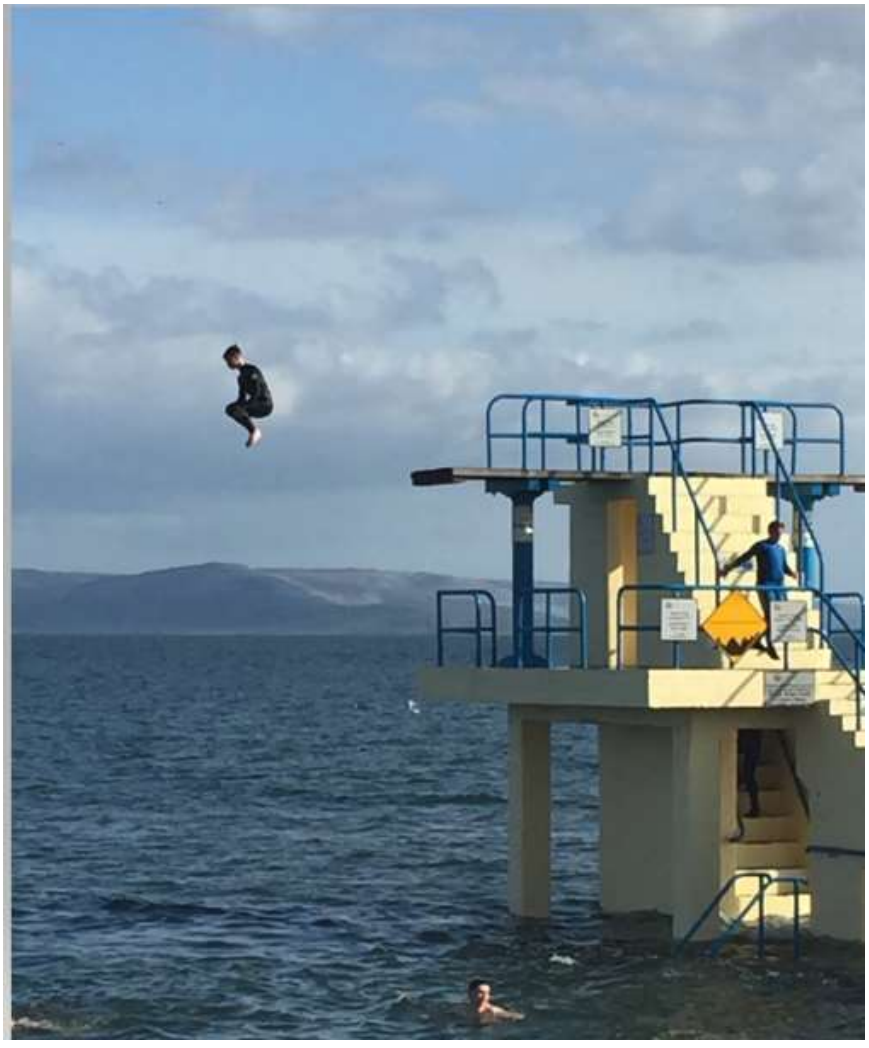
Irish Association Of Physicists In Medicine

15th Annual Scientific Meeting

Programme



Galway, 27-28th March 2026

PRESIDENT'S WELCOME

Dear ASM Delegates,

It is my pleasure to welcome you to the 15th Irish Association of Physicists in Medicine (IAPM) Annual Scientific Meeting, held at the Galmount Hotel in Galway.

Our annual meeting provides us with a valuable opportunity to reflect on the progress we have made over the past year, to exchange idea and to explore the latest developments in Medical Physics.

This event would not be possible without the dedication of the ASM Organising Committee, led by Margaret Moore, whose hard work ensures a seamless experience for all attendees. From arranging the venue and guest speakers to securing sponsorship and coordinating logistics, their efforts make this meeting a success each year.

The success of this year's scientific programme is a testament to the high-quality contributions of those who submitted abstracts and the meticulous work of our reviewers. We sincerely thank each of you for your dedication. In addition, I would like to extend a warm welcome to our invited speakers Dr Austin Craig and Professor Marcel Van Herk whose expertise and insights we are very much looking forward to hearing, as well as Dr Richard Speight who spoke at the MRI workshop. Your contributions are what make this meeting both dynamic and inspiring.

We are also deeply grateful to our sponsors, whose generous support enables us to host this event. Their commitment to advancing medical physics is commendable, and I encourage you to visit their exhibition stands and engage with them.

As in previous years, we are pleased to present the IAPM awards for best presentations, as well as the Early-Stage Research Award (ESRA) and the Xiel Bursary. We extend our sincere thanks to Xiel for their continued generosity and to Dr. Seán Cournane for overseeing the ESRA award. Best wishes to all candidates!

Beyond the scientific programme, I encourage you all to take full advantage of the opportunities to network, reconnect with colleagues and build new collaborations. These interactions can be just as valuable as the sessions themselves.

Thank you, and I wish you all a very successful and rewarding ASM
Warm regards,

Anna-May Woods
IAPM President

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CLARE CORBALLY

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.

GUEST SPEAKERS

Dr. Austin Craig

Austin is an experienced radiochemist with a strong focus on radiopharmaceutical development and project management. Over the past decade, he has worked across start-ups, hospitals, universities, and industry, contributing to nearly every stage of preclinical and clinical radiopharmaceutical development. He is the co-inventor of two radiolabeling technologies and passionate about advancing pharmaceutical development through radiolabeling and imaging. During his time in Germany, he co-founded and led Fluorizon, a CRO specializing in radiolabeling and preclinical imaging services. He is currently the Radiopharmacy Site Manager at Alliance Medical Ireland, where they are building Ireland's newest radiopharmacy. He also represents the Oncidium Foundation, which focuses on promoting radioligand therapy, as an ambassador for Ireland.

Title: "Building Ireland's new Radiopharmacy for the Era of Theranostics"

Prof. Marcel Van Herk

Marcel Van Herk is an internationally known and respected physicist, scientist, innovator and researcher. He leads a large multidisciplinary group as of the Cancer Sciences division at the University of Manchester UK covering physics, clinical oncology, clinical physics, radiography and radiology. All research is aimed at directly improving the clinical practice of cancer treatment. His work has led to new standards of care in cancer treatment and delivery and he is recognised internationally as practice changing. Marcel has co-authored over 300 papers in peer reviewed journals.

Marcel received the Emmanuel van der Schueren Award at ESRO 2024 in recognition of his significant contribution to the field of radiotherapy physics by his peers. He is best known for his work involving establishing treatment margins and image guidance in radiotherapy. In fact, his name is synonymous with the equation used extensively for margin recipe determination using systematic and random error analysis.

Marcel brings energy and fresh thinking to inspire his fellow physicists in pursuit of excellence driven by evidence.

Title: Analytical margins for complex situations - beyond 2.5SIGMA + 0.7sigma

Abstract: Between 2000 and now, very few updates have been made to the analytical margin recipe published by myself and colleagues. In the meantime, accuracy in radiotherapy delivery has greatly improved and setup error is no longer a limiting factor. In this presentation, I will review and extend analytical margin derivation for more complex situations that occur beyond IGRT and ART. I will start from a simple moving sphere, continue to multiple targets, deformation of targets, and delineation variation. I will also discuss the impact of motion correlation on the margin for rotations. In that way, the probabilistic margin formalism will be validated and extended for the modern age.

SPONSORS

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

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WORKSHOP PROGRAMME – FRIDAY, 27 MARCH 2026

When Radiotherapy invades your K-Space!

WORKSHOP SESSION SEMINAR ROOM, TOP FLOOR, RADIATION ONCOLOGY BUILDING, UHG		CHAIR: MARGARET MOORE
12:30	**LUNCH & Registration**	
13:30	Welcome to University Hospital Galway Introduction to the MR Workshop	Margaret Moore University Hospital Galway
13:40	MR Safety and the Role of the MRSE	Dr Cormac McGrath Belfast Trust
14:00	MRI for Neurosurgery	Michael O'Neill Beaumont Hospital Dublin
14:20	GUEST LECTURE Clinical Implementation of MR Imaging into Radiotherapy	Dr Richard Speight Leeds Cancer Centre UK
15:00	***Coffee Break***	
15:20	Intraoperative MRI and Quantitative MRI	Dr Michael Kelly Children's Health Ireland
15:40	Accelerated Imaging and AI	Dr Alan Stone Beaumont Hospital Dublin
16:00	MRI for Radiotherapy – Achieving geometrically acceptable imaging for radiotherapy	Paul Davenport St Luke's Radiation Oncology Network Dublin
16:30	Interactive Session – Invasion of K-space – How do we help each other?	Audience & Panel
17:00	***Close***	***Optional Tour of Radiation Oncology Dept UHG***

19:30: CONFERENCE DINNER: GALMONT HOTEL, LOUGH ATALIA RD, GALWAY, H91 CYN3

WORKSHOP PROGRAMME – FRIDAY, 27 MARCH 2026

When Radiotherapy invades your K-Space!

Richard Speight PhD

Dr Richard Speight is Deputy Head of Radiotherapy Imaging and Research & Innovation at the Leeds Cancer Centre. He has extensive clinical and research experience in the application of MRI in radiotherapy, including MR-only workflows and the use of functional MRI techniques. He chaired an Institute of Physics and Engineering in Medicine (IPEM) working group that developed the first international guidelines for the safe implementation of MRI in radiotherapy.

In this talk, he will provide an overview of these guidelines and discuss the commissioning of an MR simulator in Leeds to support both MR-CT and MR-only treatment pathways.

Cormac McGrath PhD

Cormac is the head of the Non-Ionising Radiation Group for the Northern Ireland Regional Medical Physics Service where he also leads the MRI team. He is a Magnetic Resonance Safety Expert for five NHS trusts in NI. He is a previous chair of the UK Institute of Physics and Engineering in Medicine Magnetic Resonance Special Interest Group. He chaired the IPEM working party that produced a freely available set of MRI Safety Notices, and is a member of the IPEM MRI Site Design Working Party (guidance currently out for consultation). He sits on the IPEM MR Safety Expert Accreditation Panel. He was a founding member of the American Board of MR Safety (ABMRS) and currently sits on the Board of Directors as an international member. His current interests are quantitative MRI, MR safety, MRI and radiotherapy, and Virtual Reality in medicine.
His talk will focus on MRI safety, the role of the MRSE and overall safety governance.

Michael O'Neill MSc

Over the past six years, Michael has specialised in MRI physics, working closely with neurosurgeons to help establish a robotic-guided stereotactic neurosurgery programme at Beaumont Hospital. This initiative has enabled the rollout of stereo-encephalography (SEEG) and deep brain stimulation (DBS) procedures for the diagnosis and treatment of Epilepsy and Parkinson's disease. His work spans MRI acquisition, image processing, and education, with a particular focus on understanding and communicating the limitations of imaging technologies.
His presentation today will highlight how MRI supports stereotactic neurosurgery, focusing on the geometric accuracy required for imaging and its impact on procedures such as stereo-encephalography (SEEG) and deep brain stimulation (DBS). It will also explore the use of Tractography and FMRI to

	identify critical brain regions, while addressing the limitations of imaging in clinical practice.
Michael Kelly PhD	
	Michael Kelly works as the Principal Physicist for MRI and non-ionising radiation in Children's Health Ireland. On completing his PhD in MRI at Trinity College Dublin in 2010, he worked as a post-doctoral MRI researcher at the University of Oxford for 4 years and then as preclinical imaging Lead at the University of Leicester for 5 years. In his current role he provides physics support to the paediatric MRI service at Children's Health Ireland, covering all aspects of MRI safety, sequence optimisation and implementation of new techniques such as functional MRI, quantitative MRI and intraoperative MRI (at the new National Children's Hospital of Ireland). His talk in today's workshop will focus on intraoperative MRI and quantitative MRI.
Alan Stone PhD	
	Alan is the Principal Physicist in the Neuro Physics team at Beaumont Hospital who provide scientific support for cutting-edge MRI neuroimaging in a clinical setting. He is an Adjunct Associate Professor at the UCD Centre for Physics in Health and Medicine and specialises in MRI education and research. He has 18 years of MRI experience, working in a variety of clinical and research settings and is the current convenor of the IAPM MRI Special Interest Group. His interests include neuroimaging, accelerated imaging, functional imaging, quantitative MRI and MRI safety. His talk will cover accelerated MR imaging with a specific focus on the Deep Learning reconstruction techniques that have recently emerged.
Paul Davenport MSc	
	Paul is a Radiotherapy Principal physicist working in St. Luke's Radiation Oncology Network specialising in advanced imaging for cancer treatment, with expertise in MRI-based radiotherapy and MRI coil design. He is experienced in image-guided radiotherapy, imaging system optimisation, and quality assurance. His presentation will discuss geometrically acceptable MRI images suitable for use in radiotherapy treatment planning and the multi/cross-disciplinary collaboration needed to achieve this aim.

SCIENTIFIC PROGRAMME – SATURDAY, 28 MARCH 2026

8:30 ***Registration – Main Foyer***

PLENARY SESSION
INIS MOR SUITE — **CHAIR: ANNA-MAY WOODS**

9:00	President's Welcome	Anna-May Woods
9:05	GUEST LECTURE **Building Ireland's new Radiopharmacy for the Era of Theranostics**	Dr Austin Craig
9:35	GUEST LECTURE **Analytical margins for complex situations - beyond 2.5SIGMA + 0.7sigma**	Prof Marcel Van Herk

10:15 ***Coffee Break***

POSTER EXHIBITION

DIAGNOSTIC PARALLEL SESSION
INIS MOR SUITE 2 — **CHAIR: BRENDAN TUOHY**

11:00	CT-DImQ_SSIM: An open-access platform for Structural Similarity Index Measure (SSIM) evaluation in CT - Application to anthropomorphic phantoms and AI vs iterative reconstruction	Ainur Kazhybekova
11:10	Global Mammography QC Initiative: Findings from an IAEA Coordinated Research Project incorporating Irish Data	Elizabeth Keavey
11:20	Digital phantom assessment of MRI quantitative susceptibility mapping (QSM) reconstruction pipeline	Alan Stone
11:30	First experiences of a PET Radiopharmaceutical Dispenser: Lessons learned in Radiation Safety, QA, and Workflow.	Dean McCarthy
11:40	An Image Quality Assessment of Contrast Agents used for Hysterosalpingograms	Dara O'Gallchobhair
11:50	Investigation of the Feasibility of 3D-Printed Phantoms for the Analysis of Dopamine Transport Scans in the diagnosis of Parkinsons and Related Disorders	Jacob Andriessen
12:00	Theoretical and experimental characterisation of thermal changes induced by High Intensity Focused Ultrasound (HIFU) fields	Dervil Cody

RADIOTHERAPY PARALLEL SESSION

INIS MOR SUITE 3 — CHAIR: ALAN HOUNSELL

11:00	Influence of dose-per-pulse and pulse repetition frequency on in vitro cell survival under conventional and ultra-high (FLASH) dose rates	Oran McElligott
11:10	Assessing the vendor provided field passing criteria for the IQM fluence detector for VMAT PSQA.	Dion Conlon
11:20	Derivation of Prostate PTV Margins Using Image Guidance and Deformable Dose Accumulation	Darina Hickey
11:30	A Phantom-Based Feasibility Study on the Use of Quantitative Surface Topography Metrics to Optimise SGRT ROI Selection.	Paul O'Connor
11:40	Pulmonary vein-sparing radiotherapy in locally advanced non-small cell lung cancer: a feasibility study	Fereshteh Gholami
11:50	National Intercomparison of Re-irradiation (reRT) Techniques	Lucy Griffiths
12:00	Advancing Pancreas SABR: Dosimetric and Efficiency Comparison of RapidArc Dynamic vs Standard VMAT	Cora Marshall

12:15 ***Lunch Break***

POSTER EXHIBITION

AFTERNOON PLENARY SESSION

INIS MOR SUITE — CHAIR: EILIS O'HALLORAN

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".

13:15	Film-Based Single-Point Dosimetry for Routine QA of COMS Ophthalmic Applicators: Experimental and Monte Carlo Validation	Evan Keane
13:18	A TPS-Independent Framework for Automated Lattice Radiotherapy Planning	Luca Mulcahy
13:21	Clinical Verification of the Dose Delivered in an X-ray Blood Irradiator Using a 3D Printed Phantom	Austin Stricker
13:24	Complex-Valued Magnetic Resonance Dictionary Matching for Simultaneous Estimation of Magnetic Field Perturbations and Transverse Relaxation	Kevin McNally
13:27	The use of plan complexity metrics to evaluate treatment planning templates in Monaco treatment planning system	Panagiota Aresti

13:30	Timing is everything: investigating the impact of AlignRT beam hold delay on treatment accuracy on Elekta Versa-HD linacs	Ciara Hickey
13:33	Investigating Peak Skin Dose in Fluoroscopy Guided Neurointerventional Procedures	Rachel Carey
13:36	Dosimetric analysis of vaginal cap use with the Venezia applicator in an image-guided HDR brachytherapy patient cohort with locally advanced cervical cancer	Roisin McMonagle
EARLY-STAGE RESEARCH AWARD		
14:00	Introduction to the Early Stage Research Award	Seán Cournane
14:05	Early Stage Research Awardee 2025	Michaela Walsh
14:15	Announcement of the Early Stage Research Award 2026	Seán Cournane
WIL VAN DER PUTTEN LECTURE		
14:20	GUEST LECTURE ICPM and Professional Development	ICPM Board
15:00	***Coffee Break***	
POSTER EXHIBITION		
JOINT SESSION INIS MOR SUITE		CHAIR: AOIFE GALLAGHER
15:30	Mind the (Knowledge) Gap: What Can 500+ Responses Teach Us About AI Readiness in Radiation Oncology?	Ciaran Malone
15:40	A New Deal for Task-Based Performance Assessment in CT	Ronan Coleman
15:50	The current status and future landscape of Radionuclide Therapies in Ireland	Ann McCann
16:00	A Python-based tool for interactive mapping of clinical radiation scatter fields	Eamon Loughman
AWARD CEREMONY INIS MOR SUITE		
16:15	Xiel Bursary	Phil Neale (Xiel)
16:30	***Close of Meeting***	

Table of Contents……*(Click on Section titles for shortcut to section)*

Section 1- Xiel Abstracts

Section 2- Diagnostic Parallel Session Abstracts

Section 3- Radiotherapy Parallel Session Abstracts

Section 4- Joint Session Abstracts

23 Mind the (Knowledge) Gap: What Can 500+ Responses Teach Us About AI Readiness in Radiation Oncology?

24 A New Deal for Task-Based Performance Assessment in CT.

25 The current status and future landscape of Radionuclide Therapies in Ireland.

26 A Python-based tool for interactive mapping of clinical radiation scatter fields.

Section 5- Diagnostic Poster Abstracts

27 Investigation and Characterization of Off-Focus Radiation Peaks from a Digital Breast Tomosynthesis System

28 Radiation protection requirements for ducts and penetrations through shielding barriers.

29 Making High-Resolution Tractography for Neurosurgical Guidance Practical with SMS.

30 Seeing the Unseen: A Critical Look at Detecting Defective Detector Element in Digital Mammography.

31 A 3D printed phantom for measuring geometric accuracy in MRI.

32 An Audit of Image Rejection in General X-Ray.

33 Assessing scatter corrected planar CZT imaging for lung shunt fraction estimation using anthropomorphic and 4D digital phantoms.

34 An alternative approach to reassurance monitoring of uncategorised staff working in controlled areas.

35 Characterisation of a commercially available tungsten-filled polymer filament for use in Image Quality testing and Radiation safety solutions.

36 A CT Topogram–Based Methodology for Periodic Screening and Transmission Assessment of X-ray Personal Protective Equipment

37 SureStart Bolus Tracking: CTPA Optimisation.

38 Reject Rate Analysis as a Tool to Reduce Patient Doses in General Radiography

39 Use of Tin Filters in CT: Throughput Benefit Versus Cooling Delay

40 Evaluation of a 360 degree, whole-room, radiation protection device in a cardiac catheterisation lab

41 Evaluation of a Local ^{18}F-PSMA-1007 PET/CT Protocol Against EANM Guidelines

42 Radiation Risk Assessment of Mobile C-Arm Use in Operating Theatres: Implications for Occupational Dose Monitoring.

43 Systematic comparison of foetal radiation risk with selected non-radiation pregnancy risks; risk magnitude, evidence certainty, and communication style.

44 Image quality assessment of clinically-applied CBCT protocols using a QRM Cone Beam phantom.

Section 6- Nuclear Medicine Poster Abstracts

45 Modelling Foetal Thyroid Dose Following I-131 Uptake Procedures Using a Gestation-Dependent Biokinetic Model.

46 A Microsoft Power Apps solution for radioactive waste inventory management in nuclear medicine.

47 From Capsule to Clearance: An Animation for Improving Radiation Safety Communication in I-131 Radionuclide Therapy.

48 S.W.I.M.S.: Diving into Contamination Monitoring and Spills Response in Nuclear Medicine.

49 Assessment of the distribution of radiation exposure across the hands of Nuclear Medicine workers for a range of clinically relevant radionuclides and geometries: Monte Carlo simulation and experimental validation.

50 Comparison of proportional counters and survey meters for the monitoring of 177Lu contamination arising from nuclear medicine procedures.

Section 7- Radiotherapy Poster Abstracts

51 Quality Assurance for SRS and SABR radiotherapy treatment planning with the QUASAR MRID-3D phantom.

52 Evaluation of the effect of rotations on coverage of nodal boosts in gynae SIB patients.

53 Investigation into Feasibility of using Varian Multi-Criteria Optimization (MCO) to Improve Both Simple (Prostate) and Complex (Head and Neck) VMAT Plans in the Clinical Environment.

54 An investigation into minimum bladder filling volumes for prostate radiotherapy treatment.

55 Five years of radiotherapy dose reference levels – a single institution review.

56 Evaluating dosimetric improvements in the PTW Octavius 1000SRS array for SABR QA.

57 Validating Rapid Delivery of Prostate SABR with FFF Arcs using Intrafraction Prostate Displacements.

58 Cross Modality Harmonization of UHDR Radiation Dosimetry.

59 Commissioning and Quality Assurance tests for RapidArc Dyanamic.

60 Characterization of EBT-XD Film for use in High-Dose Kilovoltage Energy Applications.

61 Investigation of the dosimetry of electron fields at oblique angles of incidence and non-uniform surfaces - comparison between the Monaco Treatment Planning System and Versa HD treatment units.

62 Assessment of conventional geometric contour comparison metrics via correlation with dose in prostate stereotactic body radiotherapy.

63 Characterisation of an ultra-high dose rate electron beam using an RP-FLASH plastic scintillation detector for FLASH radiotherapy studies.

64 A TOPAS Monte-Carlo model of standard and FLASH-enabled Elekta linacs for in vitro dose verification and prediction in pre-clinical radiobiological studies.

65 Commissioning of a “Y” endometrial applicator for HDR brachytherapy in inoperable endometrial cancer.

66 Evaluation of alternative modelling approaches for the Agility Multileaf Collimator in Monaco treatment planning system.

67 Impact of evolving dosimetry practices in Selective Internal Radiation Therapy (SIRT).

68 Calculating PTV margins for abdominal SABR using the van Herk formula.

Section 8 - Artificial Intelligence In Healthcare Poster Abstracts

69 Integration of Generative AI in Radiation Safety Training.

70 Development and Validation of a Python-Based Tool for CT Electron Density Phantom Analysis in Routine QA.

71 Reducing time to treatment in radiotherapy with AI-based auto-contouring and patient scheduling.

72 Initial evaluation of an artificial intelligence based GTV segmentation tool for stereotactic radiation surgery treatment planning.

73 A novel method of quantitative assessment of synthetic coronary angiography frames generated by convolutional neural networks.

74 A Bayesian AI Framework for personalized, uncertainty aware SGRT Margin Adaptation.

Section 1- Xiel Abstracts

Film-Based Single-Point Dosimetry for Routine QA of COMS Ophthalmic Applicators: Experimental and Monte Carlo Validation.

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Purpose:

To develop and validate a routine single-point dosimetry check for constructed COMS ophthalmic plaques loaded with I-125 seeds. The method aims to detect plaque construction deviations, particularly silastic insert thickness variations [1], provide measurements traceable to treatment planning system (TPS) calculations, and define an acceptance tolerance for clinical quality assurance.

Methods:

A 20 mm COMS plaque was loaded with IsoSeed I25.S16 (Eckert & Ziegler BEBIG, Germany) sources according to an Eye Physics Plaque Simulator treatment plan. GafChromic EBT4 film was used to measure a prescription dose of 250 cGy at a prescription depth of 7.11 mm, defined by a 6.97 mm wax eye phantom and a 0.14 mm film thickness. Two measurement geometries were employed: (i) a spherical-cap wax phantom replicating ocular curvature for routine point dose checks, and (ii) a water tank geometry providing full backscatter as a reference. Central-axis dose was extracted from film profiles for both geometries. Independent Monte Carlo simulations were performed in TOPAS to model both configurations for a single I-125 seed, and a wax-to-water correction factor was calculated for comparison with experimental measurements.

Results:

The experimentally determined wax-to-water correction factor was 0.92. Monte Carlo simulations predicted a correction factor of 0.90 ± 0.02 (k = 1), in agreement within uncertainty. Expanded uncertainties (k = 2) were 8.5% for water measurements, 4.7% for wax measurements, and 8.6% for the correction factor, yielding an overall expanded uncertainty of 9.6% for a corrected plaque measurement. End-to-end verification using an independent plaque demonstrated agreement within these bounds.

Conclusion:

A practical film-based single-point dosimetry method for routine QA of constructed COMS plaques was developed and validated using Monte Carlo simulation and independent TPS comparison. Based on measured uncertainties and reported dosimetric sensitivity to silastic thickness [1], a ±10% acceptance tolerance is recommended prior to clinical use.

References

[1] Oare, Courtney C., et al. ""On the importance of quality assurance (QA) for COMS eye plaque Silastic inserts: A guide to measurement methods, typical variations, and an example of how QA intercepted a manufacturing aberration."" Journal of Applied Clinical Medical Physics 22.8 (2021): 72-82.

A TPS-Independent Framework for Automated Lattice Radiotherapy Planning

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Introduction:

Lattice Radiotherapy (LRT) has emerged as a promising spatially fractionated approach for treating large and radioresistant tumours. However, clinical implementation remains challenging due to the time-consuming and operator-dependent nature of manual lattice sphere placement. Existing automated approaches are often treatment planning system (TPS)-specific or not openly accessible, limiting reproducibility and wider adoption.

Methods:

An automated, TPS-independent software tool was developed to optimise lattice sphere placement using standard DICOM inputs. A three-dimensional Duriseti-based lattice grid is aligned to the gross tumour volume (GTV) and subjected to stochastic optimisation via random Euler rotations and translations. For each configuration, spheres fully contained within the GTV and outside predefined organ-at-risk (OAR) exclusion margins are identified using voxel-based inclusion testing. The configuration maximising sphere inclusion is selected automatically and exported as an RTSTRUCT file containing individually labelled spherical regions. Optional PET-weighted scoring was implemented to prioritise placement within metabolically active tumour subregions.

Results:

The optimisation process typically performs 100,000 iterations in under 30 seconds, with total sphere placement completed in 1–3 minutes depending on tumour size. Testing across a cohort of 14 clinical GTVs demonstrated robust performance for a wide range of tumour sizes, shapes, and anatomical sites. Compared to manual alignment, the automated method consistently increased the number of valid lattice spheres while improving reproducibility. All generated lattice geometries were clinically reviewed and deemed feasible for treatment planning.

Conclusion:

This work presents a fast, reproducible, and TPS-independent solution for automated lattice sphere placement, addressing a key barrier to the routine clinical adoption of LRT.

Clinical Impact

By reducing lattice planning time from manual trial-and-error to a fully automated process requiring only minutes, this method enables more efficient clinical workflows while improving consistency and supporting future biologically guided lattice treatments.

Complex-Valued Magnetic Resonance Dictionary Matching for Simultaneous Estimation of Magnetic Field Perturbations and Transverse Relaxation

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Introduction:

Quantitative susceptibility mapping (QSM) uses the complex MRI signal to estimate tissue magnetic susceptibility [1]. However, its multi-stage pipeline is prone to error propagation. Dictionary matching enables simultaneous estimation of multiple tissue parameters [2]. Here, we use complex-valued dictionary matching (CV-DM) to jointly estimate transverse relaxation rate (R_2^*) and frequency perturbations (Δf) which are required for QSM. The approach was validated using a digital phantom and compared with state-of-the-art methods in vivo.

Methods:

A dictionary of complex MR signals was simulated over R_2^* = 1:1:200 s-1, Δf = -100:1:100 Hz and echo times (TE) matching the acquiring sequence. Voxel-wise pattern matching identified the dictionary entry with the maximum dot product to each measured signal. Validation used a 128×128 digital phantom [3] with added Gaussian noise (SNR = 0:10:100 dB). In vivo data were acquired from a healthy volunteer at 3T (Siemens Prisma) using 3D multi-echo gradient echo (GRE) (1 mm isotropic; 5 echoes; TE1 = ΔTE = 4.92 ms) following consensus guidelines [4]. Tissue was segmented using FSL FAST [5]. CV-DM was compared with ARLO [6] for R_2^* and NLCFF [7] for Δf.

Results:

In the digital phantom (Fig 1), CV-DM showed mean percentage errors (MPE) of 0.05% for R_2^* and 0.01% for Δf at SNR = 30 dB, with reduced accuracy at low SNR. In vivo (Fig 2), CV-DM showed MPE of 0.01% for R_2^* and 1.87% for Δf, in close agreement with reference methods. CV-DM (112 s) achieved a 12% reduction in total computation time compared with ARLO plus NLCFF (127.4 s).

Conclusions:

CV-DM can provide accurate, efficient simultaneous estimation of R_2^* and Δf from complex multi-echo GRE data. CV-DM shows strong agreement with state-of-the-art methods and potential for extension to additional parameters. By simplifying QSM input estimation and reducing error propagation, CV-DM may improve the robustness and efficiency of susceptibility-based biomarkers in clinical neuroimaging.

References:

[1]K. Shmueli, 2020. Quantitative Susceptibility Mapping, pp. 819-838.

[2]D. Ma et al., 2013. Nature, 495(7440), pp. 187-192.

[3]A. K. Jain, 1989. Fundamentals of Digital Image Processing, p. 439.

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[6]M. Pei et al., 2015. Magnetic resonance in medicine, 73(2), pp. 843-850.

[7]T. Liu et al., 2013. Magnetic Resonance in Medicine, 69(2), pp. 467-476.

Clinical Verification of the Dose Delivered in an X-ray Blood Irradiator Using a 3D Printed Phantom

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Introduction:

Transfusion-associated graft-versus-host disease is a fatal disease that can occur due to the proliferation of donor T-lymphocytes in the recipient post blood transfusion. It can be prevented by using ionizing radiation to damage DNA in donor T-lymphocyte cells prior to transfusion. In Ireland, blood is required to be irradiated to a delivered dose of between 25 and 50 Gy. The objective of this study was to establish a method for periodic quality assurance dose validation on the X-BEAM blood irradiator using a 3D printed phantom.

Methods and Materials:

Radiochromic film was investigated for use in the blood irradiator. For blood irradiator testing, a 3D printed phantom was designed for holding dosimeters in the X-BEAM. Various setups were tested using combinations of PLA phantoms and saline bags in the irradiator to determine the most appropriate methodology for future QA.

Results:

The PLA phantom displayed good repeatability; however, 90% PLA material was not water equivalent, thus necessitating the development and application of correction factors. Through testing in the X-BEAM, correction factors were calculated to equate the dose measured using 90% infill PLA phantoms to the dose measured in a water equivalent phantom.

Conclusion:

EBT-XD film can be utilized with a 90% infill PLA 3D printed phantom for periodic dosimetry QA in the X-BEAM blood irradiator; however, a correction factor will be required to give an accurate dose measurement.

Clinical Impact:

Outlines a process by which a clinical blood irradiator could have periodic dose map verification performed by in-house physicists on a more regular basis using a 3D printed phantom."

Timing is everything: investigating the impact of AlignRT beam hold delay on treatment accuracy on Elekta Versa-HD linacs

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Surface Guided Radiotherapy (SGRT) enables non-ionising motion management by tracking a patient surface region of interest (ROI) and automatically holding the treatment beam when real-time deltas exceed predefined tolerances. To reduce false beam interruptions caused by transient signal loss, a beam-hold delay (BHD) can be applied, introducing a temporal buffer before beam interruption. While clinically convenient, BHD may permit continued irradiation after genuine patient motion, introducing potential positional and dosimetric uncertainty. This study investigated the clinical impact of BHD settings during SGRT-guided radiotherapy under simulated respiratory motion.

A two-part phantom study was performed using a dynamic motion platform to simulate sinusoidal and patient-representative respiratory motion. In Part 1, positional deviations were evaluated using an anthropomorphic phantom and EPID imaging during delivery of a 3 × 3 cm² field. BHD settings from 0–5 s were assessed, and displacement beyond SGRT thresholds was quantified using an in-house Winston–Lutz analysis. In Part 2, dosimetric effects were assessed using an SRS MapCHECK detector within a stereotactic phantom under simulated free-breathing motion. Beam hold was triggered by progressively increasing motion amplitude for different BHD settings, and dose differences were calculated relative to a baseline motion condition.

Positional deviation increased with BHD duration. For sinusoidal motion, each additional second of BHD resulted in approximately 0.55 mm displacement beyond SGRT tolerance. Under clinically realistic breathing patterns, a 1 s delay corresponded to displacements of up to 7 mm during exhalation. Dosimetrically, a 1 s BHD produced hotspot and cold-spot deviations of +10.8% and −6.4%, respectively, increasing to +22.2% and −18.8% for a 2 s delay. A 5 mm planning target volume margin encompassed displacement associated with a 1 s delay but was insufficient for longer delays.

Beam-hold delay introduces measurable positional and dosimetric uncertainty that increases with delay duration. A 1 s delay was clinically acceptable for free-breathing treatments, while delays ≥2 s posed significant risk. These findings highlight the importance of optimising BHD settings to maintain treatment accuracy while minimising unnecessary beam interruptions.

The use of plan complexity metrics to evaluate treatment planning templates in Monaco treatment planning system

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Introduction: Radiotherapy treatment plan complexity reflects the degree of modulation required to achieve target coverage while sparing organs at risk. Excessive complexity may compromise plan quality, deliverability and robustness [1]. Although numerous plan complexity metrics (PCM) exist, no standard guides their use [2]. This study investigates how planning templates, optimisation strategies, and sequencing parameters influence plan complexity using PCM.

Methods: Plan complexity was evaluated for two clinical scenarios using the Monaco treatment planning system. Ten prostate volumetric modulated arc therapy (VMAT) plans were generated using a standard institutional template and a multi-criteria optimisation (MCO) template. The effects of VMAT sequencing parameters—fluence smoothing (low, medium, high) and minimum segment width (0.5 cm vs 0.7 cm)—were also assessed. Additionally, 23 stereotactic radiosurgery (SRS) brain cases were analysed, comparing VMAT and dynamic conformal arc therapy (DCAT) for two fractionation schemes (27Gy/3# and 22Gy/1#). All plans were recalculated and analysed using IBA's myQA iON software to derive eight PCM related to field size, leaf motion, gantry rotation, and modulation.

Results: For prostate VMAT plans, MCO templates, increased fluence smoothing, and larger minimum segment widths generally reduced PCM associated with small fields, while leaf-travel-related PCM were largely unchanged. For SRS brain treatments, VMAT plans exhibited higher complexity than DCAT in fractionated regimens, whereas both techniques showed comparable complexity in single-fraction treatments where the lesion sizes were smaller. One extreme outlier was traced to planning and data-handling artefacts rather than true delivery characteristics.

Conclusion: Plan complexity is influenced by template selection, optimisation strategy, and sequencing parameters. Carefully choosing and tuning these factors can reduce unnecessary complexity, ensuring plans remain both clinically efficient and dosimetrically accurate.

Clinical Impact: Applying PCM to guide template and parameter selection can improve treatment deliverability, streamline quality assurance, and enhance overall safety and efficiency in radiotherapy workflows.

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Investigating Peak Skin Dose in Fluoroscopy Guided Neurointerventional Procedures

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Introduction: Estimating skin dose in fluoroscopy guided neurointerventional procedures is challenging due to complex beam geometries, small fields and highly non-uniform dose distributions. Peak skin dose (PSD) is the most reliable metric for identifying patients at risk of radiation induced skin injury from a single procedure. Software based PSD estimates from commercial dose management systems (DMS) depend on local configuration and surrogate dose metrics, making independent validation essential.

Methods: The performance of a commercial DMS in estimating PSD was evaluated using radiochromic film as an independent reference dosimeter. A retrospective cohort of almost 7000 routine neurointerventional procedures was analysed to examine how PSD relates to other available surrogate dose metrics. Film measurements were performed on uniform PMMA phantoms and subsequently on an anthropomorphic phantom simulating two common high dose procedures. Agreement between DMS and film derived PSD was assessed using correlation, concordance and Bland-Altmann analysis, with qualitative comparison of 2D film dose maps and 3D DMS skin dose reconstructions.

Results: PSD demonstrated the strongest association with reference point air kerma, outperforming dose area product and fluoroscopy time. In anthropomorphic phantom measurements, the DMS accurately reproduced the location and shape of high dose regions, and tracked geometry driven changes. The largest discrepancies occurred for small field, high dose exposures. Removal of non-clinical default offsets in the DMS and robust film calibration significantly improved agreement between PSD derived from the DMS and film.

Conclusion: With appropriate site-specific verification, the evaluated DMS provides reliable PSD estimation for routine neurointerventional practice. Film based measurements remain valuable for detailed assessment of high dose, small field cases.

Clinical Impact: This work promotes safer neurointerventional practice by supporting reliable software based identification of patients who may require skin dose follow-ups and by providing a practical approach to local validation and quality assurance of PSD estimation.

Dosimetric analysis of vaginal cap use with the Venezia applicator in an image-guided HDR brachytherapy patient cohort with locally advanced cervical cancer

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Purpose:

To evaluate the dosimetric impact of vaginal cap use with the Venezia applicator in image-guided high-dose-rate (HDR) brachytherapy for locally advanced cervical cancer with upper vaginal extension, and to determine whether cap inclusion improves target coverage without increasing organ-at-risk (OAR) doses.

Methods and Materials:

A retrospective dosimetric analysis was conducted on six patients (FIGO stages IIIA–IIIC2) treated at Cork University Hospital between 2024 and 2025 with HDR brachytherapy (7 Gy × 4 fractions) following external beam radiotherapy (45 Gy / 25 fractions) and concurrent weekly cisplatin. For each patient and fraction, paired plans were generated with and without vaginal caps using the Venezia applicator. Dose–volume parameters were compared for HR-CTV and IR-CTV (D90, D98) and OARs (bladder, rectum, sigmoid, bowel D2cc). EQD2 summations were calculated using GEC-ESTRO methodology (α/β = 10 Gy for tumor, 3 Gy for OARs). Statistical analysis employed paired t-tests and Cohen's d to quantify effect sizes.

Results:

Across 24 paired fractions, caps significantly improved HR-CTV D98 (mean Δ 0.29 Gy; $p = 0.011$; $d = 0.56$) and HR-CTV D90 (mean Δ 0.17 Gy; $p = 0.028$; $d = 0.48$). Larger and more consistent gains were observed for IR-CTV D98 (mean Δ 0.39 Gy; $p = 0.003$; $d = 0.68$) and IR-CTV D90 (mean Δ 0.56 Gy; $p < 0.001$; $d = 0.79$). No statistically significant increases were found in OAR D2cc values for bladder, rectum, sigmoid, or bowel. When accumulated over four fractions, these per-fraction gains translate into clinically meaningful EQD2 increases to target volumes without compromising OAR constraints.

Conclusions:

Incorporating vaginal caps with the Venezia applicator yields measurable improvements in target coverage, particularly within the IR-CTV, without significant increases in OAR doses. Based on these findings, routine use of caps during the first brachytherapy fraction is recommended for patients with locally advanced cervical cancer, with subsequent fractions individualized following MRI review and multidisciplinary assessment. These results support the clinical integration of vaginal caps as a simple, low-risk technique to enhance vaginal dose conformity in anatomically complex cases.

Section 2- Diagnostic Parallel SessionAbstracts

CT-DImQ_SSIM: An open-access platform for Structural Similarity Index Measure (SSIM) evaluation in CT - Application to anthropomorphic phantoms and AI vs iterative reconstruction

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Intro/Purpose:To present an open-access CT image quality evaluation tool for comparison of reconstruction algorithms through histogram and structural similarity index (SSIM) analyses.

Methods:CT-DImQ-SSIM is a Python-based GUI (PySide6, scikit) that enables comparison of CT images to characterize the effect of acquisition/reconstruction settings in image quality. Histogram and SSIM calculations (Wang2004) are performed between a reference/base image and images obtained with other settings, with user-selected volumes of interest (VOIs). Differences in histogram distributions are locally identified and characterised with SSIM maps. As a proof of the tool performance, phantom images (Kyoto Kagaku paediatric chest with 3D-printed nodules) were evaluated (GE-Revolution, standard-thorax, reference: clinical iterative reconstruction (IR), ASIR50-lung compared to Deep-Learning reconstruction (DLR), TrueFidelityHigh), with VOIs at nodules, vessels, vertebra and heart.

Results:Histograms showed a narrower distribution in DLR images in all VOIs, with a more skewed distribution in high-contrast transition regions (nodules, vessels) compared to homogeneous areas. The former showed low SSIM values at their edges, consistent with differences in CT-value histograms (mean/skewness, nodule={IR:-150HU/0.4, DLR:-190HU/-1.3}, vessel={IR:4HU/0.01, DLR:-180HU/-1.1}) and observed visual DLR edges suppression compared to IR. In homogeneous areas (vertebra, heart), CT-values show symmetric peaks for both reconstructions, with a narrower spread with DLR (FWHM, heart={IR:125HU, DLR:25HU}, vertebra={IR:190HU, DLR:50HU}). Local SSIM maps show a scattered distribution of similarity values with no discernible spatial pattern, consistent with overall smoothing in uniform regions by DLR. Overall, high similarity between reconstructions was observed (80% pixels, 0.8<SSIM<1), which aligns with global anatomical structure preservation by DLR.

Conclusion:CT-DImQ-SSIM is an open-access tool for CT protocols and reconstruction algorithms comparison. Histogram analysis characterises the overall distribution of CT-values, while SSIM maps indicate areas in the image where discrepancies may be present.

Clinical impact: This open-access tool has potential application to identify DLR hallucinations or significant changes in CT-values in phantom and patient images.

Global Mammography QC Initiative: Findings from an IAEA Coordinated Research Project incorporating Irish Data

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Ireland plays a key role in the mammography component of an IAEA research project titled ""Advanced Tools for Quality and Dosimetry of Digital Imaging in Radiology"", initiated to address the need for regular quality control (QC) testing. As part of the coordinated research project (CRP), the Irish breast screening program implemented the IAEA remote and automated mammography QC method across eight mammography systems. The CRPs main goal was to apply and evaluate this methodology while correlating image quality (IQ) metrics with equipment performance across various clinical settings globally.

In mammography, maintaining a high level of IQ is essential, as it directly impacts sensitivity and specificity, it is crucial to ensure accurate diagnoses, which subsequently supports optimal patient management. Participating institutions utilized the IAEA QC tool (Automated Tool for Image Analysis (ATIA)) to capture IQ and dose metrics, facilitating comparable evaluations across diverse healthcare settings.

Collaboration within the CRP resulted in various sub-studies. One particularly focused on the operational characteristics of different automatic exposure control (AEC) systems and their impact on IQ evaluation using the IAEA phantom. This led to a sub-study where a modified phantom design was evaluated on 28 systems across 13 countries.

Our team contributed significantly to data collection and analysis. A comprehensive dataset from April 2022 to December 2024 was compiled, involving 15 countries and 43 institutions, and included 67 mammography systems which generated nearly 3,500 initial data points. After extensive data cleaning, 30% of these points were eliminated before further analysis.

Current findings indicate that the tool is effective for constancy testing when protocols are followed. However, limitations for cross-facility comparisons stem from variations in system designs, protocols, and phantom configurations, making universal IQ reference levels challenging. Recommendations include modified phantom design, manufacturer/model-specific ranges, clearer AEC guidelines, access to raw images, and strict adherence to phantom specifications.

Digital phantom assessment of MRI quantitative susceptibility mapping (QSM) reconstruction pipeline

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Introduction: QSM is an emerging quantitative MRI technique that maps the spatial distribution of magnetic susceptibility with promising applications in neuroimaging[1]. However, clinical translation of QSM faces the challenge that no standard image reconstruction pipeline is established. Reconstruction of QSM images generally involves three steps 1) Echo combination and phase unwrapping[2–4] 2) Background field removal (BFR)[5,6] and 3) Dipole inversion[7–9]. Various algorithms are available for each step and the choice of algorithms can yield different results[10]. Digital phantoms have recently been developed to offer tools to compare reconstruction algorithms[11]. This work aims to compare different reconstruction algorithms at each step using a digital QSM phantom.

Method: A digital head phantom was used to simulate a multi-echo gradient-echo acquisition (B0=1.5T, TR=50ms, TE1/dTE=5ms/10ms, FA=23°, resolution=1.3x1.3x1.3mm) Using different combinations of algorithms at each step a total of 30 susceptibility maps were reconstructed in MATLAB[12]. Accuracy of reconstructed maps was determined by calculating the whole brain root mean square error (RMSE) to ground truth maps. Additionally XSIM was used to assess final image quality[13].

Results: Optimum performance at each step was based on lowest whole-brain RMSE and highest whole-brain XSIM compared to simulated ground truth. For the phase processing step the lowest measured RMSE was 10.1[3]. For the BFR step the lowest RMSE was 63.5[5]. For the dipole inversion step the lowest RMSE was 81.5 and highest XSIM was 0.38[8].

Conclusion: This work demonstrates how a digital phantom can be used to assess QSM reconstruction methods. However further work is required to assess region specific metrics and corroborate the algorithm performance in physical phantoms.

Clinical Impact: This work highlights the important role digital phantoms play in optimising advanced MRI techniques for clinical implementation.

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First experiences of a PET Radiopharmaceutical Dispenser: Lessons learned in Radiation Safety, QA, and Workflow.

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Introduction

Manual handling of high-energy PET radiotracers (F-18/Ga-68) has potential to expose staff to significant extremity doses, with standard proximal-phalanx monitoring underestimating fingertip exposure. Automated dispensing/injection systems offer a major shift in PET-CT workflow and radiation safety, yet published guidance on testing and ongoing medical physics support remains limited.

This work describes the implementation of the Lemer-Pax Posijet within a PET-CT department, focusing on three areas: radiation protection, QA development, and clinical workflow impact.

Methods

The Posijet was procured via a national tender process following a structured evaluation of its safety, usability, and infrastructure compatibility. A comprehensive QA programme was developed, from acceptance and commissioning tests against manufacturer specifications and available standards, to routine QA procedures. Revised Radiation Safety Procedures, Risk Assessments, and targeted staff training supported transition into clinical use.

Results

A nine-month review (April–December 2025) covering ~700 patients demonstrated reliable system performance with minimal downtime. The Posijet achieved a mean injected-to-prescribed activity accuracy of –1.4% (SD ±2.8%). Outliers, device limitations, and operational incidents, e.g. two extravasations, were analysed and addressed, refining processes.

Ongoing staff dose monitoring indicates an approximate 50% reduction in staff extremity exposure post deployment, confirming safety benefits, although it is noted that potential for dose reduction is site specific and dependent on service scope/activities. Staff feedback was strongly positive, citing improved workflow and reduced handling risks.

Conclusions

The introduction of the Posijet, supported by a robust QA framework, delivered tangible improvements in clinical workflow and radiation safety while presenting unique implementation challenges. Lessons learned will provide a practical roadmap for centres considering similar upgrades.

Clinical Impact

Automated dispensing and injecting reduces occupational radiation exposure and optimises workflow while supporting safe, efficient delivery of PET imaging services without compromising patient care.

An Image Quality Assessment of Contrast Agents used for Hysterosalpingograms

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Introduction

The Hysterosalpingogram (HSG) is a fluoroscopy guided procedure where fallopian tube patency and the endometrial structure are evaluated in the context of infertility. A radio-opaque contrast agent is injected into the uterine cavity. Several studies report that Oil-Soluble Contrast Agents (OSCAs) produce superior image quality compared with commonly used Water-Soluble Contrast Agents (WSCAs) in HSG examinations [1–3]. These improvements are often attributed to the physical characteristics of oil-based media but do not evaluate whether differences in image quality may simply reflect differences in iodine concentration. The aim of this phantom study was to determine if there is a statistically significant difference in image quality (Contrast-to-Noise Ratio) between three contrast agents; Omnipaque™ (water-soluble), Visipaque™ (water-soluble) and Lipiodol® (oil-soluble).

Methods

Fluoroscopy of contrast-filled tubes (0.8 mm internal diameter), positioned on a 20cm PMMA stack, was performed using a Siemens Luminos Agile Max system with a clinical HSG protocol. Images acquired across multiple dose modes and tube orientations were analysed in Python to calculate contrast-to-noise ratio (CNR) for each contrast agent. Differences between contrast agents were assessed using three-way ANOVA.

Results

Statistically significant differences in CNR were found between contrast agents, dose modes and tube orientation ($p<0.05$). Across all conditions, Lipiodol® consistently produced the highest CNR. Three-way ANOVA testing showed contrast agent choice had the largest effect on CNR ($p < 0.001$), with significant interactions between agent, dose, and orientation. Tukey analysis confirmed significant differences between all agents. CNR differences closely matched iodine concentration differences, with strong correlations observed across frames, dose modes, and orientations.

Conclusion

These findings demonstrate that iodine concentration is the dominant factor for CNR given this fluoroscopic system and experimental setup. For clinical practice, this suggests that contrast agent selection, and the associated iodine concentration, has the most significant impact on image quality.

Clinical Impact

Several sites currently perform HSGs using water-soluble contrast media. The findings of this study suggest that oil-soluble contrast medium evaluated here provide improved image quality under equivalent conditions. There is the potential to reduce radiation dose while maintaining image quality. Based on the results of this study another radiology department is planning to undertake a trial of Lipiodol® in clinical practice.

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Investigation of the Feasibility of 3D-Printed Phantoms for the Analysis of Dopamine Transport Scans in the diagnosis of Parkinsons and Related Disorders

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Introduction

Quality Assurance (QA) is a fundamental component of clinical medical physics, ensuring accuracy, consistency, and reliability in medical imaging. QA commonly relies on phantoms, objects that simulate patient anatomy for system testing and calibration. However, commercially available phantoms are often expensive and lack anatomical specificity. This can limit their suitability for condition-specific imaging such as Dopamine Transport scans (DaTscans) used in the differential diagnosis of Parkinson's disease. This study investigates the development and evaluation of a low-cost, anatomically accurate, 3D printed basal ganglia phantom for use in Nuclear Medicine QA.

Method

Anonymised patient imaging data was manually segmented using free visualisation software. Both data selection and segmentation were validated by a Consultant Radiologist specialising in Nuclear Medicine to ensure clinical accuracy. The resulting three-dimensional model was manufactured using two 3D printing techniques: Fused Deposition Modeling (FDM) and Stereolithography (SLA). To address the inherent porosity of FDM prints, two surface coating techniques, polyurethane clear coat and rubber-based waterproof sealant, were tested. Ballistic gel was used as a surrounding medium to simulate soft-tissue attenuation and was housed within a 3D printed hollow head.

Results

FDM models demonstrated poor performance, with inconsistent coating results, limited visibility during filling, and a high risk of leakage. Consequently, these models were deemed unsuitable for imaging. In contrast, SLA printing provided inherent water tightness and transparency. The SLA phantom was successfully imaged using standard clinical PET-CT and SPECT-CT protocols under the supervision of Radiographers. SPECT- CT data was analysed using GE Healthcare's DAT Quant software.

Conclusion

Imaging results demonstrated accurate anatomical representation and expected tracer distribution. Volumetric comparison between CT reconstructions and the original MRI segmentation showed minimal loss. Acceptance within dedicated clinical software and successful region-of-interest placement confirmed clinical compatibility. Overall, this study establishes a scalable, low-cost workflow for anatomically accurate phantom development.

Theoretical and experimental characterisation of thermal changes induced by High Intensity Focused Ultrasound (HIFU) fields

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Introduction: High-Intensity Focused Ultrasound (HIFU) therapy uses focused ultrasound to produce thermal and mechanical therapeutic effects in targeted tissues. Clinical applications of HIFU are rapidly advancing including tumour ablation and drug delivery [1-4]. From a dosimetry and quality assurance perspective, it is essential that the acoustic and thermal properties of produced HIFU fields are well characterised [5]. Here, an experimental HIFU apparatus has been constructed. The resultant acoustic field has been modelled with open-source numerical simulation tools and compared with experimental measurements.

Methods: A comparative study of four different MATLAB© toolboxes [6-9] was first conducted to establish the most accurate model for simulating the HIFU beam characteristics. k-Wave was selected as the preferred tool for comparison with experimental results. Then, a testbed HIFU apparatus consisting of a Sonic Concepts® H-151 transducer (φ64 mm, 100 mm curvature radius, 1.1 MHz) powered by a signal generator (Keysight Technologies 33511B) and a power amplifier (75A 100B, AR Ltd.) was built. A wire thermocouple (RS Pro RS51) and IR camera (FLIR i7) were used to measure the temperature at the focus for 50 cycle bursts of up to 33 Vpp sine signals. The experiments were conducted in both distilled water and on an acoustic absorber target (Precision Acoustics, UK, Aptflex F28P) which was acoustically characterised using a scanning acoustic microscope system.

Results: Using k-Wave, the focal point temperature profiles produced by the transducer in both water and the acoustic absorber target were simulated for a range of acoustic pressures and exposure times. The simulations were then compared to experimental data acquired for the 1.1 MHz transducer. The experimental temperature increases in water (up to 1°C) correspond to simulated acoustic pressures in the range of 0.5-5 MPa at the focal region.

Conclusions: An experimental apparatus for generation of 1.1 MHz HIFU fields was constructed. The thermal profile of the focal region was experimentally characterised and used to validate k-Wave simulations to yield estimates of the acoustic pressure. Future work will involve direct characterization of the HIFU field acoustic parameters using hydrophone measurements.

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Acknowledgements : This project has received funding from the European Union's Horizon Europe Excellent Science programme under the Marie Skłodowska-Curie Actions Grant Agreement [Grant Agreement No 101126640] and in part from CÚRAM, Science Foundation Ireland Research Centre for Medical Devices [under Grant Reference 13/RC/2073_P2]. Funding for equipment was awarded by the 2024 TU Dublin HEA Supported Research Equipment Grant Programme.

Section 3- Radiotherapy Parallel Session Abstracts

Influence of dose-per-pulse and pulse repetition frequency on in vitro cell survival under conventional and ultra-high (FLASH) dose rates

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Introduction:

Temporal dose delivery parameters have attracted renewed interest given the popularity of hypofractionation and ultra-high dose-rate (UHDR) investigations. The biological significance of dose-per-pulse (DPP) and pulse repetition frequency (PRF) requires further in vitro characterisation. This study examines how varying DPP and PRF in conventional photon, electron, and UHDR electron beams affect in vitro survival of A549 lung cancer cells. It also establishes a reproducible experimental framework for further radiobiological research at our centre.

Methods:

A549 cells were irradiated at conventional dose rates (CDRs) using a 6 MV photon beam (Elekta Synergy) and at both CDR and UHDR using 10 MeV electrons (modified Elekta Precise). DPP was varied via source-to-surface distance; PRF was modified through nominal dose rate settings. Dosimetry utilized film and ionisation chambers (CDR) or film and an RP-FLASH scintillator (UHDR), verified in silico using a validated TOPAS Monte-Carlo (MC) model. Post-irradiation, colony-forming assays determined surviving fractions normalized to untreated controls.

Results:

At CDRs, DPP ranged from 0.05-0.51 mGy (photons) and 0.22-1.56 mGy (electrons), with PRFs of 50-400 Hz and 22-172 Hz, respectively. Mean dose rates (MDR) spanned 1.06-20.25 cGy/s (photons) and 3.74-26.79 cGy/s (electrons). MC results agreed within 3%, validating dosimetric accuracy. CDR cell survival exhibited dose dependency but no statistically significant variation across tested DPP, PRF, or MDR ranges for equivalent doses. At UHDR, DPPs up to 100 cGy were achieved (MDRs up to 180 Gy/s, PRFs 22-172Hz). Preliminary UHDR results indicated similar dose dependency without significant impact from DPP or PRF.

Conclusion:

Within the tested CDR range, A549 survival was unaffected by DPP or PRF variations, indicating limited biological relevance of temporal variations in clinical beams. Preliminary UHDR findings indicate similar results. The established framework supports multidisciplinary studies using our on-site radiobiology laboratory and UHDR-enabled linac. Future studies will include functional analysis extending across multiple cell lines and co-culture systems.

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Assessing the vendor provided field passing criteria for the IQM fluence detector for VMAT PSQA.

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Introduction:

The Integral Quality Monitor (IQM) is a single large area ionisation chamber that is mounted to the linac. It performs real-time verification of the treatment field fluence by comparing a calculated and measured fluence signal.[1] To implement the IQM as our clinic's primary PSQA device, this work aims to assess the detectors field passing criteria. The IQM software determines the measured signal deviations from calculation on a segment-by-segment (SbS) and cumulative basis during field delivery. These deviations are assessed against statistically determined Watch and Action tolerances.[2] The field passing criteria requires all the following metrics to pass their (respective criteria):

- Final cumulative deviation (±3%)
- Cumulative Watch Segment-weighted pass rate (SPR) (>95%)
- Cumulative Action SPR (>95%)
- SbS Watch SPR (SbSWSPR) (>95%)

Method: A 2D-array is the established PSQA device in our clinic (γ-criteria: 3%/2mm; >90%). To assess the IQM passing criteria specificity, 273 clinical VMAT fields were measured simultaneously by the IQM and 2D-array. To assess sensitivity, MLC bank opening errors were introduced into a sample of fields from 3 sites, and measured with both devices.

Results: Of 273 VMAT fields, 3 did not pass the IQM criteria, failing on the Cumulative Watch SPR metric only. All error fields except Prostate 2 (+0.5mm) were detected by the IQM, although this field also passed the 2D-array criteria (99.4%). The SbSWSPR metric detected only 4 of 18 error fields.

Conclusion: Owing to the large uncertainty of the SbS signal[3,4], the SbSWSPR is the least sensitive metric for error detection. Of the 18 error fields 17 were detected with the IQM, along with a 1.1% rate of false positives from the clinical fields. Based on this detection performance, the IQM can be implemented as the primary PSQA device in our clinic. This work has led to significant improvements in our PSQA workflow efficiency.

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Derivation of Prostate PTV Margins Using Image Guidance and Deformable Dose Accumulation

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Introduction

Daily cone-beam computed tomography (CBCT) is performed for all prostate patients. Deformable dose accumulation, recalculated on synthetic adaptive CTs (aCTs) that represent the daily treatment position, can be used to derive appropriate planning target volume (PTV) margins for prostate patients when CBCT guidance is employed.

Methods

A retrospective analysis was performed on 20 prostate and seminal vesicle patients treated with standard fractionation, comprising 594 fractions with daily cone-beam CT (CBCT). Plans were generated with a 0-mm margin and prescribed to deliver 54 Gy to 98% of the clinical target volume (CTV).

Using a semi-automated workflow, plans were imported into Velocity (Varian) to generate synthetic adaptive CTs (aCTs) via deformable registration between the planning CT and daily CBCTs. Dose was recalculated on each aCT and deformably accumulated.

Planning target volume (PTV) margins were derived using mean surface distance and conformity index metrics to quantify under-dosed CTV regions and were validated in an independent cohort of 10 patients.

Results

Derived PTV margins were validated in 10 patients and reduced from 1.0 cm isotropically with 0.5 cm posteriorly to 0.7 cm in the superior, inferior, and anterior directions and 0.5 cm in the posterior, left, and right directions. These reduced margins are expected to decrease dose to organs at risk following the introduction of daily CBCT.

Conclusions

Deformable dose accumulation on daily CBCT-based synthetic adaptive CTs allows derivation of reduced PTV margins for prostate radiotherapy. These margins are expected to reduce dose to organs at risk while maintaining target coverage. This approach is transferable to other treatment sites with daily CBCT.

A Phantom-Based Feasibility Study on the Use of Quantitative Surface Topography Metrics to Optimise SGRT ROI Selection.

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Purpose/Objective

Surface Guided Radiotherapy (SGRT) tracking relies on the definition of Regions of Interest (ROIs), yet ROI selection is typically subjective and may contribute to variability in tracking performance. Geography-derived topographic metrics (slope, aspect, Vector Ruggedness Measure (VRM), Terrain Ruggedness Index (TRI), and Topographic Position Index (TPI)) have been proposed as quantitative tools for characterising ROI surface features(1). This work presents initial phantom-based findings on whether ROIs with greater topographic complexity provide more stable and accurate tracking in a controlled setting.

Materials/Methods

An AlignRT breast phantom was used and two distinct ROIs were drawn: a ""high-complexity"" breast and a ""low-complexity"" flat ROI. A custom Python application analysed the phantom's surface mesh to calculate topographic metrics. Tracking performance was assessed using stationary tracking stability and motion tracking accuracy. Stationary stability was evaluated with the static phantom by calculating the mean and standard deviation of the Real-Time Delta (RTD) magnitude, representing ROI "flicker".The phantom was then placed on a motion platform with 7 mm sinusoidal vertical displacement to quantify the motion tracking accuracy.

Results

Topographic profiling clearly distinguished the different ROIs. The breast ROI demonstrated a higher variability in slope and aspect, alongside higher TRI (0.6±0.2 vs 0.3±0.1), and TPI (6.2±3.5, vs 0.1±1) values. These topographic metrics translated directly to improved tracking performance, with the breast ROI having greater stationary tracking stability (RTD 0.8±0.1 vs 2.4±1.2 mm) and higher motion accuracy (7.2±0.1 vs 9.7±0.9 mm) for the 7 mm target.

Conclusion

Initial findings indicate that surface topographic complexity is an important factor in SGRT tracking reliability. Quantitative metrics provide an objective, data-driven framework for ROI selection. Implementing these tools into clinical workflows may standardise practices and improve the overall consistency of SGRT delivery.

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Pulmonary vein–sparing radiotherapy in locally advanced non-small cell lung cancer: a feasibility study

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Introduction: Cardiotoxicity following thoracic radiotherapy for non–small cell lung cancer (NSCLC), including the risk of atrial fibrillation, is associated with the incidental dose to the pulmonary veins (PVs). This study aims to assess the feasibility of PV sparing in locally advanced (LA) NSCLC and to evaluate how PV dosimetry can be efficiently integrated into clinical practice.

Methods: Twenty-five patients with LA-NSCLC treated with conventional radiotherapy were selected based on PVs maximum dose (PVsDmax). All cases were planned in Eclipse for 55Gy in 20 fractions. Plans primarily used two half-arcs (0–180°), with additional arcs as required.

An initial plan prioritised PTV coverage and standard OAR constraints. A second plan incorporated PV-sparing objective. Overlap volume histograms between the PTV+2cm margin and PVs (OVHP2) were extracted. Plans were categorized into three OVHP2 regions (0–5%, 5–50%, >50%) and four dose regions (0–6Gy, 6–35Gy, 35–55Gy, >55Gy). Dosimetric differences between plans were analyzed using the Wilcoxon signed-rank test ($p<0.05$).

Results: Statistically significant differences were only observed in the 5–50% OVHP2 group ($p<0.05$), with a median PVsDmax reduction (7.71Gy±6.54). Dmax initially exceeded the threshold (35Gy) in 2/6 patients in the 0–5% group and 8/16 in the 5–50% group. All but one patient in the 5–50% group reduced below threshold, while no improvement in the >50% group.

When categorised by dose, the greatest reduction (9.60Gy±4.73, $p=0.002$) was observed in patients with an initial PVsDmax of 35–55Gy. A significant reduction (3.22Gy±2.20, $p=0.031$) was observed for the 6–35Gy group although no improvement was observed in the other categories.

Conclusion: These findings represent the first feasibility data for PV-sparing radiotherapy treatment planning in LA-NSCLC. Geometric and dosimetric features associated with feasibility are presented, providing a basis for patient selection, to minimise impact on planning resource and workflows.

Acknowledgements: This research was supported by funding from Friends of the Cancer Centre (FG) and the Prostate Centre of Excellence (CMcG).

National Intercomparison of Re-irradiation (reRT) Techniques

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Introduction: Re-irradiation (reRT) presents unique challenges in radiotherapy due to the complexity of accurately assessing cumulative doses to organs at risk (OARs). As patients undergo multiple treatment courses, understanding variability in dose accumulation methodologies across institutions has become essential. This national project aimed to evaluate current re-irradiation dose accumulation practices in Ireland and to quantify inter-centre variations in reported OAR doses.

Methods: Two anonymised lung cancer patient datasets, each comprising two treatment courses, were distributed to ten radiotherapy centres nationwide. Participating centres were asked to perform image registration, biological dose conversion, and dose accumulation according to their local clinical protocols. Each centre reported the cumulative dose to selected OARs, specifying the registration technique, α/β ratios, and dose summation method used. The compiled results were analysed to assess inter-centre variability and identify methodological differences.

Results: Variation was observed in reported cumulative doses, particularly for structures affected by anatomical distortion such as the airway (55.3-104.1 Gy), where EQD2 values ranged widely between centres. Smaller and more geometrically stable organs, such as the oesophagus and brachial plexus, showed improved agreement. The majority of centres (90%, n=10) employed rigid image registration (RIR), while a smaller subset used deformable registration (DIR) or hybrid approaches. Differences were also noted in the use of EQD2 versus BED, α/β ratio selection, and the application of planning risk volumes (PRVs). Two centres incorporated tissue recovery factor (TRF) when performing dose accumulation calculations. Despite these differences, most reported doses remained within clinically acceptable limits.

Conclusion: This study demonstrates variability in re-irradiation dose accumulation practices across Irish radiotherapy centres, influenced by registration and dose summation techniques. The results underscore the need for national benchmarking and standardisation of reRT dose accumulation protocols. Establishing such guidelines would enhance consistency, support training and implementation of new software, and improve clinical decision-making and patient safety in re-irradiation planning.

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Advancing Pancreas SABR: Dosimetric and Efficiency Comparison of RapidArc Dynamic vs Standard VMAT

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Introduction

RapidArc Dynamic (RAD) enables dynamic collimator rotation with integrated static angle modulated ports within VMAT. This study compares RAD with conventional VMAT for pancreatic SABR with a 36 Gy in 5 fractions SIB, focusing on plan quality, optimization efficiency, and delivery time.

Methods

Pancreatic SABR VMAT plans were created using a standard objective template for PTV25Gy, PTV33Gy, and PTV36Gy on ten prior patient CT datasets. VMAT objectives were applied to RAD plans, with RAD-specific parameters systematically tested.

Two techniques were compared: RAD1, a single arc with one STAMP at 220°; and RAD2, two arcs with five STAMPs (125°, 135°, 210°, 225°, 235°).

Optimization time, number of optimizations, delivery time, and plan quality were compared, with blinded physician review of RAD and VMAT plans.

Results

The optimal RAD plan for all 10 patients was the RAD1 technique plan for dosimetry, optimization time and delivery time. The median time to optimize are 364s for VMAT, 139s for RAD2 and 78s for RAD1 respectively. Median beam on time for the VMAT plans is 172s. This is reduced to 72s for the RAD1 technique.

The median % difference in PTV coverage between RAD1 and VMAT for PTV25Gy D99.9(Gy) is 5.4%, PTV33Gy D99.9(Gy) is 0.4%, PTV36Gy D99.9(Gy) is 0.7% and PTV Dmax (Gy) is -1.1%. The critical organs of interest are Duodenum, Small Bowel and Stomach. The dose guidance for these structures is V20Gy < 20cc. This was achieved using both planning strategies for all plans.

The Radiation Oncologist preferred 7 RAD1, 2 VMAT and had no preferred technique for 1 dataset during the blinded assessment.

Conclusions

RAD with 1 Arc, 1 STAMP offers faster optimization and treatment times while maintaining or improving plan quality compared to VMAT. The use of RAD could potentially lead to dose escalation up to 50Gy for Pancreas SABR.

Section 4- Joint Session Abstracts

Mind the (Knowledge) Gap: What Can 500+ Responses Teach Us About AI Readiness in Radiation Oncology?

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Purpose:

The integration of AI within radiotherapy is shifting our workforce from manual creators to supervisory validators. But can we safely supervise what we do not fully understand? This study utilises a consensus-built, psychometrically validated instrument to answer critical questions regarding workforce readiness: Is the clinical team prepared to oversee ""black box"" algorithms? Does clinical experience equate to AI competence? And what is the most effective mechanism to up-skill our departments?

Methods:

An international multidisciplinary panel developed a 22-item question bank targeting AI training concepts, terminology, governance and failure modes. Following a three-round consensus process, the validated instrument was deployed globally. We analyzed 528 responses (including 306 Medical Physicists) to benchmark performance against role, training background, perceived knowledge, and career stage using non-parametric tests and Bayesian analysis.

Results:

The instrument showed excellent internal consistency ($\alpha = 0.9$) and good/very good item discrimination (Mean: 0.6±0.15, range=0.30–0.79). Medical Physicists are currently the undisputed ""AI guardians,"" achieving the highest median scores (72.7%) compared to Radiation Oncologists (54.5%) and RTTs (40.9%) (All $p<0.0$, Bayesian significant). However, the data revealed some interesting educational insights: The ""Inversion of Expertise"": Career stage showed zero correlation with knowledge. Senior staff scored no better than junior staff, effectively breaking the traditional ""apprenticeship"" model where seniors teach juniors. Agility Wins: Respondents attending short-form workshops performed comparably to those with formal degrees ($p=0.95$). Additionally, self-perception data uncovered a ""hidden talent"" of staff with low confidence/comfort who achieved high objective scores-suggesting confidence may hinder engagement.

Conclusion

While the physics workforce is adapting well, the significant ""enablement gap"" in the broader clinical team poses a safety risk for human-in-the-loop oversight. The lack of seniority advantage indicates we must pivot to ""shared learning"" environments where seniors and juniors learn together. For the physics community, the data provides a clear mandate: we must lead not just in commissioning algorithms, but in deploying agile, targeted workshops to ensure our clinical colleagues possess the literacy required to safely audit them.

A New Deal for Task-Based Performance Assessment in CT

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Introduction:

Iterative reconstruction (IR) and Artificial Intelligence (AI) based reconstruction are becoming increasingly commonplace in Computed Tomography (CT). These non-linear methods for image formation render traditional measures of image quality inadequate for accurate assessment of performance. TG2331 outlines a series of recommended tests to measure "task-based" performance of modern CT systems. While many of these tests can be performed on commonly available equipment (e.g. Catphan 600/700), some tests require new, expensive test objects to carry out; greatly impeding adoption. To remedy this and improve accessibility, two new, cost-effective 3D printed phantoms were developed along with a suite of analysis software available on a web-app.

Methods:

A 3D-printed phantom was developed for carrying out measurement of the Task Transfer Function (TTFz) in the z-axis and for assessing noise inhomogeneity in irregular structures. The TTFz phantom was printed with PLA of different infill densities creating clean edges at the boundaries to mimic an edge between soft tissues. The second phantom consisted of a cylinder of uniform density embedded with irregular structures of higher density. Software for analysis was written in Python and deployed to a freely accessible online web-app.

Results:

The new phantoms were tested on multiple scanners, with several versions being printed in total. Results were obtained that were in agreement with ImQuest2 and in reasonable agreement with those found in the literature.3 Some systems do not allow for a complete adherence to the recommended setup in TG233 for noise-inhomogeneity testing, requiring some local adaption.

Conclusion:

A low-cost (€4 - €10) phantom was developed as well as necessary software to carry out the tests recommended by TG233. The prints only require a common filament and standard nozzle while the software requires no local installation to use, greatly improving accessibility to this new testing regime.

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The current status and future landscape of Radionuclide Therapies in Ireland

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Introduction

Historically the management of benign and malignant thyroid disorders with 131I was the mainstay of radionuclide therapy (RNT) services in Ireland, however recent years have witnessed significant growth in the number and range of RNTs being performed both nationally and internationally. In the last decade targeted treatments with 223Ra for metastatic bone disease and 90Y for the management of hepatic malignancies have been introduced in Ireland. While more recently 177Lu-based radioligand therapy services (RLT) for the treatment of neuroendocrine tumours and prostate cancer have been established. The provision of each RNT presents it's own requirements and challenges. Differences exist in several aspects of the various RNT services, including administration methods, shielding and radiation protection requirements, imaging and dosimetry requirements and the duration and degree of patient restrictions advised post therapy. The aim of this study was to determine the current status and future plans of RNTs in Irish hospitals.

Method

A comprehensive survey was distributed to all centres performing RNT in Ireland. The survey gathered information on several aspects of RNT services including the annual workload per treatment type, radiation protection methods employed, the patient discharge criteria, patient restrictions post-therapy and pre/post dosimetry performed. Details of staffing levels, responsibilities per discipline / grade, facilities and software available were also obtained.

Results:

Initial results confirm that an increasing number and variety of RNTs are being performed in Ireland, with many centres planning to introduce 177Lu RLT in the next year. Several differences were noted between centres, in particular staffing levels, access to software, advice regarding patient's post-therapy restriction and the dosimetry performed. The findings of this survey suggest harmonization of RNT standards in Ireland should be considered

A Python-based tool for interactive mapping of clinical radiation scatter fields

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Introduction:

Increasing regulatory and educational demands on medical physics and radiation protection services highlight the need for intuitive tools to support optimisation of staff and patient exposure. Existing approaches to mapping scatter fields are often based on manual plotting or generic software that may be ill suited to spatial dose mapping. Python provides a flexible environment for developing interactive applications that can enhance the impact/efficiency of radiation protection activities.

Methods:

A GUI was implemented using PyQt6 to enable loading of images or PDFs, importing measured dose/dose rate matrices, and generating heatmap or contour overlays. Users can crop and rotate images, adjust axis scaling and units, modify colour maps and transparency, and export publication quality figures with configurable resolution and size. The application architecture comprises four main tabs: image handling, intensity data input, blended overlays, and grid overlays for measurement planning. Custom Matplotlib canvases are embedded to preview raw intensity data, display blended scatter maps, and generate grid overlays, with shared state managed via a central controller.

Results:

The tool has been applied to clinical scatter datasets to compare sparse sampling strategies and interpolation schemes for visualising radiation fields. Interpolation using logarithmic, power law, exponential, linear, and inverse square approaches was evaluated against empirically measured values, demonstrating good agreement for appropriately chosen models and highlighting regimes where specific methods under or over estimate scatter.

Conclusion:

The application enables rapid generation of intuitive scatter maps for interventional, CT, and nuclear medicine environments from routinely recorded measurements in spreadsheet format. By lowering the technical barrier to creating high quality visualisations, the tool can support training, protocol optimisation, and local radiation protection decision making.

Clinical impact:

By simplifying the generation and interpretation of scatter maps, this tool can improve communication of radiation risks, support optimisation of staff positioning and shielding strategies, and ultimately contribute to safer clinical practice in radiation environments.

POSTER ABSTRACTS

Section 5- Diagnostics Abstracts

27: Investigation and Characterization of Off-Focus Radiation Peaks from a Digital Breast Tomosynthesis System

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This project investigates and characterizes off-focus radiation in the Hologic 3Dimensions digital breast tomosynthesis system, emphasizing the analysis of normalized scatter signals across various angular ranges and imaging conditions. Off-focus radiation, which can cause blurring and degrade image quality, was analysed under different fields of view, acquisition settings, and target/filter combinations to understand its impact on imaging performance.

Using the RaySafe X2 MAM sensor under standardized conditions, this study examined fields of view of 24 x 29 cm2, 18 x 24 cm2, and 15 x 15 cm2. The research extended to different acquisition planes and target/filter combinations, including W/Rh and W/Ag for 2D mode, and W/Al for 3D mode. Notably, two significant anomalous peaks were consistently detected at approximately 28°±1° and 334°±1° across all configurations, except when using the smallest field of view (15 x 15 cm2) or when the sensor was positioned 30° towards the chest wall side of the breast table, where these peaks were absent. The W/Ag combination consistently produced higher scatter signals compared to W/Rh, while the W/Al combination in dynamic mode did not show distinct peaks, likely due to the cumulative nature of scatter from multiple projections.

These findings align with previous studies by Judge et al. (2013) and Yang et al. (2016), confirming that these anomalous peaks are attributable to off-focus radiation tied to the design of the X-ray tube and collimator assembly. The results emphasize the significance of accounting for off-focus radiation and support the hypothesis that such radiation originates from the Hologic Varex tubes, as documented in multiple studies. However, with regard to dose and spatial distribution, the presence of off-focus radiation is not a concern and does not impact image quality.

28: Radiation protection requirements for ducts and penetrations through shielding barriers

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Ducts and service penetrations passing through X-ray room shielding barriers for ventilation, plumbing and electrical services require additional shielding to ensure the integrity of the barriers are not compromised. The main aim of this research was to determine the minimum level of shielding required for such penetrations to maintain adequate radiation protection. Current practice by some Radiation Protection Advisors is to recommend an arbitrary length of shielding equal to three times the diameter or widest dimension of the penetration, despite limited experimental evidence to support this approach.

Measurements were performed in a fixed fluoroscopy room. Fluoroscopy was selected as it allowed prolonged continuous X-ray exposure, producing predominantly scatter radiation suitable for measurement. The tube was positioned above a Perspex phantom to generate scatter, while a shielding barrier containing a penetration was placed adjacent to the phantom. Various duct configurations were attached to the penetration, and dose rates behind the duct were measured using a survey meter. These were compared with reference measurements taken behind an intact section of the shielding barrier.

Parameters investigated included duct type (plastic or metal; straight or with a 90° bend), lead wrap thickness and width, scatter energy (81 keV and 102 keV), distance from the scatter source and angle of incidence. Results demonstrated that reduced lead wrap lengths can provide equivalent shielding to current recommendations in certain cases. In particular, 90° ducts required substantially less lead wrapping and straight ducts were adequately shielded with a wrap of 2.5 times the diameter in many configurations.

The findings support evidence-based shielding design that maintains radiation safety while reducing unnecessary material use, cost, and construction complexity in diagnostic imaging facilities. Implementing these recommendations during room design could lead to significant resource savings and easier installation without compromising the radiation protection offered to staff, patients and public.

29: Making High-Resolution Tractography for Neurosurgical Guidance Practical with SMS

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Introduction:Tractography is vital for neurosurgical procedures as it maps the brains network [1]. Diffusion Tensor Imaging (DTI) enables Tractography by modelling diffusion-weighted MRI (DW-MRI) images to calculate maps of the brain's network [2]. Surgical planning systems now include advanced models (e.g. constrained spherical deconvolution (CSD) to better resolve the brains network. However, CSD modeling requires higher spatial resolution and more diffusion directions [3], increasing scan times beyond what is clinically feasible. Simultaneous multi-slice (SMS) acquisition offers a promising solution by capturing multiple slices at once and substantially reducing scan duration [4, 5, 6]. This study aims to investigate whether SMS can facilitate high-resolution diffusion imaging with increased angular resolution within a clinically practical scan time.

Methods: DW-MRI scans of an agar phantom were acquired using a 20-channel head coil. Voxel size, slice gap, repetition time, acquisition matrix, and diffusion directions were iteratively optimized to meet CSD requirements. SMS was integrated into the protocol, and its impact on scan time and image quality was evaluated using signal-to-noise ratio (SNR), ghosting ratio (GR), image uniformity, EPI stability, and artifact assessment.

Results: Parameter changes increased scan time from 4:55 min (standard protocol) to 14:10 min while increasing SNR by 30%. Incorporating an SMS factor = 2 halved scan time to 7:05 min, with a further 10% SNR reduction. GR, uniformity, and EPI stability remained within AAPM limits[7], while SMS = 3 produced unacceptable image artifacts.

Conclusion: Parameter changes facilitated high-resolution diffusion imaging with increased angular resolution, while an SMS factor of 2 maintained a clinically practical scan time and image quality for the 20-channel head coil.

Clinical Impact: Integrating SMS into DW-MRI protocols enables clinically practical high-resolution acquisitions for CSD modelling, improving imaging efficiency and detail for neurosurgical planning.

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30: Seeing the Unseen: A Critical Look at Detecting Defective Detector Element in Digital Mammography

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Introduction:

During routine annual quality assurance of a digital mammography system, a subtle image artefact raised concerns regarding a potential defective detector element. This study aimed to critically evaluate the effectiveness of ImageJ based methodologies (for implementing EFOMP and EUREF tests) in identifying defective detector elements that are not apparent on routine clinical images.

Methods :

In order to isolate detector performance from other system components an investigation was conducted using a 4cm PMMA uniformity phantom across five imaging configurations: standard Rh filtration, phantom rotation, removal of compression paddle, Ag filtration, and grid removal. Images were analyzed using ImageJ with the Mammo_QC plugin, applying four testing methodologies: EUREF homogeneity, EFOMP uniformity, artefact evaluation, and uncorrected-defective element. All tests were performed pre and post detector remapping.

Results:

Homogeneity and uniformity tests demonstrated limited sensitivity to detect defective elements across all configurations, both pre and post mapping. However, artefact evaluation and uncorrected-defective element analyses consistently identified regions of interest at similar detector coordinates across multiple configurations. The detected artefact persisted irrespective of phantom orientation, filter selection, or compression paddle use, indicating an intrinsic detector-related issue. Following detector remapping by the vendor, the flagged artefact resolved, confirming the validity of these methodologies. Minor spatial discrepancies between ImageJ derived and vendor identified coordinates were observed, primarily along the x-axis.

Conclusion:

Homogeneity and uniformity tests have limitations for detecting subtle defective detector elements in digital mammography. Artefact evaluation and uncorrected-defective element analysis provide useful additional information and should be incorporated into routine QA protocols to enable early detection and timely corrective action.

Clinical Impact:

Early detection and correction of subtle mammography image defects before they become clinically relevant helps in maintaining image quality, diagnostic standards and patient safety.

31: A 3D printed phantom for measuring geometric accuracy in MRI

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Introduction: Magnetic Resonance Imaging (MRI) is becoming increasingly important for stereotactic neurosurgery and radiotherapy[1]. However, MRI images are inherently prone to geometric distortion which can cause significant deviation from the intended surgical location[2] or dose delivery site[3]. Consequently, monitoring of MRI geometric distortion is recommended[4] but usually performed using phantoms that provide limited information[5] or are prohibitively expensive[6]. In this study we present a cost-effective, 3D printed phantom with an automated analysis pipeline for measuring MRI geometric distortion.

Methods: A custom phantom was fabricated from a 3D printed grid, placed in a plastic container and filled with water. The 3D printed grid contains 364 control-points arranged three dimensionally (dimensions 15cm×15cm×13cm). To measure geometric distortion, MRI images of the phantom were compared to a CT of the phantom. MRI images were acquired at 1.5T using a spoiled gradient-echo with distortion correction filters on and off. MRI and CT images were aligned using rigid body registration. Phantom control-points were automatically identified using normalised cross correlation[7]. Geometric distortion of each MRI control-point was obtained by calculating the Euclidean distance to the same control-point in CT.

Results: MRI geometric distortion measurements showed a trend of increasing distortion with distance from MRI isocentre as expected[8]. Geometric distortion measured in non-distortion corrected MRI were found to have statistically (t-test, $p<0.05$) greater geometric distortion (max=3.4mm) when compared to distortion corrected images (max=1.7mm) as expected[9].

Conclusion: In this study we demonstrate a cost-effective tool for measuring geometric distortion using a 3D printed phantom and automated analysis pipeline. MRI geometric distortions were found to be greater further from iso-centre and without distortion correction filters.

Clinical Impact: This study presents an accessible solution for measuring geometric distortion in MRI and highlights the role of careful patient positioning and distortion correction filters when acquiring MRI for stereotactic planning.

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32: An Audit of Image Rejection in General X-Ray

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Introduction

In diagnostic radiology, X-ray images may need to be repeated, for example, due to patient motion, incorrect positioning etc. This can lead to increases in radiation exposure for patients. Minimising the amount of rejected images follows the ALARA principle - keeping the dose as low as reasonably achievable. Digital X-ray systems record which images are rejected and the reasons for this based on user input. Rejected images may not always be sent to PACS so the system record allows for retrospective analysis.

Methods

A retrospective audit was carried out to assess if the locally established Key Performance Indicator (KPI) of less than 5% rejection was met. Rooms with higher rejection rates were investigated and a plan was set out to reduce future rates. Image data over the study period was collected and analysed. Variables such as: rejection reason, body part examined, associated effective dose, patient cohorts in each room and time of exam were considered.

Results

Rejection rates exceeded the local KPI of <5%, ranging from 6% to 11%. Overall, 94% of the rejected images were due to positioning errors. Rejected images contributed to the overall patient dose highlighting the need to reduce the number of rejections. Root cause analysis was performed to determine key areas for improvement. The cumulative effective dose of rejected images across the study period was approximately 10% of the total effective dose.

Conclusion

Minimising image rejection improves departmental efficiency as well as patient safety and experience. Highlighting the main causes of increased image rejection can lead to a reduction in reject rates in future audits.

Clinical Impact

This project highlights the importance of clinical audit and minimising the number of rejected images.

33: Assessing scatter corrected planar CZT imaging for lung shunt fraction estimation using anthropomorphic and 4D digital phantoms.

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Accurate lung shunt fraction (LSF) estimation is critical for reliable lung and liver dose assessment in Selective Internal Radiation Therapy (SIRT). Scatter contributions that affect LSF accuracy can be mitigated using energy window–based scatter correction, commonly validated through Monte Carlo (MC) simulation. While such approaches have been explored for sodium iodide (NaI(Tl)) gamma cameras, their applicability to modern cadmium zinc telluride (CZT) systems—which offer improved spatial and energy resolution—remains insufficiently characterised. This study evaluates LSF accuracy using CZT imaging and investigates the influence of a simple phantom-based, spectrally optimised scatter correction in the presence of respiratory motion and patient-dependent attenuation.

A GE 870 CZT SPECT system was modelled using SIMIND MC software and validated against experimental technetium-99m phantom measurements. Spectral analysis was performed to identify a CZT-specific scatter energy window. Planar acquisitions of anthropomorphic thorax phantoms with known activity distributions were used to assess LSF estimation. Patient-dependent effects were further investigated using 4D XCAT digital phantoms of varying body mass index (BMI), incorporating respiratory motion.

An optimal phantom-based CZT-specific scatter window of 123–129 keV was identified. In simplified phantom configurations, uncorrected planar LSF measurements showed substantial overestimation due to scatter contamination. Although scatter correction reduced this bias, extension to more anatomically realistic phantoms revealed instances of scatter overcorrection, particularly in higher-BMI models. These findings demonstrate that scatter correction performance is sensitive to heterogeneous attenuation not captured in conventional static phantom studies.

This work highlights the importance of assessing the quantitative accuracy of scatter correction techniques across a range of realistic digital phantoms representative of the clinical cohort prior to clinical implementation. Ongoing work extends these findings to CZT SPECT-based LSF estimation, aiming to improve confidence in pre-SIRT lung dose assessment and support safer, more personalised patient management.

34: An alternative approach to reassurance monitoring of uncategorised staff working in controlled areas

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Radiation risk assessment of C-Arm use in theatre has led to the de-categorisation of over a hundred staff and the withdrawal of their dosimeter badges. The decision to de-categorise was based upon calculated staff dose estimates using theatre DAP workloads and was evidentially supported by years of personnel and environmental monitoring records.

While no legal requirement exists to provide a dosimeter for uncategorised workers, when they enter controlled areas, it should be possible to demonstrate that exposures are ALARA and not exceeding dose limits. An alternative to individual monitoring involves ambient dosimeters attached to the arms of mobile C-Arm units to give an indication of staff exposure levels.

The seven mobile C-Arm X-Ray units in this hospital operate across 10 theatres primarily for orthopaedic, plastic, neurosurgical and urological procedures. Ambient dosimeters were attached to each C-Arm at the 30 □□position from the X-Ray tube. The cumulative dose values obtained from bi-monthly badge readings over a one-year period were used to estimate staff exposure levels.

Depending on the C-Arm workload C-Arm badge readings ranged from only 0.1 mSv up to 17.6 mSv.

It was found the staff doses estimates derived from the C-Arm badges agreed with the calculated staff doses estimates used in the risk assessment. Depending on their role and position, staff exposure estimates ranged from undetected to 0.2 mSv. Annual exposure was lowest in Plastics and Orthopaedics (0.01 – 0.04 mSv) and highest in Urology (0.01 – 0.2 mSv).

It is concluded that annual theatre staff dose estimates based on C-Arm badges readings provide convincing evidence that staff exposure levels in theatre are not breaching public dose limits and that this approach provides a realistic alternative for reassurance monitoring of uncategorised staff.

35: Characterisation of a commercially available tungsten-filled polymer filament for use in Image Quality testing and Radiation safety solutions.

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Tungsten-filled polymer filaments enable the fabrication of radiopaque structures using 3D printing; However, limited data exists describing their imaging behaviour across diagnostic modalities. This work presents an experimental characterisation of a commercially available tungsten-filled Polyethylene Terephthalate Glycol (PET-G) filament using x-ray, CT, MRI and Tc99m measurements.

Test objects, including numeric identifiers, step wedge phantoms, and uniform blocks, were fabricated. CT imaging was performed at 80, 100, and 120 kVp. Hounsfield Unit (HU) response, image noise and beam hardening artefacts were evaluated as a function of material thickness. General x-ray was used to assess contrast and feature visibility across a range of tube potentials. MRI imaging at both 1.5T and 3.0T included gradient-echo and spin-echo sequences to assess susceptibility artefact extent and qualitative safety. Tc99m transmission measurements were performed using narrow-beam geometry to estimate attenuation.

Contrast-to-noise ratios (CNR) were evaluated using three printed step wedge phantoms. Each phantom was imaged under identical conditions for comparison. Findings showed that the CNR values remained relatively consistent across all three phantoms. The Coefficient of Variation (CoV) across the three phantoms was determined to be 3% for all thickness of tungsten. This relatively high level of reproducibility suggests that Tungsten filament could be useful for 3D printed test objects in the future however further work is required. Additional metrics such as Modulation Transfer Function (MFT), Artifact assessment and Contrast Detail Curves were also assessed across multiple modalities. The study also demonstrated that custom lead shielding could also be manufactured using this filament, offering practical and bespoke solutions to improving staff safety.

This study provides a practical multimodality imaging characterisation of a tungsten-filled PET-G material supporting its further evaluation for task-specific radiographic and attenuation applications.

36: A CT Topogram–Based Methodology for Periodic Screening and Transmission Assessment of X-ray Personal Protective Equipment

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Introduction: Lead-composite and lead-free X-ray personal protective equipment (PPE) is essential for occupational radiation protection in interventional and fluoroscopic procedures. Prior to clinical use, acceptance testing of PPE is recommended to verify compliance with specified attenuation values and the absence of defects in the barrier material. Over time, X-ray PPE may degrade due to repeated flexion, mishandling, and improper storage, leading to cracks, thinning, or material failure. This work proposes a time-efficient CT topogram-based methodology for combined structural screening and transmission assessment of X-ray PPE.

Methods: The positioning of PPE and reference panels, along with CT topogram acquisition parameters, were optimised to maximise efficiency and defect detectability while minimising uncertainty in image statistics. A quantitative analysis methodology was developed, using circular regions of interest of approximately 20 mm diameter, sampling PPE items and National Physical Laboratory (NPL)-certified reference lead panels. Mean pixel values (MPVs) and associated standard deviations were recorded. Measured and reference MPVs were considered statistically similar if the difference in their pixel values was less than the weighted combined uncertainty - the quadratic sum of their individual uncertainties scaled by 1.96 for 95% confidence.

Results: Exposure parameters of 140 kVp and 20 mAs, with PPE laid flat at isocentre, yielded optimal image quality with measured noise levels below 2%. CT topograms reliably visualised structural defects and enabled transmission assessment. The methodology demonstrated sufficient accuracy to identify non-compliance with specification for PPE thicknesses in standard clinical use (0.175–0.5 mm Pb equivalence). However, misorientation of bilayer materials could not be reliably distinguished. Total scan and analysis time was approximately 3 minutes per PPE item. Overall, the combined screening and transmission assessment approach demonstrated a rapid, reproducible, and sensitive method for acceptance testing and periodic X-ray PPE quality assessment, while minimising operator dose.

37: SureStart Bolus Tracking: CTPA Optimisation

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Introduction

CT Pulmonary Angiogram (CTPA) is performed on patients with suspected acute pulmonary embolism (PE) (1). Contrast agent is used to detect any blockages within the pulmonary arteries. As CTPA tracks contrast through the vasculature acquisition as the right time is essential (2). SureStart is a bolus-tracking feature that automates scan acquisition by monitoring contrast attenuation within a ROI in real time (3). (4). A HU threshold is selected, and low-dose monitoring scans are acquired every two seconds until the threshold is reached (4). There are multiple factors that can affect the performance of SureStart. The aim of this study is to investigate the factors that influence SureStart and contribute to image quality issues.

Methodology

A review of published literature was conducted and found HU trigger level, contrast volume, ROI placement, exposure parameters, needle gauge size, patient size were factors that influenced SureStart performance. A survey of CTPA examination image quality from four hospitals was conducted in the context of these factors. Comparison of SureStart protocols provided insight into leading factors that contribute to the image quality issues.

Results

Site A was found to use a higher HU trigger level (220 HU) compared with other sites (160-180 HU) and published research. Other sites demonstrated greater protocol flexibility, including manual triggering, increased exposure for large patients, and repeat planning scans when anatomy was unclear.

Conclusion

This study highlights the importance of optimising HU trigger thresholds and protocol flexibility when using SureStart to achieve diagnostic image quality. Findings were shared with Site A, and collaboration with other hospitals was recommended.

Clinical Impact

This project outlines the importance of protocol optimisation. A substantial amount of CTPA scans in Site A were repeated due to poor image quality. By adapting the changes to their protocol, a decrease in repeat scans and patient dose has been seen.

38: Reject Rate Analysis as a Tool to Reduce Patient Doses in General Radiography

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Introduction: The aim of this project was to identify general radiography protocols associated with frequent high-dose alerts and use these protocols in conjunction with reject rate analysis (RRA) to tailor focused staff education sessions. The aim of these sessions was to reduce the percentage of alerts and rejected images in order to keep doses to patients As Low As Reasonably Achievable (ALARA).

Methods: This project analysed data from our GE XR656 X-ray system to identify protocols with particularly high reject rates. Reasons for rejected images were also reviewed for these protocols. Data was also extracted from our dose management software, Dosewatch, to assess which protocols had higher numbers of high dose alerts. Based on these results focused education sessions were held and a target of 5% was established for dose alerts post-intervention.

Results: Initial data analysis indicated highest reject rates and/or alert rates for pelvis (reject rates of 9%), lumbar spine (reject rates of 9%), and hip joint (reject rates of 18%). Dosewatch data showed inconsistent use of Automatic Exposure Controls (AECs) for these protocols. The most frequently selected reasons for rejecting images for all three protocols were found to be 'collimation', 'patient positioning' and 'patient jewelry/clothing'. Education sessions were held in conjunction with clinical specialist radiographers focusing on these three protocols and tailored around patient set-up and AECs. Dose alerts showed a decrease post-intervention for pelvis (3%), lumbar spine (0%) and hip joint (1%) examinations, meeting the target of 5%. However, no changes in reject rates were recorded.

Conclusions: Focused education sessions successfully reduced the number of high-dose alerts seen in our general x-ray department, thereby reducing patient radiation dose. Further work is required to bring the reject rates down.

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39: Use of Tin Filters in CT: Throughput Benefit Versus Cooling Delay

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Background:

Tin (Sn) filtration is increasingly used in dual-source CT systems to reduce patient radiation dose and improve spectral separation. On the SOMATOM Go.Top platform, the use of tin filters may introduce increased tube heat load, potentially affecting system throughput due to extended cooling time delays.

Purpose:

This project evaluates the impact of tin filtration on scanning throughput on the SOMATOM Go.Top CT scanner by comparing throughput metrics with and without tin filters, with particular focus on cooling time delays. The study aims to assess whether the radiation dose and image quality benefits of tin filtration outweigh the associated loss in scan efficiency.

Methods and Materials:

Using a Catphan QA phantom, standardised scan protocols were acquired using equivalent imaging parameters, with and without tin filtration. Scan duration, inter-scan cooling delays, and overall throughput were measured. To assess whether parameter optimisation could reduce tin-related cooling delays, pitch and gantry rotation time were systematically adjusted while maintaining equivalent effective mAs. Cooling delays, scan duration, throughput, dose metrics, and image quality were compared with baseline tin-filtered protocols to evaluate whether throughput improvements could be achieved without compromising radiation efficiency

Results:

The use of tin filters resulted in a measurable increase in tube cooling time, leading to a reduction in overall scan throughput. However, this throughput loss was balanced against the advantages of tin filtration, including improved dose efficiency and enhanced beam hardening control. The magnitude of throughput reduction was protocol-dependent and most pronounced during high-duty cycle examinations.

Conclusion:

While tin filtration on the SOMATOM Go.Top introduces cooling-related throughput limitations, the associated benefits in radiation dose optimisation and spectral performance may justify its use in selected clinical applications. Careful protocol selection is necessary to balance patient safety with operational efficiency.

40: Evaluation of a 360 degree, whole-room, radiation protection device in a cardiac catheterisation lab

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Introduction

Cardiologists are of interest in the monitoring of occupational radiation exposure doses due to their close proximity to the scatter source (the patient) and generally higher workload procedures. This work compares the scatter protection provided by a 360 degree, whole room, radiation protection device with that of standard shielding, namely table lead skirts and ceiling suspended lead screens.

Methods

Raysafe i3 real time dosimetry badges measured dose outside of the lead apron and thyroid shield at collar and hip level, locations representative of eye and body dose, for both primary and secondary operator. Doses were recorded for procedures performed using a Phillips Azurion fixed C-arm. Recorded doses were normalised by DAP to account for case complexity and patient variation.

The i3 dosimeters measure Hp(10), not a direct operational quantity for eye dose, but this was not considered an issue for the purpose of comparing reduction factors rather than absolute dose magnitudes.

Results

The dose distributions for both operators were compared for cases using the shielding device to those using standard shielding only. Greater than 95% reductions in both the average and median DAP-normalised dose were observed at hip level for the primary operator and over 80% for the secondary operator. The collar level reduction was greater than 70% for the secondary operator. The reduction in collar level doses for the primary operator was less significant, approximately 41% and 33% in average and median doses.

Conclusion

The results show the potential occupational dose reductions using the device, but with a strong dependency on the correct use of existing shielding. The potential eye dose reduction is likely more significant, due to body doses being heavily attenuated by a user's lead apron, meaning the high relative reduction at those levels translate to less of an effect in absolute terms.

41: Evaluation of a Local ^{18}F-PSMA-1007 PET/CT Protocol Against EANM Guidelines

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Introduction:

PSMA PET/CT has become standard of care for investigating prostate cancer. EANM has published procedural guidelines to standardise PSMA PET/CT practice around Europe. However, in real-world clinical settings, practical considerations such as available equipment, access to radiopharmaceuticals and institutional workflow often require local adaptation of these guidelines. This study aimed to compare local ^{18}F-PSMA-1007 PET/CT protocol against EANM guidelines, identify deviations, and assess their clinical and dosimetric impact.

Methods:

A retrospective review of 123 ^{18}F-PSMA-1007 PET/CT examinations performed over one year on a digital PET/CT system was conducted. Radiotracer administration was assessed via activity per body weight and deviation from target. Uptake times were analysed, and a bimodal distribution prompted a comparative evaluation of PET image quality between shorter uptake (60–70 minutes) and guideline-recommended uptake (90–100 minutes), using a five-point Likert observer study with three radiology registrars.

Local DRLs were generated and compared against national benchmarks. During the review period, protocol modifications related to patient arm positioning were implemented, enabling assessment of their impact on CT dose metrics.

Results:

Median injected activity was 2.62 MBq/kg, below EANM recommendations, reflecting increased sensitivity of the digital PET/CT system. Deviations of up to 60% from target MBq/kg were observed, highlighting the potential benefit of an auto-injector system. No statistically significant difference in PET image quality was observed between uptake time groups (p=0.686). All examinations were of diagnostic quality. The CT component accounted for a median of 74% of the total effective dose, driven by routine use of diagnostic-quality contrast-enhanced CT and extended scan range. Adjusting patient arm position from up to down reduced the local DRL by 21% and reduced beam hardening artefacts in the thoraz.

Conclusion:

This study demonstrates the value of systematic, data-driven protocol review to balance guideline compliance, image quality, radiation dose, and clinical practicality.

42: Radiation Risk Assessment of Mobile C-Arm Use in Operating Theatres: Implications for Occupational Dose Monitoring

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Introduction:

Mobile C-arm fluoroscopy is routinely used in operating theatres to support a wide range of surgical procedures, resulting in occupational exposure to scatter radiation for clinical staff. Although personal dose monitoring is commonly implemented as a precautionary measure, the actual occupational radiation risk associated with contemporary mobile C-arm practice is not well defined. This study aims to assess occupational radiation exposure during mobile C-arm procedures and to evaluate whether routine personal dose monitoring is justified for operating theatre staff.

Methods:

A comprehensive risk assessment of mobile C-arm usage was conducted over a continuous four-month period in 2025. Retrospective review of theatre records quantified procedural workload using anonymised data, including procedure date, theatre identifier, C-arm system, procedure type, consultant category, and dose–area product (DAP). Annualised DAP values were extrapolated from these data. Worst-case scatter radiation exposure was assessed through in-theatre measurements performed in the smallest operating theatre using clinically representative C-arm angulations, exposure parameters, beam settings, and typical staff positions. Measurement data were combined with workload information to estimate dose per procedure. Occupational doses were calculated for consultants, radiographers, anaesthetic staff, scrub nurses, and circulating nurses, both with and without standard protective equipment, and compared with relevant regulatory classification thresholds.

Results:

Estimated annual and weekly occupational doses for all staff groups were well below Category A and Category B dose limits. Use of standard protective equipment further reduced estimated doses to negligible levels.

Conclusion:

Routine personal dose monitoring for consultants and nursing staff involved in mobile C-arm procedures is not warranted under current practice.

Clinical Impact:

These findings support evidence-based decisions on occupational dose monitoring, reinforce good radiation protection practice, and contribute to optimisation of safety protocols in interventional operating theatre environments.

43: Systematic comparison of foetal radiation risk with selected non-radiation pregnancy risks; risk magnitude, evidence certainty, and communication style

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Introduction: Despite having low absolute risk, foetal exposure to diagnostic imaging during pregnancy may generate disproportionate concern among patients and clinicians. Indeed, clinicians may withhold or delay essential diagnostic imaging from patients due to perceived risks. CT scans with the foetus in the field of view typically deliver foetal doses well below deterministic thresholds and are associated with only small increases in stochastic risk. In contrast, common pregnancy risks such as maternal smoking and obesity are associated with higher and better-established risks to offspring health, including childhood cancer, yet are frequently communicated qualitatively and normalised in clinical practice. Other common exposures encountered in emergency hospital care, including certain medications, are similarly rarely framed using absolute risk estimates.

This study aimed to systematically compare foetal radiation risk estimates from CT with those of selected non-radiation pregnancy risks, examining alignment between risk magnitude, evidence certainty, and communication style.

Methods: Foetal dose estimates from peer-reviewed literature and guidelines were used to estimate absolute childhood cancer risk using conservative linear no-threshold models. Absolute risk estimates for maternal smoking, obesity, diabetes and different medications were obtained from epidemiological studies and meta-analyses. Irish and international guidance documents, decision support tools and patient-facing materials were analysed for risk framing, including quantitative descriptors, precautionary language, and normalisation.

Results and Discussion: This novel study contextualises foetal radiation risk alongside other childhood cancer risks and communication practices. Analysis revealed a systematic mismatch: low-magnitude foetal radiation risks are often communicated with numeric estimates and cautionary language, whereas higher-magnitude non-radiation risks may only be presented qualitatively. This discrepancy may contribute to anxiety and misperception of radiation risk.

Conclusion: Findings underscore the critical role of medical physicists in contextualising risk, supporting evidence-based counselling, and guiding imaging decisions during pregnancy. Integrating quantitative risk estimates into broader pregnancy risk communication may reduce anxiety and improve clinical decision-making.

44: Image quality assessment of clinically-applied CBCT protocols using a QRM Cone Beam phantom

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Introduction: Cone beam CT (CBCT) is implemented across interventional, surgical, and diagnostic systems, with image quality characteristics varying between platforms and clinical protocols. The QRM Cone Beam phantom offers the possibility to assess image quality metrics such as image noise, contrast-to-noise ratio, spatial resolution and geometric accuracy in-plane. The purpose of this study is to perform a cross-platform assessment of CBCT image quality using clinically applied protocols and establish baseline image quality metrics to support quality assurance (QA).

Methods: CBCT acquisitions of the phantom were performed on five X-ray systems providing CBCT functionality: two Siemens Artis Icono systems used for interventional head and abdominal applications, a Siemens Artis Pheno, a Medtronic O-arm, and a Siemens Multitom RAX. All scans were acquired with vendor-default acquisition and reconstruction settings. Image quality assessment was conducted in accordance with EFOMP–ESTRO–IAEA guidelines[1]. Metrics include image uniformity, signal-to-noise ratio (SNR), contrast-to-noise ratio (CNR), spatial resolution, and geometrical accuracy.

Results: Preliminary analysis of two Artis Icono systems demonstrates substantial protocol-dependent variation in image quality. Higher kVp protocols showed improved contrast and structure visualisation, while low-kVp or short-scan protocols exhibited increased noise and reduced low-contrast detectability. The image noise index, quantified within the uniformity module of the phantom, ranged from 23.36 ± 2.97 for a high-kVp protocol (109 kV) to 96.1 ± 11.4 for a low-kVp protocol (70 kV), with corresponding SNR values of 0.65 ± 0.10 and 0.12 ± 0.06. CNR values were 27.55 and 8.08 respectively, highlighting the strong dependence of image quality on protocol selection.

Conclusion: Preliminary findings demonstrate strong protocol dependence of CBCT image quality. These findings are consistent with previously published CBCT image quality studies, which report improved uniformity, reduced noise, and increased SNR with increasing tube voltage[2].

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Section 6- Nuclear Medicine Abstracts

45: Modelling Foetal Thyroid Dose Following I-131 Uptake Procedures Using a Gestation-Dependent Biokinetic Model

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Introduction: Diagnostic I-131 uptake studies are routinely performed prior to radioiodine therapy. In pregnant patients, foetal effective doses are reportedly low due to the low activities (~1 MBq) employed. However, models suggest that foetal thyroid dose levels may approach or exceed the 300 mGy thresholds for physiological effects [1]. Around the onset of foetal thyroid function when there may be uncertainty of pregnancy status, limited modelled estimates exist on the potential foetal thyroid doses. Thus, the objective of this work was to develop a model for estimating early and mid-gestation foetal thyroid doses as a result of I-131 uptake for hyperthyroid patients.

Methods: A gestation-dependent maternal–foetal iodine biokinetic model based on ICRP 88 was implemented in Python to estimate foetal thyroid dose following acute maternal ingestion of I-131 [2]. An extensive compartmental model simulating iodine transport using gestational-age-dependent transfer coefficients was validated against published maternal thyroid doses and foetal % uptake (within <2%) [3,4]. The model was subsequently adjusted to model a hyperthyroid cohort focusing on early pregnancy.

Results: For normal uptake ranges (<30%), estimated foetal thyroid doses per MBq administered were negligible prior to approximately 10–12 weeks' gestation, reflecting the absence of functional foetal thyroid tissue. Following this, foetal thyroid dose increased rapidly, approaching ~300 mGy at 20–21 weeks' gestation (±1 week). Increased hyperthyroid maternal uptake substantially reduced foetal thyroid dose and delayed the gestational age at which this level was approached, to 26–27 weeks for moderate uptake (~55%) and 34–35 weeks for high uptake (~75%) scenarios.

Conclusion: This validated, gestation-dependent model quantifies foetal thyroid dose following diagnostic I-131 uptake and demonstrates how maternal thyroid physiology influences foetal thyroid exposure.

Clinical Impact: The findings support that correct implementation of established pregnancy screening and timing policies should prevent clinically significant foetal thyroid doses in diagnostic I-131 uptake studies.

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46: A Microsoft Power Apps solution for radioactive waste inventory management in nuclear medicine

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Healthcare facilities with nuclear medicine departments must maintain a detailed radioactive waste inventory, ensuring full traceability from entry into the radioactive waste store until decay to safe levels and final disposal. While paper-based logs meet these regulatory requirements, they are slow and cumbersome to search and review, especially during audits and inspections. To address this, a digital system was developed using Microsoft Power Apps to provide structured, searchable records that improve workflow efficiency and long-term traceability.

The mobile application digitises radioactive waste inventory and storage workflows. On entry to the store, each item is assigned a unique QR code, which is scanned to create a record including radionuclide type, initial activity and storage entry date. For subsequent decay checks and disposal, scanning the same code reopens the record, prompting verification that the required decay period has elapsed and confirming that the item has reached background levels. Radiation survey measurements are then recorded before removal from the inventory and waste store. All data are stored in a centralised Microsoft SharePoint list, allowing real-time access for authorised staff and providing a traceable digital audit trail.

The app has been in routine use for four months. Transition from paper logs to the digital app has significantly reduced the time required to enter, retrieve and verify waste records, while improving consistency and standardisation in record keeping. Staff report that the system is intuitive and supports timely clearance of waste once it has decayed to safe levels for disposal. This locally developed solution demonstrates that low-code tools can deliver an efficient radioactive waste inventory system within existing hospital infrastructure and with no additional software cost.

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[2] Environmental Protection Agency. Guidance for undertakings on the application of the Ionising Radiation Regulations (IRR19). EPA, 2022.

47: From Capsule to Clearance: An Animation for Improving Radiation Safety Communication in I-131 Radionuclide Therapy

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Introduction

Patients undergoing I-131 therapy for thyroid cancer are provided with a booklet as well as meeting with physics staff to discuss radiation protection measures and their therapy pathway. Traditional written and verbal communications can be overwhelming particularly when patients are anxious and unfamiliar with nuclear medicine procedures. Patients are often unsure what to expect in terms of the in-patient therapy room and managing this period of isolation. Visual resources including images of the room may improve patient comprehension and preparedness.

The aim of this project was to develop an animated patient information video that clearly explains the I-131 therapy pathway, radiation safety principles and patient expectations in an accessible and engaging format.

Method

An animated video was designed through a collaboration with an Arts college, the in-house design lab and the Nuclear Medicine Team. A patient centered script and storyboard was co-created and incorporated into the animation outlining the I-131 treatment journey including preparation, administration, radiation safety advice and post treatment considerations.

Results

A six-minute informative animated video was produced that visually explains the I-131 therapy process and associated radiation safety measures. The resource provides patients with a clear overview of what to expect before, during and after treatment, helping to reduce uncertainty and anxiety.

Conclusion

Animation is an effective method for communicating radiation concepts to patients undergoing I-131 therapy. By improving patient understanding, this supports optimisation of radiation safety, patient compliance and informed consent. It is intended that the animated video will be made available to patients in advance of their I-131 therapy via digital platforms and QR codes in their appointment information.

Clinical Impact

Aims to improve patient experience and understanding of I-131 therapy, associated radiation safety requirement and supports a smoother clinical pathway.

48: S.W.I.M.S.: Diving into Contamination Monitoring and Spills Response in Nuclear Medicine

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Introduction

Radiation protection (RP) training is a legal requirement and spills training forms part of this. Nuclear Medicine (NM) involves the use of unsealed radioactive materials, spilling even small amounts of this creates a hazard. Dealing with spills in a standardised, effective and timely manner can be a challenge. To ensure consistent understanding and application of RP practices a novel training video was developed and distributed. The S.W.I.M.S. protocol was introduced to staff outlining the steps needed to deal with a spill: Stop, Warn, Isolate, Minimise, Secure. The aim of this video is to ensure a standardised response to spills and that staff feel prepared to deal with them.

Methods

A script and storyboard for the video was developed based on department protocols and learnings from previous in-person training sessions focusing on areas where spills are likely to occur. Filming was carried out by the hospital medical illustrations team. The video details the steps to follow in the event of a spill, the personal protective equipment required and correct monitoring techniques. This video is intended as a complementary tool, along with in-person training to highlight the correct methods for dealing with spills.

Results

A video of the steps to take when dealing with a spill and possible scenarios of where they might occur was produced. Since the project started it was found that staff are more aware of when spills occur, how to apply the S.W.I.M.S protocol and are more likely to pause and report spills to the physics team.

Conclusion

This informative and user-friendly video provides a consistent communication tool for staff working in the NM department and allows for ease of access to online training for staff.

Clinical Impact

Improving staff preparedness in these events minimises risks associated with radioactive spills and enhances staff and patient safety.

49: Assessment of the distribution of radiation exposure across the hands of Nuclear Medicine workers for a range of clinically relevant radionuclides and geometries: Monte Carlo simulation and experimental validation.

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Introduction:

Ring dosimeters, worn at the base of the finger, are routinely worn to monitor Nuclear Medicine workers' skin dose. However, it is widely accepted that this measured dose reflects the dose received at the monitored location only and there is a considerable variation in the distribution of dose across the entire hand. This is of particular importance when working with beta-emitters. Current tools used in the assessment of skin dose during non-routine exposure (on-line calculators, Varskin) can yield very differing results and the required geometry can be difficult to reproduce. The aim of this project was to develop and validate Monte Carlo simulations (MC) to assess the exposure at various locations from or on the hand for a range of clinically relevant geometries and radionuclides and to compare MC to the currently available dose assessment tools.

Method:

A simple bespoke 3D-printed tissue-mimicking phantom designed and simulated previously, was used to experimentally assess the dose received at sample locations on the hand for various clinically relevant geometries for a range of radionuclides (99mTc, 177Lu and 68Ga). The dose was recorded by both electronic personnel dosimeters (EPDs) and in-house LiF TLDs. The phantom model was further developed using EGSnrc MC software to include additional geometries, measurement locations and radionuclides.

Results:

Differences ranging from 20% to > 100% were observed between the various methods of dose assessment. The MC model was found to be the most accurate assessment of Hp(0.07) compared to the experimental values. Results for a range of radionuclides and geometries will be presented.

Conclusion: The assessment of maximum skin dose for routine and ad-hoc exposure scenarios can be challenging. The MC simulation model can provide an accurate way to assess Hp(0.07) distribution on the hand for exposure geometries encountered in Nuclear Medicine.

50: Comparison of proportional counters and survey meters for the monitoring of 177Lu contamination arising from nuclear medicine procedures

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Introduction

Routine contamination monitoring is of particular importance when high activity concentrations of radionuclides are used for nuclear medicine. To confirm compliance with regulatory disposal limits and area classification, quantification of contamination in terms of Bq or Bq/cm2 is important. The purpose of this study was to assess the performance of commonly used Geiger-müller tubes (Rad-Eye B20 and Raysafe 452) and large proportional counter (Berthold LB 124) in terms of sensitivity, linearity, and minimal detectable activity for 177Lu.

Methods

Following IAEA Safety Report No. 16[1] meter calibration recommendations, four 100cm2 squares of absorbent paper 177Lu were prepared with activities ranging from 30kBq to 950kBq. Sources were measured using each meter at a selection of clinically relevant distances, with various filter and meter settings. Calibration factors were established to convert detector measurements to Bq/cm2. The minimum detectible activities were also established.

Results

Results of the performance assessment will be presented in detail. However, the main findings were: 1) Proportional counters were found to have differing sensitivities, so characterisation of each meter is recommended. 2) The proportional counter had the highest sensitivity, hence performs best for waste management, however for one proportional counter over-saturations occurred for concentrations in excess of 8 kBq/cm2 at 2 cm. This high sensitivity leads to a poor performance in localising focal points of contamination. 3) The Radeye B20, had adequate sensitivity for the two applications while also providing dose rate data with the filter on for supplementary hazard assessment. 4) To check with conformance with area contamination limits, only one of the proportional counters and the Radeye B20s placed at 2 cm from the surface, could determine if the activity concentration is less than the Supervised Area limit, 4.0 Bq/cm² for Beta/Gamma Emitters.

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Section 7- Radiotherapy Abstracts

51: Quality Assurance for SRS and SABR radiotherapy treatment planning with the QUASAR MRID-3D phantom

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Introduction:

MRI has been increasingly integrated into radiotherapy and is a requirement for SRS and some SABR treatments. Geometric accuracy of the planning MRI must be assessed, with displacements of less than 1 mm over the clinically relevant volume advised1. This study aims to evaluate the geometric accuracy of a GE 1.5T MRI scanner and characterize any geometric distortion present for radiotherapy treatment planning.

Methods:

Geometric distortion of the GE 1.5T MRI was assessed using the QUASAR MRID-3D analysis system. The QUASAR and CIRS Stereotactic End-to-End Verification (STEEV) phantoms were scanned using a selection of 3D T1 Fast Spoiled Gradient Echo (FSPGR) and 3D T2 Fast Spin Echo (FSE CUBE) sequences. Geometric accuracy was evaluated by measuring the dimensions and volume of a 30 x 40 x 50 mm cuboid in the QUASAR phantom and a 30 mm diameter spherical target in the STEEV phantom.

Results:

The QUASAR phantom cuboid dimensions and volume were within ± 0.2 mm and ± 1.2%, respectively, of their nominal values. The diameter and volume of the 30 mm spherical target in the STEEV phantom were within ± 1.0 mm and ± 2.6%, respectively, of their nominal values.

For the QUASAR phantom, mean distortion along the x-, y-, and z-axes was < 0.3 mm, with absolute distortion < 0.4 mm, measured 30 mm from the isocentre relative to the cuboid center. Confidence ratings for all scans were ≥ 94.5%, and all points were within 1.0 mm of their true positions, meeting the 1.0 mm accuracy recommended for SABR/SRS planning1.

Conclusions:

The GE 1.5T MRI scanner demonstrates sub-millimeter geometric accuracy with minimal distortion. This high level of precision supports its reliable use in MRI-based radiotherapy treatment planning, particularly for SABR and SRS, where accurate target localization is critical for safe and effective treatment.

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52: Evaluation of the effect of rotations on coverage of nodal boosts in gynae SIB patients

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Introduction

Limited CBCT field-of-view (FOV) can prevent verification of distal nodal boosts in cervix SIB plans. With increasing distance from isocentre (diso), small residual rotations create larger geometric displacements that may decrease coverage. The aim of this study was to quantify how patient rotations affect dose to boosted distal nodal targets.

Methods

Five patients with locally advanced cervical cancer treated with VMAT SIB (Monaco v6.1.3, Rx: pelvis [45 Gy/25#] with SIB [55 Gy/25#]) were retrospectively analysed. CTs and structures were rigidly rotated about the isocentre by ±3°, ±5°, and ±7° for pitch, roll, and yaw, giving 18 rotations per patient. Rotations were applied using Python and plans recalculated without re-optimisation. Outcomes were assessed as the change in D98% of rotated plans compared to original plans (ΔD98%) for each PTV. d_iso values were measured between the treatment isocentre and centroid of each PTV. ΔD98% was analysed with respect to d_iso.

Results

Across 34 boosted nodes, rotations ≤5° were associated with reduced coverage of distal nodes. Pitch and yaw produced a quadratic loss of coverage with increasing diso (R^2 = 0.36, 0.44), while roll produced a weak linear correlation (R^2 = 0.02). Reductions of ΔD98% up to 6.79 ± 1.17 Gy (12 ± 2.9%) for 5° setup error were estimated for nodes at diso of 163 mm, the distance between the edge of FOV and treatment field for the machines in this study. The distance of a given node from the axis of rotation was a strong indicator for change in dose coverage (Figure 1).

Conclusion

When distal nodal boosts are outside the CBCT FOV, residual rotations ≤5° can materially reduce PTV SIB coverage, scaling with d_iso. Uniform margins and standard IGRT protocols may be insufficient for these nodes. Findings support distance-stratified margins or tolerances for nodal boosts, and more advanced set-up protocols such as SGRT.

53: Investigation into Feasibility of using Varian Multi-Criteria Optimization (MCO) to Improve Both Simple (Prostate) and Complex (Head and Neck) VMAT Plans in the Clinical Environment

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Intro:

Achieving optimal PTV coverage whilst minimizing dose to OARs is a challenge when creating a satisfactory plan. This can lead to time consumption for the planner. MCO is a tool by Varian which creates Pareto-optimized plans in which the planner can explore trade-offs between target site and OAR dose.

Method:

The feasibility of this tool was investigated for 10 simple and 10 complex pre-existing VMAT plans by reoptimizing standard plans with the Varian Eclipse MCO tool and comparing several parameters (namely MUs, mean dose to OARs, robustness, conformity index, and max dose to PTV).

Results:

It was found MCO can and may reduce dose to OARs, although this comes with a tradeoff to PTV coverage. Results for simple plans were more satisfactory compared to complex plans due to overlapping structures. All plans are still deemed clinically acceptable.

Conclusion:

MCO should not be used as a replacement to planning, rather a supplementary tool. It is therefore case dependent. There are 2 instances where MCO can be used - an inexperienced planner who requires support, or when difficulty arises when meeting constraints and plan options still need to be explored after conventional methods.

Clinical Impact: This study shows that MCO may reduce time in the planning process and may improve plan quality.

54: An investigation into minimum bladder filling volumes for prostate radiotherapy treatment

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Bladder filling protocols are used within prostate radiotherapy to reduce dose to organs at risk (OARs), particularly the small bowel, by displacing them away from the high dose region of the treatment field. When pre-treatment Cone Beam CT (CBCT) shows a bladder volume smaller than planned, treatments are often delayed due to dosimetric concerns for OARs. This study aimed to establish a threshold minimum treatable bladder volume (V_Bmin) to allow safe treatment at reduced volumes without violating OAR constraints.

Three treatment protocols (46 plans total) were analysed:

68 Gy in 25#

66 Gy in 33#

60 Gy in 20#

Using the Treatment Planning System (TPS) Monaco, V_Bmin was determined by assessing the volume required to maintain OAR dose constraints. Small bowel dose was inferred indirectly, based on the bladder volume needed to displace it from the high dose region. A contour generation method was developed to project these V_Bmin volumes onto CBCTs.

Key Findings:

1. Volume Reductions: Mean planning bladder volume was 356 mL (σ = 110 mL).

2. Protocol Variance: V_Bmin varied by protocol; 68 Gy in 25# required the smallest volume (131 mL , σ = 28 mL), while 60 Gy in 20# required the largest (204 mL, σ = 42 mL).

3. Limiting Factors: In most cases, bladder dose constraints, rather than the small bowel, were the primary limiting factor for V_Bmin.

4. Threshold Accuracy: Using a generic relative volume as a threshold can result in bladders being either unnecessarily large or smaller than dosimetrically allowable. Patient-specific absolute volume thresholds are more suitable.

The study demonstrates that substantial reductions in bladder volume relative to the planning CT are possible without compromising safety. Implementing patient-specific V_Bmin contours on CBCTs can provide a more objective assessment and reducing unnecessary treatment delays without compromising patient safety.

55: Five years of radiotherapy dose reference levels – a single institution review

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Introduction:

Dose reference levels (DRLs) provide a method of ensuring that patient radiation exposure during a CT procedure is kept at a reasonable level. The Health Information and Quality Authority (HIQA) provide guidelines on their use in radiotherapy computed tomography (CT) scanning. Per-protocol local facility DRLs should be established and reviewed on an annual basis. This work reviews the previous five years of facility DRLs at a single institution with two CT radiotherapy scanners.

Methods:

GE Healthcares “Dosewatch” software is used annually to generate the median dose-length-product (DLP) for each of 45 clinical protocols available on two GE DiscoveryRT CT scanners. These DLPs are the local facility DRLs and are compared to the previous years data and published literature. The Pareto principle is used to action the 20% of protocols exhibiting the largest differences with the previous year. Analysis of local facility DRLs between October 2021 and January 2026 was carried out to search for any longer term trending and unexpected changes. Any anomalies were investigated.

Results:

A number of protocols, typically associated with metal artefact reduction or extremities were flagged as having low usage ($n < 15$) and their median DLPs were considered of lower statistical quality. For frequently used protocols, no major trending of DRLs over a five year period was evident. Larger, more sudden changes were investigated, and were associated with an adjustment in scan borders or scan procedure. No unexplained, unexpected changes in DRLs were found in this analysis, suggesting the CT scanning at this institution is robust.

Conclusion:

The year-by-year generation and comparison of DRLs at this institution was expanded into a more general analysis over five years. This showed no unexplained changes in DRLs over time. Any flagged protocols had either low usage with inter-patient variability, or had changes in scan borders or procedure.

56: Evaluating dosimetric improvements in the PTW Octavius 1000SRS array for SABR QA

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Intro: The aim of this study was to compare the dosimetric characteristics of the PTW Octavius 1000SRS array pre- and post-upgrade and to evaluate any improvements in the array's performance.

Method: The array's performance was tested post-exchange by PTW of the entire detector field and front foil with the latest version. Results were compared to the pre-upgrade measurements acquired at commissioning. The calibration of the central chamber, relative calibration of peripheral chambers, water equivalent depth of the effective point of measurement (EPOM), signal leakage, dose rate linearity, output factors and gamma analysis passing rates for ten SABR plans were evaluated[1].

Results: The EPOM and absorbed dose calibration under reference conditions remain unchanged, but signal leakage for all chambers and the relative calibration of off-axis chambers improved post upgrade. The workflow for VMAT deliveries with FFF beams initially involved multiple calibrations based on the average dose rate of the particular plan. As the array exhibits improved dose rate linearity post-upgrade a single calibration file at 1000 MU/min is now sufficient. A response variation of < ± 0.4% across the range of dose rates expected in clinical plans (700–1300 MU/min) was recorded. Other studies[2] recommend field size dependent output factor corrections, however output factor measurements showed agreement within 0.95% of the treatment planning system for field sizes ≥ 1.5 × 1.5 cm2 and indicate this is not required for SABR QA. There was also an increase of 9.2% in gamma analysis passing rates for clinical deliveries using a 2%/1 mm criteria (3D gamma, global dose, and 10% threshold).

Conclusion: The upgrade had a positive impact. Improved dose-rate linearity, relative calibration of peripheral chambers, and signal leakage mean measurements under non-reference conditions such as a VMAT delivery are more accurate than before.

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57: Validating Rapid Delivery of Prostate SABR with FFF Arcs using Intrafraction Prostate Displacements

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Intro:

Prostate SABR treatments have been justified in clinical trials[1,2]. The PACE-B trial protocol guidance as well as reported displacements in the literature suggest treatment delivery within 240-360s of imaging should be acceptable[1,3]. The aim of this study is to determine clinical delivery times for SABR prostate treatments on a conventional linac and determine if intrafraction prostate displacements during this interval are acceptable.

Method:

A retrospective analysis was carried out on 50 fractions across ten patients, with twenty-five post-treatment CBCT images being analysed from subset of five patients. All patients received 36.25Gy/5# using 6 MV FFF and a single 360° arc. The time intervals between pre- and post-treatment CBCTs were recorded along with treatment completion times. Translational and rotational displacements were retrospectively calculated on the post-treatment CBCTs to assess intrafraction prostate motion.

Results:

Across all fractions the median predicted delivery time was 78.6s (IQR = 78.0 to 83.1s) however, the actual median clinical delivery time was 96.0s (IQR = 88.6 to 112.9s), with the variation due to beam interruptions during treatment. For the five patients; the median time from the pre-treatment CBCT to the post-treatment CBCT was 383.5s (IQR = 336.3 to 408.0s). The median translational displacements of the prostate across all fractions in the left/right, superior/inferior and anterior/posterior directions were: 0.20cm (IQR = 0.10 to 0.30cm), 0.10cm (IQR = 0.08 to 0.20cm) and 0.10cm (IQR = 0.10 to 0.23cm) respectively. Median rotational deviations, yaw, pitch and roll were 0.25°, 0.35° and 0.40° respectively.

Conclusion:

The intrafraction prostate motion observed on post-treatment imaging remained within accepted limits despite longer 'on couch' times. These findings support the feasibility of prostate SABR with a fast delivery on a conventional linac using pre-treatment CBCT imaging and SGRT intrafraction monitoring.

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58: Cross Modality Harmonization of UHDR Radiation Dosimetry

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Purpose:

To harmonise ultra-high dose rate (UHDR) beam parameters across three modalities; two LINACs (a Varian Clinac 21EX and an Elekta Precise) which have been modified to produce UHDR electrons, a kV photon FLASH-SARRP, and a FLASH-enabled Varian ProBeam.

Methods:

A flashDiamond and a HYPERSCINT RP-FLASH were used to determine the range of beam parameters that can be produced by each UHDR source via integral dose and dose-time course measurements, respectively. Gafchromic and Orthochromic film were used to confirm integral doses and assess field distributions. The parameters of interest include dose, mean and instantaneous dose-rates, irradiation time, and field size.

Results:

X-ray tube heat production in the FLASH SARRP presents the most limiting constraint to the cross-modality average dose rate (<80Gy/s for relevant field sizes). A lower limit on MU per unit area for a given nozzle current constrains minimum dose and field homogeneity for proton FLASH beams, with a target lower bound of 10Gy decreasing achievable field homogeneity and dose-rates (<70Gy/s). UHDR electron fields have no field geometry limitations and can produce the widest range of doses and dose rates; dose and dose rate tuning is required to correct for electron dose resolution, which is limited by large doses per pulse. The range of achievable doses (10-15Gy) and dose rates (0.033-70Gy/s) that can be achieved across beamlines was determined for a target field size (35mmx35mm^2).

Conclusions:

This study investigates protocol harmonisation for multi-modality UHDR radiation dosimetry. The protocols rely heavily on two commercially available dose rate independent dosimeters to determine beam parameter spaces common to four research beamlines. This framework lays the foundation for cross-institutional parameter-matched studies evaluating the influence of particle type on the FLASH effect.

59: Commissioning and Quality Assurance tests for RapidArc Dyanamic

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Introduction

RapidArc Dynamic (RAD) (Varian Medical Systems) is a novel optimisation and delivery system that enables dynamic collimator rotation and incorporates integrated Static Angle Modulated Ports (STAMPS) within volumetric modulated arc therapy (VMAT). The aim of this study was to design and establish a quality assurance (QA) programme for RAD following commissioning. This centre is the first to implement RAD clinically in the UK and Ireland.

Methods

The RAD technique was commissioned and validated on a Varian TrueBeam linear accelerator for four photon beam energies (6X, 10X, 6FFF and 10FFF). Validation was performed using five clinical treatment sites: breast with simultaneous integrated boost (SIB), lower lung, prostate with pelvic nodes, lung stereotactic body radiotherapy (SBRT), and pancreas.

Monthly QA and patient-specific quality assurance (PSQA) procedures were established for RAD. A novel quality control test, Varian Dose Rate Collimator Speed test (DR-CS), was used to assess synchronisation of dynamic collimator and gantry rotation, multi-leaf collimator (MLC) positioning, and dose rate. The DR-CS test plan consists of five gantry sub-segments designed to deliver a uniform dose to five sectors of a circular field using unique combinations of collimator speeds and dose rates. This test was implemented for monthly QA, while EPID-based portal dosimetry and ArcCHECK (Sun Nuclear) were used for PSQA. Results of DR-CS were compared to values compiled by the RAD Consortium.

Results

Monthly QA results using the DR-CS test demonstrated average absolute deviations within a 1.5% tolerance. PSQA results for three patient cases showed excellent agreement, with gamma passing rates meeting 2%/2 mm criteria.

Conclusions

This study demonstrates a practical approach to commissioning and quality assurance of RAD plans and provides a robust framework for routine clinical implementation.

Clinical Impact

The QA procedures introduced ensure the safe and accurate delivery of RAD treatment plans within the clinical workflow.

60: Characterization of EBT-XD Film for use in High-Dose Kilovoltage Energy Applications

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Introduction

Radiochromic film is a useful dosimetry system for clinical applications; however, its usefulness can be limited by its dose range. Gafchromic EBT-XD film is designed to have a higher dose range than other forms of Gafchromic film. While previous literature has performed characterization work for EBT-XD for high-dose MV applications, there is limited available work that characterizes the kV range or across energy ranges. This study performed characterization testing for EBT-XD film for high-dose applications in the kV range.

Methods and Materials

Gafchromic EBT-XD film was calibrated with a kV X-ray therapy unit at 200 kV between 15 and 50 Gy. The film was scanned using an Epson Expression 12000XL scanner and imported into myQA software. Testing included light sensitivity, repeatability, orientation/position effects, polymerization reaction timeline, and energy dependency.

Results

Testing showed that EBT-XD film is sensitive to light that contains a UV spectrum. There is some sensitivity to the scanner light; however, this is likely negligible. Some energy dependency is shown when calibrated in the kV range and used in the MV range. EBT-XD shows some orientation effects. Scanner position does impact the read dose. The EBT-XD and scanner system shows good repeatability at high doses, but there can be warm-up effects when used in low-dose applications. The scan time post-irradiation has a large impact on the read dose, with the largest changes occurring in the first 24-hours.

Conclusion

EBT-XD film is appropriate for use in high-dose kV applications; however, to minimize uncertainty, some controls should be taken including: calibrating film in the same beam energy of expected use, maintain the same scan time post-irradiation, maintain the same film geometry for the duration of the work, maintain film in a UV free environment while not in use, and ensure that the scanner is warmed up prior to use.

61: Investigation of the dosimetry of electron fields at oblique angles of incidence and non-uniform surfaces - comparison between the Monaco Treatment Planning System and Versa HD treatment units

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Electron beams are commonly used for the treatment of superficial lesions, including those located on the scalp, extremities, and for breast boost treatments. Historically, electron dose calculations were performed using manual hand calculations based on phantom data, which are only valid for flat surfaces and beam incidence angles below 20°. The introduction of electron Monte Carlo (eMC) dose calculation algorithms allows for improved modelling of complex surface geometries and oblique beam incidences. The aim of this study was to evaluate the accuracy of eMC dose calculations for oblique beam incidence and non-uniform surfaces by comparing calculated and measured dose distributions.

A wax phantom replicating the curvature of a patient's scalp was constructed to simulate a realistic clinical geometry. Absolute dose calibration of an IC Profiler 2D ion chamber array was performed for 6, 9, and 12 MeV electron beams using reference measurements with a Roos ionisation chamber. Dose measurements were acquired for 10 × 10 cm^2 fields at 100 cm SSD using both the curved scalp phantom and a flat control phantom. Measured dose profiles from the IC Profiler and EBT3 radiochromic film were compared with dose profiles calculated using the eMC algorithm.

For 12 MeV electrons, measured and calculated doses agreed within 5% across all evaluated points, including off-axis locations on the curved phantom corresponding to oblique beam incidences of approximately 30°. For 9 MeV electrons, agreement within tolerance was observed for off-axis points; however, central-axis points at greater depths exceeded the 5% tolerance. Reliable measurements could not be obtained for 6 MeV due to limitations related to phantom depth.

The eMC algorithm demonstrated good agreement with measurements for oblique beam incidence at clinically relevant depths, particularly for higher electron energies. These findings support the safe use of eMC calculations for selected oblique electron treatments and may inform future revisions of clinical beam angle limitations following further validation.

62: Assessment of conventional geometric contour comparison metrics via correlation with dose in prostate stereotactic body radiotherapy

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Introduction :Currently utilised geometric contour comparison metrics may poorly correlate with clinically relevant quantities such as dose [1]. This study assessed common geometric metrics and their correlation with planned dose.

Methods :Patients were treated in the SPARK trial (n=46) and received volume modulated arc therapy delivering 36.25Gy in 5 fractions to the prostate planning target volume [2],[3]. An auto-contour structure set was generated using Limbus Contour (V1.8.1) on CT. Dose-volume histograms (DVH) were calculated for rectum and bladder using auto-contours and manual clinician contours using dicompyler-core. Geometric metrics comparing contouring methods (Dice Similarity Coefficient (DSC), Hausdorff distance (HD), 95% Hausdorff distance (HD95) and mean Hausdorff distance (HDmean)) were calculated using plastimatch. Contour height differences were additionally extracted. PACE dose constraints were extracted for the rectum (V18.1Gy, V29.0Gy, V36.0Gy) and bladder (V18.1Gy, V29.0Gy, V37.0Gy). The difference in DVH metrics between contour sources were tested for correlation with geometric metrics using Spearman's rank correlation coefficient (ρ).

Results : Bladder ΔV18.1Gy exhibited a moderate correlation with HDmean (ρ=–0.71), while ΔV29.0 Gy showed a moderate correlation with HD95 (ρ=–0.68). For the rectum, DSC was moderately correlated with ΔV18.1 Gy (ρ=–0.67) and fairly correlated with ΔV29.0 Gy (ρ=–0.54). Rectum ΔV36.0Gy demonstrated no correlation with any metric (ρ<0.10). Bladder inferior height difference was found to moderately and negatively correlate with dosimetric parameters (ρ=–0.53 to -0.57) due to most of the inferior bladder being in, or proximal to, the PTV with more inferior contours corresponding to higher doses.

Conclusion:The performance of conventional geometric metrics has been tested for prostate radiotherapy patients. Poor correlations between conventional geometric metrics and high dose metrics demonstrate the need for improved metrics.

Clinical impact :This assessment will provide a benchmark for developing a radiotherapy-specific metric to improve correlations. An improved metric will allow determination of significant changes in structures if utilised in adaptive workflows.

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63: Characterisation of an ultra-high dose rate electron beam using an RP-FLASH plastic scintillation detector for FLASH radiotherapy studies

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Introduction:

This work aimed to characterize an ultra-high dose-rate electron beam ("eFLASH") produced by a previously modified Elekta Precise linac. The study focused on analysing the beam's temporal profile and determining optimal parameters to maximize stability for the purposes of UHDR dosimetry research and pre-clinical radiobiological studies.

Methods:

The linac produces 10MeV eFLASH beam, controlled by an in-house pulse-based trigger system. In the present work, this system was validated at conventional dose-rates using a PTW Roos chamber and a Medscint RP-FLASH plastic scintillator.[1] With the RP-FLASH, high-resolution temporal analysis allowed optimal electron gun parameters for eFLASH to be established. Beam profiles and percentage depth doses (PDDs) were measured using radiochromic film and RP-FLASH. Linearity and constancy were analysed as functions of pulse repetition frequency (PRF) and pulse count. Mean dose-rate (MDR) and dose-per-pulse (DPP) ranges were determined via film and verified against TOPAS Monte Carlo (MC) simulations.

Results:

The control system proved robust and reproducible, with an optimal gun current of 7.4 A established for eFLASH production. Temporal characterisation (1 ms resolution) allowed optimization of multiple gun parameters. Output was approximately linear with PRF but non-linear with pulse count, due to DPP variations during ramp-up. A gun warm-up procedure was developed to improve reproducibility. A maximum isocentric MDR >53 Gy/s (mean DPP >0.3 Gy/pulse) was achieved, with relative MC simulations (matched to within 6%) indicating MDR >175 Gy/s at minimum source-to-detector distance. MC-simulated PDDs showed excellent agreement beyond dmax (100% gamma-passing rate at 1%/1 mm). Similarly, beam profiles exhibited >99% passing rates (2%/1 mm).

Conclusion:

Optimal eFLASH operating parameters were determined through temporal characterisation of a 10MeV electron beam from a modified linac, improving stability and reproducibility for future FLASH studies. Future work will involve a complete dosimetric assessment using RP-FLASH and reference detectors, along with refinement of the beam monitoring procedure.

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64: A TOPAS Monte-Carlo model of standard and FLASH-enabled Elekta linacs for in vitro dose verification and prediction in pre-clinical radiobiological studies

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Introduction:

This work aimed to construct and comprehensively validate in silico models of a standard Elekta Synergy linac and a locally modified, ultra-high dose-rate (UHDR)-enabled Elekta Precise linac using the TOol for PArticle Simulation (TOPAS) Monte Carlo (MC) toolkit. These models support dose verification and prediction for ongoing dosimetric and pre-clinical radiobiological studies where standard dosimetry is unreliable or impractical.

Methods

:Detailed MC models were built in TOPAS for three beams: 6 MV photons, 10 MeV standard electrons, and 10 MeV UHDR ("eFLASH"). Source parameters and geometries were iteratively optimized against measured data. Standard beam PDDs and profiles were validated with high-resolution PTW microDiamond measurements; radiochromic film utilized for eFLASH. Additional metrics included field size output factors and beam quality specifiers.Custom in-vitro cell flask phantoms were also modelled, with simulated irradiations compared to film measurements to verify delivered dose and flask coverage. These models were used to predict relative dose-rate changes with varying dose-per-pulse (DPP), confirmed experimentally via ion chamber and film measurements. Comprehensive uncertainty analyses were performed for all simulations and measurements.

Results:

MC-simulated PDDs showed excellent agreement beyond dmax, achieving 100% gamma-passing rates (GPRs) at 1%/1 mm criteria for all beam models. All profiles exhibited >99% GPR (2%/1 mm). Output factors and quality indices agreed within 3% of measurement. Maximum statistical uncertainties were 0.6% (photons) and 1.4% (electrons). Simulated relative doses within cell irradiation setups agreed with measurement to within 3% (conventional) and 6% (eFLASH) at all SSDs, confirming predictive accuracy for relative dose, dose rate, and mean DPP.

Conclusion:

TOPAS models of standard and UHDR-enabled linacs were comprehensively validated, accurately reproducing measured dosimetry for standard and UHDR beams. Cell-irradiation geometries reliably predicted delivered dose. The complete model suite (including applicators, MLCs, and phase-space files) provides a robust framework for dose verification, supporting radiobiological research where standard dosimetry is unreliable or impractical.

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65:Commissioning of a "Y" endometrial applicator for HDR brachytherapy in inoperable endometrial cancer

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Introduction

Endometrial cancer represents the majority of uterine malignancies, and high-dose-rate (HDR) brachytherapy is a cornerstone of treatment for patients who are medically inoperable [1]. Applicator choice is critical to achieve adequate target coverage while sparing organs at risk (OARs). This project aimed to commission and clinically evaluate Varian's HDR Universal Endometrial Applicator Set for HDR brachytherapy in inoperable endometrial cancer, comparing its performance with the ring-and-tandem applicator.

Methods

Commissioning was performed in accordance with AAPM TG-56 and MPPG-13a guidelines [2,3], including visual inspection, geometric verification, offset and dwell position measurements using Gafchromic film, and applicator reconstruction in the Brachyvision treatment planning system. Following successful commissioning, 18 CT-based volume-guided treatment plans were generated for previously treated inoperable endometrial cancer cases. Dosimetric comparisons were conducted between (i) the "Y" applicator with three tandems and a ring-and-tandem applicator, and (ii) the "Y" applicator with three versus two tandems. Planning objectives followed American Brachytherapy Society recommendations [4].

Results

All commissioning tests met recommended tolerances, confirming geometric integrity, accurate source positioning, and reliable applicator reconstruction. Dosimetric analysis demonstrated that the "Y" applicator with three tandems achieved superior CTV coverage (D90) and improved sparing of critical structures, particularly the rectum and sigmoid, compared with both the ring-and-tandem applicator and the two-tandem configuration. These findings were consistent with published literature [5,6]. Clinical review by a radiation oncologist supported routine use of the three-tandem configuration with standardised insertion and planning protocols.

Conclusion

Varian's HDR Universal Endometrial Applicator Set was successfully commissioned and validated for clinical HDR brachytherapy. Its three-tandem configuration provides enhanced dosimetric performance and greater anatomical adaptability for inoperable endometrial cancer.

Clinical Impact

Implementation of this applicator expands treatment options for patients with medically inoperable endometrial cancer, enabling improved target coverage with reduced OARs dose, thereby supporting safer and more effective HDR brachytherapy delivery.

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66: Evaluation of alternative modelling approaches for the Agility Multileaf Collimator in Monaco treatment planning system

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Introduction

Accurate mulitileaf collimator (MLC) modelling within treatment planning systems (TPS) is essential for precise dose delivery in Intensity-Modulated Radiation Therapy (IMRT) and Volumetric Modulated Arc Therapy (VMAT). The Elekta Agility MLC incorporates complex geometric features, including tilted leaves that can compromise modelling accuracy [1]. However, excessive parameter tuning carries a risk of over-modelling [2]. This study evaluated and optimised key MLC parameters in the Monaco TPS to determine whether refinement leads to meaningful dosimetric improvements over the current clinical model.

Methods

The Agility MLC was assessed using a combination of adapted ExpressQA THREEL fields, Sweeping Gap (SG), and Asynchronous Sweeping Gap (aSG) tests. High-resolution 2D measurements were acquired using IBA's myQA SRS detector, while SG and aSG doses were measured with a Farmer-type ionisation chamber in water-equivalent material. Several Transmission Probability Filter (TPF) parameters—leaf transmission, leaf groove width, and leaf tip leakage—were modified to generate three optimised models, which were compared against the current clinical model using profile analysis, dose–gap linearity, fluence reduction metrics, and gamma analysis.

Results

Among the optimised configurations, one model demonstrated marginally improved agreement with measurements in transmission and groove regions for the THREEL and aSG tests. Linear behaviour was confirmed for SG tests ($R^2 > 0.999$). Despite these local improvements, gamma analysis showed no substantial differences between the current and optimised models, indicating comparable overall dosimetric performance.

Conclusion

Modest adjustments to selected TPF parameters can marginally improve agreement in specific MLC-related regions; however, these refinements do not translate into clinically meaningful differences. The existing Monaco Agility MLC model provides accurate and reliable dose calculations without the need for further optimisation.

Clinical Impact

This work confirms confidence in current Agility MLC modelling for IMRT and VMAT, supporting safe clinical use while avoiding unnecessary parameter tuning and reducing the risk of over-modelling.

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67: Impact of evolving dosimetry practices in Selective Internal Radiation Therapy (SIRT)

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Ytrrium-90 (90Y) TheraSpheres are used in SIRT for treatment of liver tumours. Previous guidance recommended a prescribed dose of 150 Gy to the target volume. The DOSISPHERE-01 trial (2020) demonstrated improved outcomes for tumour absorbed doses >205 Gy using personalised multicompartment dosimetry implemented via treatment planning software (TPS), as compared with standard single compartment dosimetry. Given the updated guidance, a comprehensive review was undertaken comparing patient- and dose-specific metrics before and after implementation of multicompartment dosimetry, to evaluate the impact of evolving dosimetry practice.

Patient-specific metrics (disease type, target volume, whole-liver volume) and dose-specific metrics (target dose, administered activity) were compared in patients treated before and after multicompartment dosimetry implementation (2016–2021 and 2022–2025). Dose rates at 1 m, 0.3 m, and in contact with the patient's upper abdomen were measured following SIRT. This data was used to model radiation doses to close contacts based on literature-reported interaction patterns.

Average target volumes were 337 ± 252 cc and 667 ± 479 cc between 2016–2021 and 2022–2025, respectively. Target volume doses more than doubled from 149 ± 26 Gy pre-2022 to 326 ± 146 Gy post-2022, while mean administered activity remained stable (2.4 ± 1.5 GBq vs 2.5 ± 1.4 GBq). Dose rates measured in contact with the patient increased between the two time-periods, with mean and standard deviations of 59 ± 41 µSv/hr and 77 ± 143 µSv/hr for the pre-2022 and post-2022 cohorts, respectively. Estimated radiation doses to close contacts for the specified time periods will be presented.

Implementation of multicompartment dosimetry facilitated planning of higher tumour doses, as supported by emerging evidence. This study also provides an evidence base to inform and optimise RP guidance, supporting the development of patient-specific recommendations.

Clinical Importance: The work shows that implementing personalised multicompartment dosimetry in SIRT enables delivery of higher tumour doses while providing the data needed to keep radiation protection measures appropriate for close contacts as treatment practices evolve.

69: Calculating PTV margins for abdominal SABR using the van Herk formula

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Introduction:

Stereotactic ablative radiotherapy (SABR) for abdominal targets demands highly accurate treatment delivery due to steep dose gradients and the proximity to OARs. Appropriate PTV margins ensure sufficient target coverage while minimizing normal tissue exposure. At this institution, current practice is to employ a 5 mm isotropic margin expanded to 7 mm in the superior-inferior (SI) direction for end-expiratory breath-hold (EEBH) and 5 mm isotropic margins for free-breathing (FB) SABR. This work evaluated the adequacy of these margins using the expanded van Herk formula by quantifying sources of systematic (∑) and random (σ) errors.

Methods:

Errors due to target intrafraction motion (Σ_intra and σ_intra) were quantified using daily CBCT imaging data from 67 patients (n=27 for EEBH; n=40 for FB). Furthermore, inter-user variability in tumour delineation, isocentre coincidence with gantry rotation, and MLC and IGRT software accuracy were evaluated.

Results:

Σ_intra was highest in the SI direction at 1.81 mm for EEBH, versus 1.17 mm for FB. Isocentre coincidence error was 0.55 mm, 0.27 mm, 0.54 mm for the anterior-posterior (AP), SI, and medial-lateral (ML) directions respectively. Lastly, 1.5 mm delineation uncertainty and 0.58 mm uncertainty in IGRT and MLC accuracy across all three cardinal axes were noted. Calculated PTV expansions in the AP, SI and ML directions were 4.97 mm, 7.29 mm and 5.16 mm (EEBH) and 5.23 mm, 6.45 mm and 5.73 mm (FB). These results represent the margins required for 90% of patients to receive at least 90% of the prescribed dose.

Conclusion:

The results validate the institutional PTV margins for the EEBH patient cohort, while indicating that the currently employed FB margins may not be sufficient for adequate PTV coverage in most patients.

Clinical Impact:

Margin optimisation can help reduce toxicity risks while preserving tumour control probability. An understanding of uncertainty sources also informs protocol standardisation, improving consistency and safety across SABR treatments.

Section 8- Artificial Intelligence in Healthcare Abstracts

69: Integration of Generative AI in Radiation Safety Training

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Introduction

Radiation protection training is a legislative requirement but is often limited by competing clinical priorities, variable staff working patterns and the availability of medical physics personnel to deliver in-person sessions. This pilot project aimed to improve mandatory radiation safety refresher training compliance by utilising open-access artificial intelligence (AI) tools to create multimodal educational resources. By hosting these resources on an e-learning platform, the initiative seeks to enhance accessibility, flexibility, and engagement in radiation protection education for hospital staff.

Methods

Existing radiation safety slide decks and guidance documents were used as source material processed using large language models (LLMs) within Perplexity AI. The generated summary was imported into Google Notebook LM to create a two person conversational style podcast. Audio content was edited in Clipchamp to generate MP3 podcast and MP4 video formats. The podcasts were then hosted on the LearningMate e learning platform alongside traditional slide decks, allowing staff to select their preferred learning format. Successful completion of a quiz was required to pass the module.

Results

This pilot was implemented across multiple staff groups including administration, scheduling, security, nursing and radiography. Early results from the e-learning platform revealed that 88% of participants selected AI-generated materials over traditional slide decks with higher quiz pass rates indicating improved learning efficiency. Verbal feedback highlighted 24/7 multi-device access as a key advantage. Transitioning to the e learning platform is projected to reduce annual in person training time for medical physicists by over 60%.

Conclusion

AI-driven podcast generation offers a flexible and engaging approach to radiation safety refresher training. Although initially time-intensive to develop, this approach offers significant long-term benefits by reducing the medical physics departmental workload and accommodating diverse learning preferences within busy clinical environments.

Clinical Impact

Integrating generative AI into radiation safety training facilitates educational access, continuous professional development, legislative compliance and promotes positive radiation safety culture within hospital environments.

70: Development and Validation of a Python-Based Tool for CT Electron Density Phantom Analysis in Routine QA

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Introduction

Accurate CT electron density (ED) measurements are critical for radiotherapy dose calculation. Automated workflows can improve efficiency and consistency but require validation against established manual methods. This study reports the development and validation of a Python-based Pylinac script for analyzing images of the CIRS 062M ED phantom acquired on two GE CT scanners in both Axial and Helical modes during routine monthly quality assurance (QA).

Methods

A baseline was established using manual ED measurements during commissioning, obtained with a measurement tool of approximately 150 mm^2. ED values for 17 pre-defined region of interests (ROI)s of the CIRS 062M ED phantom were subsequently analysed using both manual ROI selection and the Python-based pylinac script. The differences between manual and Python-derived measurements relative to the baseline were evaluated using one-way ANOVA, with p-values used to determine whether the differences were statistically significant.

Results

24 image sets, resulting in a total of 408 ROI measurements were analysed using the Python script. One-way ANOVA yielded p-values between 0.5 and 1.0, indicating no statistically significant difference between manual–baseline and Python–baseline measurements. For all 17 ROIs, Python-derived measurements were within ±20 HU of the commissioning baseline. An exception was observed for the Bone ROI (1250 HU), where 3 out of 6 helical acquisition measurements on one scanner exceeded the tolerance by 2 HU; this deviation was associated with comparison against manual baseline values and a slight bias introduced during manual ROI placement to avoid streaking artifacts.

Conclusion

The Python-based pylinac script provides ED measurements statistically comparable to manual ROI-based methods relative to the commissioning baseline. This validated workflow could serve as a reliable and efficient tool for routine CT QA, supporting standardized, operator-independent ED assessment and facilitating streamlined QA processes.

71:Reducing time to treatment in radiotherapy with AI-based auto-contouring and patient scheduling

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Introduction: Radiotherapy departments are continuously striving to improve workflow efficiency for patients. Improved efficiencies in real world contouring tasks using AI-based contouring systems have been reported, with shorter contouring task and workflow times.1 However, the assumption that these efficiencies automatically translate into faster patient pre-treatment pathways has been challenged.2 This study aims to evaluate how AI based contouring and patient scheduling can be utilised to accelerate the treatment pathway.

Materials/Methods: Workflow data was retrospectively evaluated over three years (2023-2025), before and after the introduction of the MVision Contour+ auto-contouring software. Data evaluated included radiotherapy schedules for 3722 patients. Task completion times were recorded from the Quality Check Lists available from the department oncology information system. The contouring workflow time and the overall CT to treatment interval were evaluated pre/post implementation of the auto-contouring software. Patients start dates are scheduled post treatment planning to optimize the CT to treatment workflow time.

Results: The mean contouring time for patients went from 5.2 ± 5.1 calendar days (95% CI 4.9-5.5) in 2023 before auto-contouring to 3.9 ± 3.8 days (95% CI 3.7-4.1) and 3.7 ± 3.7 days (95% CI 3.4-3.9) in 2024 and 2025, post implementation of auto-contouring. The mean CT to treatment interval was 17.1 ± 8.1 calendar days (95% CI 16.6-17.6) in 2023 compared to 15.6 ± 6.8 days (95% CI 15.3-16) and 14.8 ± 6.7 days (95% CI 14.4-15.2) in 2024 and 2025. The percentage of contours completed out of hours, weekdays 6pm-8am and weekend days, decreased from 42% in 2023 to 18% across 2024/2025.

Conclusion: Delays in starting radiotherapy are associated with increased risk of local recurrence3. This study has shown that both the contouring workflow time and the overall CT to treatment interval can be reduced with MVision Contour+ and optimized scheduling of patient start dates post treatment planning.

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72: Initial evaluation of an artificial intelligence based GTV segmentation tool for stereotactic radiation surgery treatment planning

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Introduction:Radiotherapy departments are continuously aiming to improve treatment accuracy and workflow consistency for patient treatments. At present, artificial intelligence (AI) based auto-segmenting software tools are routinely used for OAR delineations to achieve these goals.1,2 However, GTV delineations are still performed by a radiation oncologist (RO). This study aims to assess the accuracy of the Brainlab Elements AI Tumor Segmentation tool for GTV delineation for stereotactic radiation surgery (SRS) treatment planning.

Materials/Methods:A retrospective analysis was carried out on 32 GTVs from 19 patients treated with SRS at our department. Each GTV was automatically contoured by the Brainlab Elements AI Tumor Segmentation tool and PTV margins were applied as per department procedures. The AI segmented GTV and PTV for each patient was compared to the original GTV and PTV approved by the RO for the patient's treatment, using volume based and Dice Similarity Coefficient (DSC) analysis.

Results:For GTVs below 4 cc (n=27), the mean volume decreased from 1.59 cc ± 1.65 cc to 1.15 cc ± 1.20 cc with the AI-segmentation software volume smaller for each patient. Similarly final PTV volumes reduced from 3.27 cc ± 1.65 cc to 2.30 cc ± 1.20 cc. This is equivalent to a mean reduction in PTV diameter of 1.91 mm ± 0.95 mm when independently using the AI-segmentation tool compared to RO only delineation. The mean DSC score for the AI-segmented GTVs was 0.79 ± 0.10 when compared to the RO delineation.

Conclusion:AI based auto-segmenting tools for GTV delineation are now commercially available, although their routine clinical use is still not widespread. In this study, independent AI-generated contours produced consistently smaller GTVs and PTVs for SRS treatment planning, leading to reduced target diameters. These findings support AI as an assistive tool for SRS GTV delineation, with clinical oversight remaining essential.

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73: A novel method of quantitative assessment of synthetic coronary angiography frames generated by convolutional neural networks

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Video frame interpolation can utilise convolutional neural networks to synthesise intermediate frames between existing ones in real-time. Synthetic fluoroscopy frames interspersed between real frames have been proposed as a method of reducing radiation doses in coronary angiography procedures.

Two video interpolation algorithms, Real-time Intermediate Flow Estimation (RIFE) and Residue Refinement Interpolation (RRIN) have previously been evaluated by cardiology experts. Quantitative evaluation of the performance of these models is a non-trivial task – medical physics tests are generally unsuited to heavily-processed patient images, while traditional computer vision metrics have been shown to correlate poorly with clinical findings. Over-smoothed images perform well despite blurring critical clinical details. This work proposes the use of the 3D Blur Metric (BM_3D) to quantify resolution in the spatio-temporal domain of coronary angiography sequences produced using video frame interpolation algorithms.

BM_3D builds upon the concept of “blur annoyance”, first described for photography, by extending the algorithm into the third (temporal) dimension. Calculation of BM_3D for 29 patient datasets found that the original images performed better than both RIFE and RRIN ($p < 0.05$), while it suggested that RIFE performed better than RRIN though no statistical difference was found ($p = 0.058$). A comparison of BM_3D also confirmed higher degrees of blurring for all acquisitions taken at 7.5 frames per second (FPS) than at 15 FPS.

Unlike traditional computer vision metrics, BM_3D ranked the algorithms in the same order as the clinical experts, further demonstrating its potential use as a quantitative metric in dynamic x-ray imaging.

74: A Bayesian AI Framework for personalized, uncertainty aware SGRT Margin Adaptation

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Purpose:Current deterministic AI models typically output point estimates without indicating confidence, posing a safety risk if the model is confidently wrong. This study evaluates a Bayesian Neural Network (BNN) designed to solve this transparency gap. Instead of a single 'best guess,' the BNN outputs a most-likely prediction paired with a calibrated 'uncertainty range' (High-Density Interval, HDI). We ask: Can a BNN allow us to use early SGRT data to safely predict a patient-specific intrafraction PTV margin, while also signalling when the model is too uncertain to deviate from a safe population margin?

Methods:Using intrafraction SGRT data (N=105 H&N patients), we trained a BNN to predict the systematic (Σ) and random (σ) intrafraction motion components, alongside patient-specific noise parameters, based on the first N fractions (N = 1-30). Unlike standard deep learning, this probabilistic framework learns distributions over each model parameter. By sampling these, we generated a posterior predictive distribution for the PTV margin, yielding a ""most likely"" value bounded by a 95% High-Density Interval (HDI). This interval explicitly captures both Aleatoric (inherent patient variability) and Epistemic (model ignorance) uncertainty, allowing us to benchmark the safety and utility advantages of Bayesian inference over standard training.

Results:At N=1, predictions reverted to the population margin with uniformly wide HDIs (appropriate behaviour under sparse evidence). As information accrued (N=3->5->10), predictions individualised, scatter tightened around y=x (r = 0.7-0.8), and HDIs narrowed in the common 0.5-1.5mm range while remaining wider for rare large margins. By N=5-10, the model was clinically informative, stratifying patients into stable (~16% of patients, PTV <0.5mm, narrow HDIs), standard (population margin), and erratic cohorts (~24%, PTV >1.0mm, wide HDIs). From N≥15 the model performance began to plateau.

Conclusion: We demonstrated that Bayesian-informed neural networks can provide clinically actionable predictions after 5-10 fractions, allowing for early, confident margin reduction, while simultaneously flagging erratic outliers requiring extended monitoring. This approach bridges the gap between complex AI and clinical practice: by presenting uncertainty as an intuitive credible interval, it empowers end-users to make risk-informed decisions without requiring specialized knowledge of neural network architectures.