective dose (BED) or equivalent dose in 2Gy fractions (EQD2).

Methods: Velocity's BED calculation process was validated by comparison of point-doses against manual calculation and against an independent in-house software. The nuances of the calculation process at structure boundaries and within overlap regions were also investigated. Workflows were developed for the dosimetric assessment of re-irradiation cases using both rigid and deformable registration, both for guiding the development of new patient plans and for evaluating cumulative OAR dose following plan production.

Results/Conclusion: Velocity's BED conversion tool was validated and incorporated into a workflow for the assessment of re-irradiation patients undergoing lung SABR at St. James's Centre in SLRON. This helped to standardize the existing local procedure, providing a more consistent and reliable dosimetric assessment, and thus greater confidence, in the safety and accuracy of lung SABR treatment plans developed in the re-irradiation setting.

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RADIOTHERAPY SESSION

A retrospective evaluation of HDR cervical brachytherapy treatments based on the EMBRACE II planning aims

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1. *Cork University Hospital*

Purpose: To retrospectively evaluate the dosimetry of HDR cervical brachytherapy treatments for 15 patients treated with a combination of 45 Gy EBRT, concomitant chemotherapy and 28 Gy HDR brachytherapy.

Methodology: The dosimetry for 15 patients who previously completed their treatment was evaluated and compared to the EMBRACE II planning aims. The HDR brachytherapy aspect of the treatment was delivered using a Venezia or Ring and Tandem applicator and a HDR Iridium-192 source over 4 fractions. MR and CT imaging was utilized when planning these treatments. The dosimetry parameters which were evaluated in this retrospective study included: D90_CTVHR_EQD2 and D2cc for the organs at risk namely bladder, rectum, sigmoid and bowel. Compliance with the EMBRACE II planning aims provided a measure of the quality of the treatment.

Results: The results of dosimetric assessment of target and OARs are summarized as follows:

Target Achieved Doses (Gy)	Number of patients	Percentage
D90_CTVHR_EQD2 ≥ 95	3	20%
> 90, < 95	6	40%
≥ 85, ≤ 90	5	33.3%
< 85	1	6.7%
OAR (D2cc)		
Bladder < 80	11	73%
≥ 80, < 90	4	27%
Rectum < 65	11	73%
≥ 65, < 75	4	27%
Sigmoid < 70	13	87%
≥ 70, < 75	12	13%
Bowel < 70	12	80%
≥ 70, < 75	3	20%

Conclusion: The treatments mostly complied with the EMBRACE II criteria in terms of D90_CTVHR_EQD2 and D2cc to the OARs. However, 1 patient received D90_CTVHR_EQD2 less than the prescribed dose constraint of 85 Gy. The bowel and the rectum were the limiting factors for this patient as they were approaching the hard dose constraints as per the EMBRACE II protocol. The use of interstitial needles could offer a solution in such cases. Based on this study, it is clear that the cervical brachytherapy treatments which were reviewed are of a high quality.

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RADIOTHERAPY SESSION

Implementation of MVision Contour + Guideline Based AI Segmentation (GBS) at Cork University Hospital (CUH)

Michael Roche[*1], Patricia Coen[1], RB Ezhilalan[1], Christopher Walker[1], Suzanne Kelleher[1], Eoin McGrath[1], Orla McKivitt[1], Ciara Hegarty[1], Dr. Neil Wallace[2], Dr. Laura Royo[1], Dr. Martin Higgins[1]*

1. *Cork University Hospital*
2. *Peter MacCallum Cancer Centre, Australia*

Purpose

Radiotherapy departments are looking to improve the treatment pathway for patients by bringing in tools for improved efficiency. Artificial intelligence (AI) solutions for delineation of anatomical structures have been commercially developed that can help achieve this goal. This presentation will describe the results from implementing MVision Contour + GBS at CUH.

Method

Automatically generated structures of routinely segmented OARs from Contour + GBS were qualitatively and quantitatively reviewed to determine accuracy with structures created by a clinical expert. The time saved from using contour plus was measured. Limitations of the automatic solution were investigated and a quality assurance (QA) system was developed to ensure that the delineations can be safely used in clinical practice.

Results

From the qualitative review Contour + GBS had an average score of 4 out of 5 for segmentations on H&N, prostate and breast cases. The average contouring time saved was measured to be 53%. DICE coefficients for a range of structures were used to quantitatively determine accuracy with structures created by a clinical expert. Contour specific and quarterly quality control (QC) tests were implemented.

Conclusion

Segmentations from Contour + GBS were of a high standard and allowed for savings in the time taken to contour clinical patients. However, at this point the produced delineations of the AI segmentation solution are not fully accurate. As a result, it is important that a QA system or process is implemented to ensure that the delineations are reviewed by a clinical expert before use.

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RADIOTHERAPY SESSION

Comparing the setup accuracy of Brainlab Thermoplastic Masks for Head Immobilisation Effectiveness in Stereotactic Radiosurgery

Irish Apale[1], Adam Agnew[2], Daniel Foley[2]*

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2. *Mater Private*

This study evaluates the effectiveness of three Brainlab thermoplastic masks: the Cranial 4pi basic mask (Close Mask V1), Cranial 4Pi stereotactic mask (Close Mask V2), and Cranial 4pi open-face mask (Open Mask) in minimizing head movements during Stereotactic Radiosurgery (SRS). Using a brain phantom to simulate patient head movements in pitch, yaw, and roll, the study aimed to guide radiotherapists in selecting the most suitable immobilisation device for enhancing SRS precision and safety. The Open Mask was found to be the most effective, allowing the least mean displacement in all directions, closely followed by Close Mask V2, especially in minimizing yaw movements. In contrast, Close Mask V1 exhibited greater displacement and variability. This investigation underlines the critical role of patient immobilization in radiotherapy, particularly in SRS, where precision is paramount. By systematically applying increasing forces, the study quantitatively evaluates each mask's ability to stabilize against induced motions, providing valuable insights for oncologists in enhancing treatment precision, patient safety, and comfort. The Open Mask's superior performance suggests it as a preferred choice for maintaining patient immobilization in precision-required procedures like SRS.

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XIEL BURSARY

An Investigation into the Effect of Ring Snaking in the Varian 3D Interstitial Ring Applicator on Dose to the Clinical Target Volume and Organs at Risk

Amey Bermingham[1], Anysja Zuchora*[1]*

1. *University Hospital Galway*

An Investigation into the Effect of Ring Snaking in the Varian 3D Interstitial Ring Applicator on Dose to the Clinical Target Volume and Organs at Risk.

Purpose: Due to the mechanical propulsion of Ir-192 source wire into the Varian ring, the source may slip from its planned positon by up to 0.4cm, as described by Fagerstrom et al.(1) This is known as “snaking”. This project aims to investigate the impact on dose to the high and intermediate risk clinical target volume(HR-CTV, IR-CTV), and organs at risk(OARs) for gynaecological HDR treatments.

Materials and Methods: Twenty four plans (8 patient plans, 3 fractions per plan) were retrospectively copied and a counter-clockwise rotational offset of 1-4mm was applied. For each plan and offset, dose to two targets(HR-CTV D90, IR CTV D98), and four OARs (Bladder D2cc, Sigmoid D2cc, Rectum D2cc, and Bowel D2cc), were calculated and compared to delivered dose. Student T-test was used to test for statistical significance.

Results: For the HR-CTV, there was a statistically significant mean dose reduction for offsets > 3mm. For the IR-CTV there was a mean increase in dose delivered, however this was not statistically significant. For the bladder D2cc, all offsets resulted in a statistically significant reduction in dose. Dose differences were observed for the other three OARs, however these results were not statistically significant.

Discussion: This study used 8 clinical patient plans to inform the actual clinical impact of snaking. It is not surprising to see significant changes in dose to the HR-CTV and bladder due to their proximity to the ring.
Conclusion: Quantifying ring snaking during commissioning is important, as this affect may lead to significant changes in clinical plans.

(1) Fagerstrom, J.M., 2023. Practical experience commissioning MRI-compatible tandem and ring applicators for use with the Bravos HDR afterloader. Journal of Applied Clinical Medical Physics, 24(11), p.e14094.

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XIEL BURSARY

Clinical Data Analytics: Characterization and Compensation of Motion Artifacts in Ambulatory Near-Infrared Spectroscopy Measurements (NIRS)

Rayne Pericica[*1], Ciaran Finucane[2], Ivan Ilfanov[2]*

1. *UCD School of Physics*
2. *MPBE, MISA, St James Hospital*

Emerging technologies such as Near-Infrared Spectroscopy (NIRS) offer promising diagnostic approaches which can provide objective information on brain-blood flow dynamics in falls, syncope, stroke and cardiology assessment. One challenge in applying NIRS in an ambulatory clinical setting is the prevalence of movement artifacts in the real-world data, which can introduce significant distortions and noise. This study aimed to explore the characteristics of NIRS related motion artifacts and methods for their correction and removal in a clinical setting.

As part of a larger study, healthy participants (mean age 36 ± 5.23 years) simulated six motion artifacts: (i) head tilting up, (ii) head tilting down, (iii) head tilted to the side, (iv) eyebrow raises, (v) frowning, and (vi) external pressure applied to the NIRS sensor. The effectiveness of four motion artifact removal methods were compared using two metrics: Root Mean Square Error (RMSE) and Pearson Correlation Coefficient (R).

Artifacts arising from external applied pressure, head tilted down, eyebrow raises, and frowns were the largest, most influential artifacts (8.9 µM+/-3.46; 4.3 µM+/-1.4; 4.4 µM+/-1.4). These are easily detected, based on their morphology and can be differentiated from expected physiological changes. The motion correction method Temporal Derivative Distribution Repair (TDDR) performed the best according to our two metrics (RMSE ±0.185µM , R= 0.73). These findings enhance our understanding of motion artifacts in the context of clinical assessment, providing insights which could help in improving the reliability of emerging diagnostic approaches.

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XIEL BURSARY

Inorganic Scintillator-Based Optical Fibre Dosimetry for UHDR Electron Beams on a FLASH-enabled linac

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Background: FLASH-RT involves the delivery of radiation treatments at ultra-high dose rates > 40Gy/s (UHDRs). Typical dosimetry techniques include ionisation chambers and radiochromic film. This study investigates the use of novel inorganic-scintillating detector (ISD) based optical fibre dosimetry for UHDR electron beams. ISDs offer advantages over plastic alternatives for scintillation output, radiation hardness and visibility on kV images for real time in-vivo target-proximal dosimetry.

Methods: Our study used a converted Varian Clinac 21EX at the University of Maryland, Baltimore to produce UHDR 16 MeV beams. The scintillating detectors were made using powdered inorganic phosphors. Two phosphors were tested: Gd2O2S:Tb and Gd2O2S:Pr. The optical fibre probes were coupled to a HYPERSCINT RP-100 reader to collect the scintillation signal. The utility of one ISD in real-time, target-proximal in vivo dosimetry was tested in a rat prostate irradiation experiment. The ISD was trans-rectally placed near the prostate, and imaged with kV planar imaging.

Results: The ISDs were subjected to varying instantaneous dose rates ranging from 6 kGy/s to 25 kGy/s. Results demonstrated that both detectors are dose rate independent above the FLASH threshold, and the ISD signal scales linearly with increasing dose rate for UHDR electrons. Importantly, the dose measurements obtained through the HYPERSCINT system exhibits a linear correlation with the ion chamber charge (R2=0.99), providing further evidence of the detectors' dose rate independence.

Conclusion: Inorganic scintillation-based optical fibre dosimeters are dose rate independent up to ~68 Gy/s. ISDs can be used for real-time, target-proximal in-vivo dosimetry.

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XIEL BURSARY

Practical implementation of Harmonisation and Scaling in Digital PET Optimisation

Hannah O'Driscoll[1], Jane Burns[2], Eamon Loughman[1],*

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2. *Mater Misericordiae University Hospital*

PET/CT acquisition and scan optimisation has a renewed importance with the widespread use of EARL harmonisation techniques. These harmonisation efforts allow participation in multicentre dataset collection for quantitative image assessment. Local optimisation of scan protocol may also be facilitated using similar methods. Correlation of local practice to quantitative output requires scaling radiomic features to allow reasonable comparison.[1]

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Harmonisation techniques such as EARL mask signal information in NEMA dataset. Clinical patient image assessment must guide radiomic analysis of phantom and specific patient anatomy features. All pass filter dataset may highlight differences relevant to optimisation in phantom optimisation. Scaling features allows clinical interpretation of abstract mathematical radiomic features. Reproducibility of radiomic features not found, however clinical trend remained in radiomic features.

References

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XIEL BURSARY

Validation of deformable image registration for dose deformation in head and neck region

Robert Nolan[*1]*

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Aims: The aim of this study is to validate Mirada RTx (Mirada Medical, UK) for deformable image registration, contour deformation and dose deformation in the offline adaptive radiotherapy treatment of head and neck radiotherapy patients in this centre.

Method: The AAPM TG 132 framework, including digital phantom testing, end to end physical phantom testing and testing on clinical cases, is followed to establish the accuracy of Mirada RTx for deformable image registration, contour deformation and dose deformation.

Results: Digital phantom testing, end to end physical phantom testing and clinical case testing was performed. CT to CT deformable registration and contour deformation were shown to perform accurately on previous head and neck cases. RTx performed poorly when registering CT to CBCT images. Dose mapping errors were found to be case dependent and dependent on the anatomical location within the patient.

Conclusion: Deformable image registration, dose and contour warping in RTx has been tested using the TG 132 framework. Registration with RTx is likely to result in time saving for deforming CT data and contours to new CT data for head and neck patients. Dose deformation uncertainty has been characterised. Further clinical data testing is required for clinical implementation for other treatment sites.

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EARLY STAGE RESEARCH AWARD – WINNER 2023

A novel holographic sensing approach for daylight photodynamic therapy (D-PDT) patient dosimetry

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Daylight photodynamic therapy (D-PDT) is a treatment that kills cancer cells by combining a light-sensitive topical drug with daylight as a light source. At present, there is no widely implemented technique for D-PDT patient dosimetry. This study describes a holographic sensor technology that can measure the dose received at the patient's treatment location during D-PDT.

A photosensitive film-based holographic grating is proposed to offer more precise, personalized dosimetry, with the goal of quantifying the dose of daylight received by a patient during D-PDT to enhance treatment outcomes. Unlike other commercially available UV-responsive films, these holographic sensors can be designed specifically for D-PDT dosimetry in the visible band.

A unique photosensitive composition has been developed to enable fabrication of light-responsive gratings. The rate of bleaching of the films under this exposure has been determined. Recording conditions and sample parameters were optimised to maximise grating diffraction efficiency. The holographic gratings were found to erase following controlled light exposure, highlighting their applicability in D-PDT sensing applications.

Altering the thickness of the grating was found to change the rate of grating erasure during light exposure. The gratings' stability was examined over a range of spatial frequencies and time points. The resultant findings established that increased thickness of the photosensitive film and a lower spatial frequency were effective in maximising initial diffraction efficiency and long-term stability of the grating. Further work will include testing the rate of grating erasure with white light sources to simulate daylight exposure and modelling the nature of the grating.

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JOINT SESSION

Developing a National approach for patients undergoing re-irradiation: A status report by the Re-irradiation Subcommittee of the IAPM RT-SIG

Louise Fahy[1], Conor Heeney[2], Paul Hill[3], Karl Jordan[4], Colin Kelly[5], Anne Marie Kennedy[6], Cora Marshall[6], Margaret Moore[1], Paul Mulligan[7], Alan Pembroke[8], Eoin Toomey[9], Anysja Zuchora[1]*

1. *University Hospital Galway*
2. *Mater Private Limerick*
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4. *St Vincent's Private Hospital Dublin*
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9. *Bon Secours Radiotherapy Cork*

Approximately 50% of patients with invasive cancers require radiotherapy as part of their treatment. As survivability improves, and patients live longer, the number receiving more than one course of radiation is increasing. The treatment of patients in this re-irradiation scenario is complex. The time between treatments may vary from a number of months to decades and the treatment may involve multiple institutions across different countries. The historical and new treatment plans need to be combined with consideration to radiobiological effects due to different fractionations and elapsed time. The availability of the treatment record information may vary from summary paper reports to full DICOM datasets containing images, structure sets, plans and dose information. Each patient requires treatment tailored to their own specific needs and history.

There is a lack of general guidelines on re-irradiation. A subcommittee of the IAPM RT-SIG has been established to develop a national framework to assist departments develop their own local procedures. The group is comprised of representatives from all radiotherapy departments in Ireland. Six meetings have been held to date. A framework document, "A National Approach to Patient Re-irradiation" has been created. This covers topics such as: literature review, data availability, dose accumulation, dose metrics, image registration, clinical pathway, plan optimisation, beam algorithms, multimodality considerations and paediatrics. This framework aims to gather national and international best practice on re-irradiation in one place so that departments can select how these can be combined to develop their own local procedures.

An overview and status of the framework is presented.

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JOINT SESSION

Clinical Data Analytics: Characterization and Compensation of Motion Artifacts in Ambulatory Near-Infrared Spectroscopy Measurements (NIRS)

Rayne Pericica[*1], Ciaran Finucane[2], Ivan Ilfanov[2]*

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4. *MPBE, MISA, St James Hospital*

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JOINT SESSION

Python based occupational dosimetry reporting and communication system – PyRP

Darragh McCague[1], Cian O' Hara[1], Jackie McCavana[1]*

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Purpose

Doses for interventional cardiologists and radiologists require close monitoring to ensure that annual dose limits are not exceeded. For staff working in multiple sites, there are further challenges, necessitating establishment of individualised local dose constraints and dose sharing. In the absence of a national dose register, automated communication across sites is required to ensure efficiency and to reduce the administrative burden. The aim of this work was to develop software that provides this functionality, in addition to assessing the integrity of dose data, monitoring the results received and generating reports.

Methods

A series of Python scripts were developed analysing dose data and pdf reports to:-

1. Perform quality checks on results received, examining control dosimeters used, checking for radiation type and doses received in transit.
2. Screen results and inform RPA & RPOs on monthly and/or cumulative doses that exceed internal dose constraints/ reporting thresholds.
3. Generate monthly reports for RPAs and RPOs and quarterly reports for the Radiation Safety Committee.
4. Communicate, via email, individualised results to dosimeter wearers and the RPA/RPO of other employers, when applicable, using customised templates for different staff groups.

Results

Code was produced to achieve the above functionality and communicate results automatically. For 'high dose workers' graphical results were incorporated into the emails showing monthly, 12 month cumulative dose readings and comparing them to limits and constraints. Anonymised bar charts comparing doses with equivalent colleagues were also included. These monthly communications facilitated integration of radiation protection tips and messages.

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JOINT SESSION

Driving continuous improvement in an External Services Medical Physics group with the ISO9001:2015 Quality Management System

Michael Rowan[*1], Geraldine O'Reilly*[1]

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Introduction: Ensuring that the services an External Services (ES) Medical Physics group provide are delivered consistently, continually improve and meet the expectations of external institutions is critical. The implementation of Quality Management Systems (QMS) can assist in putting structures in place to ensure that these consistently high standards of quality are achieved. The MPBE Dept. in St James received ISO9001:2015 certification in 2018 with the group coming into scope in 2022. This paper describes the implementation of the QMS in the group and demonstrates how it has created a culture that is focused on quality and continuous improvement.

Methods: ISO9001:2015 is a globally recognized standard that lays down the requirements for a QMS. Six aspects of the standard are described which have driven continuous improvement. These include internal and extremal audit, competence assessment, customer satisfaction, KPIs, internal PPPG management and quality objectives.

Results:
1. Frequent internal and external audits are performed.
2. The key competencies of staff are tracked on a rolling 6-monthly basis.
3. Regular surveys are undertaken to ensure that the group is meeting customer expectations.
4. The group has developed KPIs that track key activities such as QA.
5. The MPBE Dept. has developed a robust system to manage PPPGs in a structured manner, which is used by the group.
6. Longer terms projects are managed in a structured way using the 'Quality Objective' framework.

Conclusions: The QMS is deeply embedded into group operations. It ensures that continuous improvement and quality is central to the group's work.

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JOINT SESSION

Developing safety policies for MRI scanning of implanted medical devices

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Aims: There is currently a lack of policy documents defining how patients with implanted medical devices are assessed for MRI scanning both nationally and internationally. In order to protect our hospitals from the risks that are inherently associated with MRI scanning of implanted devices, formal written policies are required that clearly define individual roles and responsibilities, work flows and decision making processes, scenarios requiring case-specific risk assessments, etc. This work outlines recent experiences in Children's Health Ireland (CHI) in developing policies for MRI scanning of implanted medical devices.

Methods & Results: Two separate policy documents were developed, covering passive and active implanted devices respectively. A multidisciplinary group was established consisting of medical physicists, radiographers, radiologists, referring clinicians, anaesthetists and risk management personnel. In parallel, dedicated training sessions on implant safety were developed for the relevant staff groups. Governance and reporting structures were established for all incidents and near-miss events involving implants in MRI. The policies were formally approved by the local MRI safety committee prior to implementation.

Conclusions: Formal policy documents for MRI scanning of implanted devices should be developed in all hospitals with MRI scanning facilities. Developing workable and practical policies is a laborious but worthwhile task that should be supported by the Medical Physics community. Future work will involve developing template policies from our locally developed policies in CHI in order to allow their adaptation and implementation nationally.

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POSTER SESSION

POSTER SESSION

ATIA as a Routine Optimisation Tool for Portable X-ray

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The absence of Automatic Exposure Control (AEC) on portable X-ray systems presents challenges in consistently achieving optimised X-ray images. Advanced image quality metrics are often used to facilitate optimisation of clinical protocols. The remote QA methodology from the IAEA [1] provides advanced metrics for routine image analysis. The performance of the IAEA phantom and the T020 Leeds test object for routine optimisation of a Chest AP portable x-ray protocol were compared.

Established clinical baselines were used to guide parameter choice for Portable Chest AP optimisation. Fixed unit AEC exposure dose and IQ were compared to equivalent portable exposure. Quantitative analysis of the IAEA QA phantom was done with the Image Analysis Toolset for Assessing Medical Imaging Quality (ATIA) software [1]. TO20 test object were analysed both semi quantitatively and visually on reporting monitors.

Results showed that ATIA metrics such as Modulation Transfer Function (MTF), Noise Power Spectrum (NPS) and Signal-to-Noise Ratio (SNR) provide valuable insights into the overall image quality characteristics of the portable Chest AP exposures for both phantoms. ATIA as a general IQ assessment software allows practical optimisation of portable X-ray imaging protocols, ensuring the acquisition of high-quality diagnostic images.

Reference:

[1] Mora P et al. (2021). The IAEA remote and automated quality control methodology for radiography and mammography. J Appl Clin Med Phys, 22(11), 126-142.

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POSTER SESSION

A review of PET/CT DRLs in Digital PET/CT system using dose tracking

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In 2022 MMUH acquired a digital PET/CT system. One of the technical advantages of digital PET/CT is the reduction of administered activities to patients due to the higher sensitivity and resolution of these systems. In MMUH a weight-based approach is used and the systems are connected to a dose tracking system (DMS), Siemens Teamplay.

HIQA recently published the national diagnostic reference level for Nuclear Medicine procedures which includes PET/CT. This report highlighted the fact that both fixed doses and weight-based doses are used across the various PET/CT centres in Ireland.

The aim of this study is to review the doses obtained from the DMS connected to PET/CT against the national DRL and examine the issues with comparing digital and non-digital system against the national DRLs.

PET/CT dose data from 2023 was exported from the DMS. Exams were filtered, using DICOM header information, into relevant categories as laid out by HIQA. The categories included were:
- Whole Body FDG
- PSMA Whole Body
- Brain FDG
- Cardiac FDG

Statistical summaries were generated for the Injected Activity (MBq) and the Injected Activity per kg (MBq/kg), for each DRL category. In addition, scatter plots were created as visual references for the distribution of data.

The injected activities in PET for 2023 were substantially below the established DRLs set by HIQA in their recently published report.

Results suggest that rapid advancement in the area of PET/CT technology will require a more detailed approach to reviewing patient doses and establishing DRLs.

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POSTER SESSION

Scorim - Development of a novel online visualisation platform for facilitating image perception studies

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Introduction

Observer studies are a key component of image perception and optimisation research. Streamlined display of images and recording from observers - usually time-poor clinicians - can increase the yield of studies but may be difficult to achieve. The importance of such studies is further underscored with the implementation of Artificial Intelligence reconstruction and acquisition acceleration approaches, where their effect on image quality is still poorly understood. Software exists that can facilitate image viewing and scoring, local setup on a device is required, imposing limitations on accessibility and viewing conditions.

Materials & Methods

Accordingly, to address these limitations and to provide a more expedient way of conducting perception studies, a new program, named “Scorim”, was developed. Scorim utilises Flask to handle the application logic and client requests to serve HTML pages to the user which allows for an intuitive experience guided by best practices in user experience design.

Results

A pilot study of Scorim was carried out at ECR 2024, utilised across multiple scoring stations with the results synchronised across all instances of the application for the study.

Summary

The web-app proved flexible, easy to use and only requires a web browser and internet connection. Study creators can upload DICOM files to the platform and set “per image” and “per participant” questions to fully customize the study. Survey results of participants from the ECR 2024 will be presented and used to inform and guide further development of Scorim.

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POSTER SESSION

Breast ultrasound imaging performance evaluation and advanced mode optimisation using a breast-specific contrast detail detectability phantom

Sean Cournane[*1], Andrew J. Fagan[2], Jacinta E. Browne[2]*

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Breast ultrasound imaging, with its high sensitivity and specificity for lesion detection, allows for a comprehensive diagnosis, management, and treatment of breast abnormalities, either as a primary or adjunct imaging modality. Current commercially-available ultrasound phantoms, used for breast ultrasound testing, do not adequately replicate the complex nature of breast tissue and, to date, have not allowed for sensitive performance evaluation of advanced imaging modes of high-end ultrasound systems. This study presents an evaluation of the imaging performance of a number of breast ultrasound systems using novel breast-specific contrast-detail phantoms, which contained clinically-realistic lesions, in terms of size, contrast and depth, to adequately challenge high-end breast ultrasound systems and advanced imaging modes.

Phantoms containing anechoic and low contrast (-2 dB) spherical lesion targets, of a range of diameters (1 - 4 mm) and depths (10 - 55 mm), were imaged using a range of high-end breast ultrasound systems. The imaging performance for different transmit frequencies and advanced imaging modes (Compounding, Tissue Harmonic Imaging (THI), etc) was determined using the metric, Lesion Contrast-to-Noise Ratios (LCNR), measured using an in-house Matlab® programme.

These low contrast spherical target phantoms offered the ability to discern the imaging performance of high-end ultrasound systems and, further, evaluate the effect of advanced mode imaging techniques on lesion detectability. Differences in imaging performance were much more pronounced for the 2 dB spherical lesion target phantom, which provided a more challenging and clinically realistic evaluation. Furthermore, these breast-specific phantoms were capable of optimising the imaging parameters of the evaluated breast ultrasound systems.

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POSTER SESSION

Modelling the relationship between Breast Ultrasound Contrast Detail detectability and slice thickness.

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Breast Ultrasound imaging is used to distinguish lesions of varying size and subtle contrast from background tissue. Thus, low contrast and anechoic target detectability tests are the most relevant performance indicators for this speciality. Axial and lateral resolution values for breast ultrasound imaging are typically ~1mm, while slice thickness values up to 5mm are reported for typical depths imaged during breast ultrasound examinations. However, the effect of slice thickness on contrast target detectability has not been detailed in the literature. Current, commercially available ultrasound phantoms, typically employ cylindrical target inserts and, as such, do not provide the ability to evaluate the influence of these beamforming characteristics. Accordingly, this work investigated the influence of slice thickness on focal lesion detectability through the use of a geometric model validated with purpose-built phantoms.

High-end ultrasound systems were used to image purpose-built anechoic cylindrical and spherical target phantoms, with varying target diameters (1-4mm) and depths (10-55mm). Lesion Contrast-to-Noise Ratio (LCNR) was determined for different slice thicknesses using an in-house quantitative analysis programme. The ratio between the Spherical and Cylindrical LCNR was compared with derived theoretical geometrical model results for each lesion diameter. The model had an excellent fit to the phantom measurements, with a mean R2 of 0.92 ±0.06 (±1σ) and 0.87 ±0.12 (±1σ) for the respective systems, particularly demonstrating that there was a significant overestimation of focal lesion detectability when using cylindrical target phantoms. This work highlights the need for increased availability of spherical target phantoms for clinically realistic performance evaluation.

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POSTER SESSION

Online, modular radiation protection training - changing the world one lecture at a time

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Objective: "Education is the most powerful weapon which you can use to change the world." Although it's unlikely Nelson Mandela was specifically referring to the ALARA principle, the sentiment remains valid when considering radiation protection training. To ensure a safe working environment, our clinical colleagues require access to clear, concise and up to date radiation protection (RP) training material, packaged in an accessible and modern format.

Methods and Materials: The Medical Physics and Bioengineering (MPBE) department in St. James's Hospital have developed a number of online training courses for various audiences who would routinely have involvement with radiology services, such as speech and language therapists, dentists and referring medical practitioners. The courses are hosted on an online platform "teach:able" where they are accessible around the clock to those registered, ensuring the material can be digested at a time and place of the users choosing. The courses have defined learning outcomes and are presented in a structured, modular fashion. A competency assessment concludes the user experience, whereupon successful completion a certificate is issued.

Results: Since its launch, the site has over 200 registrants signing up to the various courses on offer. Back-end statistics from the site facilitate useful insights on user habits such as pooled data on answers to quiz questions, and retention rates for video content. This type of feedback allows continuous refinement of the content to ensure a valuable user experience.

Conclusions: Provision of RP training on an online platform proves a successful mode of delivery

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POSTER SESSION

A review of the management options for Extravasation of Radiopharmaceuticals and the evaluation of Massage methods and Compression devices as a potential aid to reduce patient and staff dose

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Purpose of the study:
The extravasation of Radiopharmaceuticals in Nuclear Medicine results in localised retention of radiopharmaceutical and an extended radiation exposure to the patients arm. [1, 2] For high dose radiopharmaceuticals including radio-ligand therapies this has the potential to lead to severe soft tissue damage. Staff involved in the care of these patient will also incur an additional radiation exposure in managing the intervention required in management the extravasation. This study explores the options available to aid the dispersion of the infiltrated radiopharmaceutical and the potential radiation dose reduction for patients and staff.

Methods:
This study evaluated a number of options for patient doses reductions including:

- Manual hand massage
- Electric massage gun
- Compression therapy device

An experimental set-up was developed with the aim of quantifying the pressures that various methods would deliver to a patients arm.

The study analysed the following aspect of staff doses:
A comprehensive analysis of the staff radiation doses for a range of radiopharmaceuticals for diagnostic and therapeutic purposes was calculated using Varskin.

Summary of the results:
This study shows that depending on the radio-isotope, staff can receive high radiation doses if attempts are made to deal with patient extravasation. The use of devices theoretically could reduce radiation doses to patients and staff.

Conclusion:
This study explored various options including the use of massage and compression therapy devices that could be used to expedite the dispersion of an extravasation and reduce patient radiation doses. In theory these methods may also reduce staff radiation dose.

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POSTER SESSION

Practical and regulatory radiation protection experience in the delivery of Radio-Ligand Lutetium (177Lu) PSMA Therapy doses to patients in Ireland as part of a multi-disciplinary team

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Purpose of the study: Prostate cancer is the most common male cancer in Ireland, affecting approximately one in eight men. 177Lu PSMA-617 (Half-life 6.7 days) is a radio-ligand therapy that has been shown to be effective in delivering patients benefits for metastasised castration resistant prostate cancer. The Mater Misericordiae University Hospital (MMUH) Dublin were successful in gaining compassionate access to this therapy for two patients. This study outlines the practical and regulatory radiation safety and protection aspects of safely delivering this therapy in MMUH.

Methods: Due to the fact that this treatment was new to Ireland a number of regulatory and radiation compliance tasks were required before treatment could commence, including: Medicine Regulation (HPRA), Patient Radiation Protection (HIQA) and Radiation Safety (EPA). A comprehensive risk assessment was developed and submitted to the EPA. The risk assessment address safety aspect for staff, members of the public and environmental issues. An apparatus and procedure for safely delivering Lu-177 PSMA therapy was developed.

Summary of the results: Two patients received Lu-177 PSMA therapy over a number of cycles. Staff doses were recorded for all key staff involved and results demonstrated a reduction in time due to experience gained throughout the cycles.

Conclusion: Lu-177 PMSA is an important treatment option for metastasised castration resistant prostate cancer. MMUH have demonstrated that from a patient protection and staff radiation safety perspective this treatment can be delivered routinely to patients on an outpatient basis in the Nuclear Medicine Dept.

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POSTER SESSION

Quality Assurance Methods of Ireland's First Halcyon Linac

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Objective: To establish a Quality Assurance (QA) procedure for the first Varian Halcyon Linear Accelerator (Linac) in Ireland. The QA is similar to conventional techniques for C-arm Linacs with modifications applied due to the bore-type design of the Halcyon.

Methods: In line with recommendations from reports of the AAPM (TG142) and IPEM (Report 81), QA procedures were devised in three different categories; dosimetry, imaging and mechanical movements. Halcyon user experience publications were also researched. The Halcyon does not have an optical distance indicator (ODI) therefore source to surface distance (SSD) values cannot be measured. The set-up procedure for many of the QA tests were adjusted accordingly with respect to conventional techniques.

Results: Methods for dosimetry, imaging and mechanical QA were determined on a weekly, monthly and annual QA schedule. QA equipment is setup to a virtual isocentre using lasers before loading to treatment isocentre inside the bore. Imaging is used as a surrogate for the lack of field light and ODI to confirm positioning of QA equipment.

Conclusion: A QA program was established in line with recommendations from IPEM Report 81 and AAPM TG142.

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POSTER SESSION

Initial Evaluation of feasibility of an airport X-ray scanner for lead apron testing

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Testing of personal protective equipment (PPE) is essential for any radiation safety program. The testing of PPE is usually carried out by a radiation safety officer (RSO) / clinical specialist radiographer using fluoroscopy units or CT topograms. Testing in this manner has a number of drawbacks, including (i) manual handling risk, (ii) radiation risk (fluoroscopy), (iii) reducing clinical availability of valuable equipment and the potential to damage equipment and (iv) sub-optimal use of expert clinical personnel's time.
Airport security scanners provide rapid assessment of X-ray attenuation and may be a cost effective solution for testing of PPE.

Aim: To carry out initial evaluation of an airport X-ray system for the testing of lead aprons.

Materials and methods: A number of pieces of lead and lead light PPE (some of which with known defects) were passed through a Smiths Detection X-ray system operating at 160 kVp. The images were compared with X-ray imaging of the same PPE using fluoroscopy (Siemens Artis Zee). Images were evaluated by an experienced radiation protection adviser (RPA) and RSO. Initial findings found that the visibility of the defects was poorer than that using fluoroscopy and it was noted that the folding of lead aprons affected the visibility of some of the defects. Next steps include exploration of optimisation with lower kVp.

Results:

The system facilitated rapid, ergonomic testing of aprons and other PPE.
Conclusion: Security scanning systems have the potential to overcome some of the limitations of current PPE testing techniques.

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POSTER SESSION

Optimisation of Personal Dosimetry for Categorised Workers in Nuclear Medicine

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There are a many different radionuclides used in the nuclear medicine department in the Galway Clinic. These are used for gamma camera imaging, PET imaging and also therapeutic treatment. Each radionuclide has its own specific properties which include half-life, specific activity and the type of ionising radiation it releases during the decay process (alpha, beta or gamma). Staff working in the nuclear medicine department are required to wear a chest and finger TLD and for PET imaging an electronic personal dosimeter are required.

The Environmental Protection Agency (EPA) is our national regulatory body which deals with the protection of workers and members of the public in relation to ionising radiation. There are two documents we have to adhere to, which are;
- S.I No.30 of 2019
- Guidance for undertakings on the application of Ionising Radiation Regulations IRR19 which outline the categorisation and monitoring of workers

Staff working with ionising radiation can be categorised as category A or B, both of which have dose thresholds which cannot be exceeded. There are annual (50mSv/y) and monthly (12.5mSv/y) dose thresholds for extremities in nuclear medicine. The finger TLD is usually worn on the dominant hand but is this best practice?

Due to training of new staff in radiopharmacy, a review of current injection preparation technique was completed as well as adherence to regulation 41(1) and 50(1)b of IRR19 was conducted over a 12-month audit. This audit has greatly improved the accuracy with which categorised staff are monitored as it identified that some staff were wearing the finger TLD on the hand which received less dose.

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POSTER SESSION

PET Patient Personalisation Method

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Introduction

Digital PET has led to large reductions in injected activity and scan times leading to overall improvements in patient experience. The balance of these two components can be difficult to reproducibly achieve in clinical practice. The ability to adjust PET scan parameters based on individuals' needs is required [1].

Materials & Methods

Previous clinical optimisation determined an optimum injected activity and bed duration for our adult cohort (1min@2.5MBq/kg). The NEMA image quality phantom was scanned with various activities and scan times. Sinogram, series and image intensity metric relationships were investigated. Total prompt counts were identified as a proxy for image quality [2] to relate to clinical standard. EARL compliance for bed duration and activity modifications was examined with EFOMP software[3].

Results

Total counts decision algorithm data compares well with publications and guidance on injected activity for a variety of PET modalities and patient groups. Data collection can be performed with annual count rate linearity measurements. A robust clinical algorithm for radiographers to adapt injected activity and scan time was created.

Summary

A robust method of varying clinical scan time and patient injected activity has been developed. For clinical optimisation, we recommend the use of sinogram data, or unfiltered image data, to allow comparison across series and sites with differences in activity or bed duration.

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POSTER SESSION

Automated Nuclear Medicine Quality Assurance image analysis with Python for improved uncertainty analysis

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Purpose

Nuclear medicine (NM) quality control (QC) programs are mandated by (2013/59/EURATOM)[1]. NM QC involves defining system performance, ensuring that the system complies with manufacturers' characterised specifications and NEMA standards, and testing system performance at regular intervals to ensure that performance has not deteriorated since installation. Traditional NM QC analysis using NM workstation computers has significant user input and limited sampling of parameters, and therefore is open to inter- and intra- operator variation and inaccuracies. A suite of Python scripts were developed to carry out quantitative analysis on planar and SPECT test results. The code facilitates comprehensive sampling to assess the parameter of interest with minimal operator interaction. This work seeks to compare results from Python scripts to those from traditional methods and to examine the uncertainties associated with each methodology.

Methods

Python scripts were developed following image analysis methods outlined in IPEM and IAEA publications for the following tests:

- Intrinsic energy resolution
- Spatial resolution
- Planar uniformity
- SPECT resolution
- SPECT uniformity
- Whole-body tests

Data analysis was carried out on various datasets for sodium-iodide (NaI) gamma cameras using traditional methods and the automated scripts.

Results/Conclusions

A comparison of the results and associated uncertainties for the two methodologies, in the context of the published tolerances, will be presented.

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POSTER SESSION

Evaluation of Image Quality software for CT AEC performance assessment

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CT is a high dose imaging modality, which has led to the development of complex AEC systems to manage patient exposure. The methods and phantoms used to assess AEC performance are well established, however the various software available to evaluate IQ relevant to AEC performance require intercomparison.

The Mercury 4.0, Leeds AEC50, and CTDI phantoms were each scanned on a Siemens Edge Plus CT. In addition, each phantom was scanned with a Catphan 600 positioned as a control. Acquired images of each AEC phantom and Catphan were analysed using three image quality metrics available from commonly used software packages. The opensource software packages consisted of two ImageJ plugins: Quantitative-IQ and SPICE-CT and two MATLAB runtime libraries: ImQuest and IQMetrix-CT. A python program was also developed as an additional method of analysis to display the effective mAs on each acquired scan.

TTF, NPS and Detectability were successfully obtained from ImQuest and Quantitative-IQ. Additional metrics generated by the software were incompatible for intercomparison due to differences in calculation methods. SPICE-CT and IQMetrix-CT had insufficient functionality to provide required AEC IQ metrics. Python program provided a customisable parameter display enabling consistent comparison without the use of complex IQ metrics. Further work is required in this area to provide reliable software for IQ based AEC performance assessment.

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POSTER SESSION

Characterisation of Artificial Intelligence based Noise Reduction Software in General X-Ray Systems

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A manufacturer of diagnostic x-ray systems has developed Artificial Intelligence (AI) based noise cancellation software. The manufacturer claims that this software provides users with the ability to improve image quality at nominal-dose levels or preserve image quality at reduced dose levels. It is claimed that image sharpness, low contrast objects and high frequency details are preserved when this novel method of noise reduction is employed.

This study aims to characterise this AI software and queries the claims made by the manufacturer regarding image quality. Limitations of this software are also sought, as no independent, peer-reviewed papers discussing the efficacy of this software have been published to date.

In order to objectively determine the behaviour of this novel AI based image processing, image quality metrics were extracted from an anthropomorphic phantom and several image quality phantoms. This study was able to successfully characterise components of the AI post processing in response to variations in exposure parameters and phantom thickness.

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POSTER SESSION

Optimisation of Radiation Protection Practices in Incubator Imaging

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Methods: A Perspex phantom was used to estimate the scattered radiation dose to holders in several clinical scenarios. Direct exposure to the hands was also considered. Several audits were conducted to establish current practice at three sites providing neonatal care in the Republic of Ireland.

Results: In this study, approximately 37% of portable x-ray examinations were poorly collimated and reject rates between 2.4% and 5.2 % were found across participating sites. In a clinically realistic scenario, a holder would need to be present for over 90,000 examinations before their annual dose limit to the lens of the eye was exceeded. More than 3,000 primary beam exposures to the fingers would be required to exceed the annual public dose limit for the extremity. It was also found that the incubator lid significantly attenuates the primary beam (24.5%).

Conclusions: Local DRLs for neonatal incubator imaging and National DRLs for low birth weight patients must be established to aid in optimisation in NICU / SCBU. Higher workloads in the NICU / SCBU produced more optimised radiation protection practices, as supported by the reject analysis audit. Training and education should be established to standardise good practice across sites.

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POSTER SESSION

A Comparative Study of the Imaging Performance of Traditional and Hand-Held Diagnostic Ultrasound Systems.

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Technological advances have seen a resurgence in the popularity of diagnostic ultrasound imaging, and as such ultrasound machines have shifted from conventional, large, room-based scanners capable of advanced diagnostic procedures, to handheld, portable devices designed for quick bedside patient evaluations, also known as point-of-care ultrasound (POCUS).

The objective of this research is to evaluate and compare the imaging performance of traditional and handheld diagnostic ultrasound scanners. A tissue mimicking material (TMM) based ultrasound test object was designed and fabricated to include ultrasonically identifiable markers at clinically relevant depths. The acoustic properties (speed of sound, attenuation coefficient) of the TMM were evaluated via scanning acoustic microscopy techniques. B-mode images were acquired of the custom-built phantom as well as a standard B-mode test object using both traditional diagnostic ultrasound scanners and handheld POCUS devices, for all available frequencies and pre-set imaging protocols. A comparison was then made between the performance of the traditional scanners and the new POCUS devices with regards to marker depth accuracy, image signal to noise ratio (SNR) and contrast to noise ratio (CNR). In addition, a comparison was conducted between two identical handheld POCUS models to assess standardization and accuracy across both. The curvilinear transducer in the traditional system showed better depth accuracy than POCUS systems. Moreover, the traditional system exhibited higher SNR and CNR levels compared to POCUS systems.

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POSTER SESSION

Use of ultrasound QA to determine the clinical efficacy of diagnostic ultrasound systems and probes

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Aim

Quality Assurance (QA) testing in ultrasound is important to ensure reliable diagnostic results and detect deterioration of image quality.

The aim of this study was to:

1. Assess the sensitivity of QA metrics to reported differences in clinical image quality between ultrasound systems.
2. Detect, using QA testing, when an ultrasound probe should be taken out of clinical use.

Methods

QA was carried out on two different ultrasound systems; System A (manufacturer A, 2022) and System B (manufacturer B, 2019). QA consisted of 'In Air' and phantom tests to assess probe performance and image quality. Phantom tests were performed using the Gammex 404GS phantom.

Results:

- On average the sensitivity and resolution of probes on System A was superior to the equivalent probes on System B (e.g. sensitivity of the large curvilinear probe on system A was 1.66±0.07cm and 1.45±0.11cm on System B).
- Noise and sensitivity tests were more reproducible on System A.
- More cystic targets were visible on System A (e.g. small linear probes, on average 8.67 targets were visible for system A as opposed to 5.67 on System B).

Conclusion

In conclusion, QA metrics can detect differences in probe and system performance that are linked to reported differences in clinical image quality. The most useful metrics in our QA protocol are sensitivity, resolution and cystic target accuracy. If degradation in probe sensitivity is detected in routine QA, further phantom testing should be carried out to determine if the probe is appropriate for continued clinical use.

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POSTER SESSION

Examining the feasibility of adopting a weight based approach for Nuclear Medicine Bone Imaging as part of an optimisation workflow

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Purpose of the study:

Patient administered activities using a Weight-based method for all Nuclear Medicine (NM) procedures are recommended by the ICRP. HIQA recently published the national diagnostic reference levels (DRLs) for NM procedures and indicated that they encourage all facilities to consider a weight based approach. The HIQA report for diagnostic NM procedures showed that fixed administered activities are still predominantly used in Ireland.

Bone Imaging in Nuclear Medicine is performed for a number of clinical indications including: Oncology, Orthopaedic, and Rheumatology. The purpose of this project was to examine and optimise the administered activities for the various Bone indications protocols used in MMUH. This project also assessed the feasibility of introducing a weight-based approach to administered activities for Bone Imaging.

Methods:

An audit was undertaken with the aim of comparing weight-based factors recommended by the EANM to the fixed activities set for Bone procedures in MMUH.

The audit steps were as follows:
-Patient were weighted before their injection was administered and results recorded.
-Patients were administered the fixed doses as per MMUH Department protocol.
-Based on the recorded patient weight the projected activities were calculated.
-These results were further analysed based on the scanning type (Planar & SPECT) and the clinical indications.

Summary of the results:

The results of this project identified that the fixed administered activity used in the MMUH is below the HIQA National DRL for both Planar and SPECT procedures and the EANM recommended activity ranges for Standard and Obese patient.

Conclusion:

This project highlighted the need for optimisation of administered activities for Bone Imaging procedures in MMUH and a need for more detailed approach based on clinical indications.

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POSTER SESSION

A comparison of the dose and image quality obtained on Multi-Slice Computed Tomography with that achieved on three Cone Beam Computed Tomography systems using the QUART EFOMP-ESTRO-IAEA Test Set

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Purpose: This study aimed to compare the effective dose and image quality obtained on two modern Multi-Slice CT (MSCT) systems with that obtained from three Cone Beam Computed Tomography (CBCT) systems used in three different configurations (Dental, Interventional Radiology and SPECT).

Methods: All acquisitions were made using the default head CT protocol on all systems. Image quality measurements including noise, contrast-to-noise, homogeneity, spatial resolution, geometric precision and CT number accuracy were performed using a dedicated CBCT image quality phantom and the methodology specified in the 2017 EFOMP-ESTRO-IAEA CBCT quality control protocol. Image quality analysis was preformed using the software tool supplied by the phantom manufacturer along with the image analysis program ImageJ. The effective dose on the two MSCT systems and the Interventional Radiology CBCT system was calculated using the Monte Carlo based NCICT CT organ dose calculator and PCXMC respectively. DAP/DLP to effective dose conversion factors were used to calculate effective dose on the two other CBCT systems. Image quality parameters across all systems were compared as a function of effective dose.

Results: From this analysis, it was determined that MSCT consistently outperforms CBCT systems for most image quality parameters tested when effective dose was factored in. MSCT systems exhibits lower level of noise as well as superior contrast-to-noise and homogeneity. The difference in spatial resolution (Modulation Transfer Function) between the systems was less pronounced and there was no difference perceptible in geometric precision. There was however also a significant variation in the Hounsfield units exhibited by each system for a given target, which was likely due to the high levels of noise present in the CBCT systems.

Conclusions: These findings provide valuable insights into the strengths and limitations of each imaging modality, facilitating informed decision-making in clinical and research settings.

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POSTER SESSION

A retrospective study on the dose received by paediatric patients during whole spine X-rays in Children's Health Ireland (CHI) using different diagnostic X-ray systems.

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In recent years, the demand for whole spine imaging has grown. In CHI, these exams are used to assess paediatric patients with scoliosis. These X-rays are carried out in multiple locations, with different technologies, across CHI. The purpose of this study was to compare the dose the patient received from whole spine X-rays using the different X-ray systems.

A retrospective study was carried out where the DAP, kVp and mAs were recorded for these patients. X-rays were taken on Carestream DRX Evolution, a Siemens Multitom RAX or a Shimadzu RAD Speed Pro X-ray system. Data was grouped based on age ranges following National and European DRL guidelines.

Results showed that although the majority of DAPs recorded were below the National DRLs, DAP values recorded on the Siemens unit were higher than those recorded on the Carestream and Shimadzu systems for patients in the same age group. This could be due to the more complex patients seen in this room and longer SID in use. Also, each unit had a wide range of DAPs recorded within each age group, likely due to variation in patient sizes in this cohort.
This study highlighted the need for continuous standardisation of protocols for whole spine imaging across all X-ray systems in CHI to ensure consistency of patient dose and image quality. Challenges in assessing the data included the variety of technologies available across CHI and the varying patient age and size. However, results from this audit will be used to further inform the optimisation of these systems.

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POSTER SESSION

Patient Radiation Safety Video Infographics

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Objective:
Legislation requires that patients are informed of the risks and benefits of medical exposures. Radiation Safety information is usually only available in written form in a Radiology Department, which does not give patients much time to absorb the information prior to being asked to consent to the procedure. Infographic animation videos help visualise information which is needed to be conveyed in a correct and curious way by taking the elements of communication and visual communication into account.

Naas General Hospital Radiology Department decided to make radiation safety information more accessible for their CT patients through digitising it. Clarity in communication is vital for patients undergoing a CT scan. This helps them prepare mentally for what to expect in a CT Scan, and to reduce their potential anxiety of undergoing the scan.

Methods and Materials:
The video was designed through a collaboration with Moving Image Design Dept in NCAD. A timeline of a patient undergoing a CT scan was written by a radiographer and a script detailing the timeline of events was created.

Results:
A three and half minute video animated infographic for patients before they undergo a CT scan was developed. It provides information on the radiation risk involved and steps patients through the contrast process.

Conclusions:
Animated infographics will be available to patients in advance of their CT scan via QR codes in their patient letter and displayed in screens in waiting areas, providing patient with better accessibility to radiation protection assurance regarding their CT in advance of their scan.

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