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Oral Abstracts

Patient examination consent for all imaging procedures: a shared vision

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As medical imaging specialists we want to provide our patients with the best safest examination we can give them. We need to ensure that they have all the information they need to understand and then consent to their imaging procedure. We can only do this if we put them at the centre of the process.

Consent was in the past limited to larger or more complicated procedures. The changing expectations mean we need to change our processes. The conundrum for low-risk procedures is how we do this in a busy X-ray department without compromising the quality of the information and the safety of our patients.

Are allied health students sufficiently prepared to deal with intimate partner violence?

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Background: Intimate partner violence (IPV) is a major issue in society having implications for healthcare workers. Because victims are more likely to seek healthcare services,[1] healthcare professionals and students are in a unique position to provide assistance and respond to those experiencing IPV.

Aim: The aim of this study was to investigate the confidence of students in responding to IPV victims in clinical practice. Our vision is to raise awareness on the lack of IPV education and push for its inclusion in university curricula to improve clinical knowledge and patient care.

Methods: A literature search was conducted using Monash University library database with keywords intimate partner violence, allied health students, and students' perspectives on IPV. Results were refined to English peer-reviewed journals published after 2009. There was limited research undertaken on this topic; no studies on radiography students were obtained. Six most relevant and high-quality resources were chosen in this review.

Results: A coherent finding across the literature highlighted students' lack of confidence in detecting and responding to cases of IPV.[2,3] Although the nature and consequences of IPV were mostly understood, a recent study showed victim-blaming attitudes were evident among male respondents;[2] 45% of medical students feared offending patients when asking about IPV.[3] Insufficient education was identified to be the major underlying reason.

Conclusions: Results indicated students have limited knowledge of IPV and desire additional education to feel better equipped for future practice. This literature review suggests the need for future healthcare professionals to recognise their roles in the situation and promote respectful attitudes towards IPV victims.

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When a primary caregiver of an autistic child needs cancer treatment: a case study

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In Australia in 2018, it is estimated that 3.5% of Australians (approximately 875,000 people) were primary carers for people because of disability or age.[1] Interestingly, over one-third (37.4%) of primary carers have a disability themselves, in excess of twice the rate of non-carers (15.4%).[1] A cancer diagnosis does not discriminate. So, when a primary caregiver requires cancer treatment, what additional support do they require?

Jane* is a mother and primary caregiver of an autistic 9-year-old boy. Autism is defined as a 'developmental disorder of variable severity that is characterised by difficulty in social interaction and communication and by restricted or repetitive patterns of thought and behaviour'.[2] When Jane attended her initial radiotherapy clinic appointment, she was visually anxious. Her concerns were not around her cancer treatment, but the impact her treatment would have on her family, and in particular, her autistic son. This posed a unique set of challenges for the radiotherapy team, tasked with balancing the best outcome for Jane while minimising the impact on her family.

This presentation discusses the additional support, flexibility and understanding Jane required prior to and throughout her radiation therapy treatment. It also demonstrates how the relationships radiation therapists form with their patients every day helps provide the best quality care for each individual, tailored to the unique set of circumstances that each patient presents with.

*Jane is a pseudonym used for the purpose of this presentation.

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Building local proton beam therapy planning knowledge in an advanced paediatric radiation therapy centre

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The Australian radiation therapy landscape is prime for the introduction of a dedicated proton beam therapy (PBT) centre. Current process sees a small number of our patients travel internationally for PBT through the Australian Government Medical Treatment Overseas Program. The introduction of the first national facility will enable greater accessibility for Australian patients to receive PBT and confront many clinicians with the decision of whether or not to refer their patients for PBT.

Peter MacCallum Cancer Centre (PMCC) aims to establish local knowledge to readily transition to accommodating the availability of a local proton therapy centre. In order to achieve this, priority has been given to train and equip a small number of staff to build the skills necessary to undertake advanced intensity modulated proton therapy planning.

With the assistance of vendor-specific training and collaboration with international colleagues, retrospective planning is being undertaken utilising the broad scope of paediatric patients currently referred to PMCC. It is expected that the results will enable clinicians and patients to better understand the objective benefit between proton and photon radiation therapy plans.

This project will assist in establishing definitive criteria for the application of PBT once available in Australia and allow clinicians and patients to be prepared for the range of treatment options available.

A vision for superficial radiotherapy in rural western Victoria

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A partnership between a regional health service and a metropolitan radiotherapy service provider was formed to deliver publicly funded superficial radiotherapy for patients in Western Victoria. It is a single operator unit that commenced treatments in May 2019. Recognising the need to deliver comprehensive skin cancer care to the people of the Grampians region, the Victorian Department of Health and Human Services requested and subsequently approved a submission for a capital grant to fund the purchase of superficial treatment machine, minor room works and start-up costs of the service.

This presentation will outline the processes used and challenges encountered in setting up a remote superficial radiotherapy service when partnering with another health service. Drawing on the experience of the first 11 months of operation, utilisation data will be presented along with a discussion of the communication and promotion strategies implemented. The logistical and practical challenges encountered when running a remote single operator service, including verification procedures, cyber security arrangements, administrative support, staff redundancy and opportunities for education and team inclusion of the single operator will be discussed.

Community initiative drives implementation of 3D-printed bolus in a regional radiotherapy centre

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Objectives: Access to reliable and advanced healthcare can be a challenge in regional and remote Australia.[1] A newly developed regional cancer centre provides state of the art radiotherapy treatment with the support of a local foundation. This combination has continued the advancement of cancer initiatives throughout the region. Bolus has been used in radiotherapy to increase dose delivered to the patients' skin for many years, however, tradition bolus materials introduce uncertainty and inconsistency in dose modelling.[2] 3D-printed bolus is at the forefront of modern technology and is becoming more common in metropolitan radiotherapy centres.

Methods: Radiation therapists secured a grant to implement cutting-edge 3D-printed bolus technology to benefit patients within the region. An Ultimaker 2 Extended+ printer which utilises polylactic-acid filament was purchased. A streamlined process was developed to export bolus structures from Eclipse directly into the printer software. Verification was completed on the HU value and spatial accuracy of the 3D-printed bolus, along with its conformity to patient surface.

Results: When compared to traditional wax, thermoplastic, or gelatine-based bolus, the 3D-printed bolus more accurately reflected dose modelling in Eclipse. Results also showed that overall workflow was less labour intensive than traditional processes.

Conclusion: 3D-printers are becoming more common in radiotherapy, producing more consistent bolus when compared to traditional methods, thus increasing the reliability of dose modelling. The unique collaboration between the foundation and regional cancer centre has created a health service that emulates its metropolitan counterparts and continually strives to deliver the most advanced cancer treatment available.

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Implementation of applicator insertion for vaginal vault brachytherapy by radiation therapists

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High dose rate (HDR) vaginal vault brachytherapy (VVBT) is a common adjuvant treatment for endometrial cancer that aims to reduce the risk of local recurrence post-hysterectomy. Typical regimens involve 2–4 fractions during which a brachytherapy applicator, most commonly a single channel cylinder, is placed intra-vaginally. An Iridium-192 radioactive source is then positioned inside the applicator at pre-specified locations and times using a remote afterloader.[1]

Historically, applicator insertion has been the domain of a radiation oncologist (RO) and the role of radiation therapists (RTs) has been in treatment planning and afterloader operation. This presentation outlines a project which aims to improve efficiency and workforce utilisation by introducing RT-led cylinder insertion and treatment delivery for VVBT at a New Zealand radiation therapy department. This is the first project of its type in New Zealand.

A project group was setup to develop a competency framework and training module to allow eligible RTs to perform insertions and treatment under RO supervision for fraction one and without supervision for subsequent fractions. An overview of the module as well as the rationale, relevant regulations, implementation process and barriers will be explored. At the time of reporting, only one RT has been trained and is certified to perform cylinder insertions, however it is expected that this could be rolled out to more RTs at a later stage. This will significantly increase the proportion of cases that are RT-led and will further support our institution's vision of improving efficiency and workforce utilisation.

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The 30% rule: visualisation of the pectoralis muscle on the craniocaudal view of the breast

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Objective: Visualisation of the pectoralis muscle on craniocaudal (CC) views of the breast (Figure), is used to evidence posterior breast tissue inclusion.[1] The most commonly cited visualisation rate, originating in the film screen era is 32%, and anecdotally called the '30% rule'.[2] This research investigates the visualisation rate of the pectoralis muscle on digitally acquired CC views of the female breast and factors which may influence its presence on the image.

Methods: A retrospective review of 2688 paired CC view mammograms was performed on women attending BreastScreen NSW. Pectoralis muscle visualisation, width and length (mm) and variables hypothesised to increase visualisation: compressed breast thickness (mm), posterior nipple line length (mm) and age were recorded. Statistical analysis was performed using descriptive and inferential statistics. Ethics approval was granted by the NSW Population & Health Services Research Ethics Committee (AU/RED Ref: HREC/18/CIPHS/50).

Results: Pectoralis muscle visualisation was reported in 10.4% of images unilaterally (one breast, left or right only), 14.1% bilaterally (both left and right breasts) and 24.5% overall (unilateral and bilateral combined). No clinically significant correlations were identified.

Discussion/Conclusion: The '30% rule' was not able to be replicated in bilateral (14.1%) or unilateral (10.4%) digital images impacting current understanding of this aspect of image quality assessment. The clinical significance of the 30% rule must be challenged where the vast majority of images do not comply and there is no requirement for repeat imaging. Further research exploring diagnostic images and positioning techniques is required to validate this research.

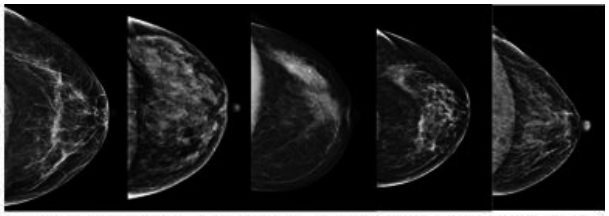

Figure 1: Varying presentations of the pectoralis major muscle on the left craniocaudal (CC) view of the breast. Source: BreastScreen NSW

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Automated image quality analytics in BreastScreen Victoria: a new vision?

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Background: BreastScreen National Accreditation Standards[1] require image quality reviews, using the PGMI (Perfect, Good, Moderate, Inadequate) grading criteria, to be undertaken for all radiographers. Reviews are time consuming and there is variance in criteria interpretation and application by designated radiographers.

A US Food and Drug Administration approved analytics software allows uniform assessment of image positioning and compression factors. The software analytics has potential to inform practice and provide real time technique and compression feedback to radiographers during screening.

Aims: This study aims to review the usefulness of Volpara Enterprise Analytics (VEA) software in the BreastScreen setting.

Methods: A retrospective VEA analysis of images from a Melbourne metropolitan BreastScreen site was undertaken. 50 cases were randomly selected for each of 15 radiographers. These cases were reviewed independently by two senior BreastScreen radiographers using the BreastScreen Victoria Image Quality Review process. The outcomes of the two systems were analysed and compared to determine their efficiency and accuracy of PGMI application. Compression values were also reviewed.

Results: The overall gradings for cases compared well between the manual and automated systems but the criteria selected differed.

Discussion: VEA is a useful tool, providing feedback regarding image quality to the individual radiographer. It identifies common positioning issues providing relevant video tips for optimising technique. Feedback on compression applied will assist the radiographer to modify their technique and has potential to positively influence client experience. Looking to the future the use of this VEA tool by designated radiographers can improve effectiveness of the review process.

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Exploring correlations between breast density of Papua New Guinean women and breast cancer risk factors

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Background: Papua New Guinea (PNG), has experienced an increase in breast cancer incidence correlating to the westernisation of the country.[1] Increased breast density is known to increase breast cancer risk.[2] This study investigates for factors unique to the women of PNG that may impact breast density and breast cancer risk.

Method: A survey was undertaken of 1161 women who had undergone mammographic imaging at the Pacific International Hospital.[3] Results were correlated with the five Tabár patterns (TP), previously reported for each women and breast cancer risk factors. Statistical analysis was undertaken using chi-square test, Fisher's exact test and odds ratio (OR). Ethics approval was granted through the School of Medicine and Health Sciences Research Ethics Committee.

Results: Relationships were identified between TP and parity ($P < 0.001$), marital status ($P < 0.001$), smoking ($P < 0.001$), alcohol intake ($P = 0.029$) and HRT ($P = 0.029$). There was no evidence of a relationship between TP and geographical location ($P = 0.290$), breast size ($P = 0.592$), occupation ($P = 0.724$), menstruation ($P = 0.866$) or exercise ($P = 0.290$). Married women (OR = 0.4004, 95% CI 0.2873–0.5579) and those with higher parity (OR 0.5034, 95% CI 0.3693–0.6862) were half as likely to have increased breast density reducing risk.

Conclusion: Factors associated with increased breast density in PNG included parity, marital status, smoking, alcohol, and HRT use were evidenced in this snapshot of PNG women. Breast cancer risk was shown to be reduced for married women and those with increased parity.

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Seeing the gaps – breast imaging for women with chronic kidney disease

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Introduction: In Australia, one in 10 adult women suffer from chronic kidney disease (CKD), with the incidence rate 11 times higher among Indigenous women, especially those living in Central Australia.[1,2] It is believed that this is due to a combination of biomedical, socioeconomic and geographical factors.[1] Among the numerous comorbidities of CKD little research has focussed on its impact on breast health and the practice of breast imaging for this group of patients.

Case Presentation: A 44-year-old Indigenous woman with end stage kidney disease presented with recurring unilateral breast pain and swelling over a 3-year period. Multiple imaging modalities were utilised to investigate these symptoms. Mammograms and sonograms showed extensive skin thickening and breast oedema.

Management/Outcome: Although these radiographic signs might stand out as indicators of inflammatory breast cancer, inflammation of the breast parenchyma could also be indicative of other underlying pathologies such as acute mastitis or a breast abscess.[3] Each of these pathologies often display symptoms and radiological characteristics that mimic each other.[3] Multiple biopsies have ruled out a malignancy, however, to date there is an ongoing discussion about the cause of this patient's condition.

Discussion: In accordance with hospital policy, an exploration into the patient's medical history and extensive discussions with her nephrologists were undertaken. This case study aims to highlight the gap in knowledge of CKD and its impacts on breast health as well as the lack of an integrated breast imaging protocol for women undergoing renal dialysis.

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3D scanning and 3D printing for skin cancer radiation therapy patients

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Background: Skin cancer patients receiving radiation treatment to the face require custom lead shielding masks to treat the cancer while shielding healthy normal tissue. Previously this required a plaster impression of the face, taking ~1 hour with the patient, plus an additional 2 hours of staff time to create the plaster mould and lead mask. This is often an uncomfortable procedure for the patient. A quality improvement project investigated utilising 3D scanning and printing to streamline this process.

Methods: Using a hand-held 3D scanner (accessory mounted to an iPad), a quick 3D-scan (<1 min) of the patient's face is acquired. Post-processing extracts the region of the face to be treated, which is sent for 3D printing. This 3D printed mould is used to create the customised lead mask.

A plaster mould was also made using the existing technique. Masks were constructed on both the plaster and 3D moulds. Assessments were completed focussing on geometric equivalence, patient comfort, patient and staff time and cost of materials.

Results: 55 patients have utilised this new 3D-scan to print workflow. Both techniques were found to be geometrically identical, cost comparable with the 3D printing method showing substantial improvement around patient time and comfort levels, also saving 2 hours of staff time/patient.

Conclusion: Implementation of the 3D-scan to print workflow has created a streamlined, cost comparable process, benefiting both patients and radiation therapists. The 3D-scan to print process has now been implemented clinically for all patients requiring a lead mask.

Evaluation of the clinical implementation of 3D printing in a radiation oncology department

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Objectives: Traditional forms of commercially available bolus have been used in most radiation oncology departments. However, as found in other centres, reproducibility has proven to be difficult.[1,2] Personalised 3D printed bolus can be a solution to this problem by reducing airgaps and creating plans that better represent and replicate the treatment planning system to achieve improved treatment delivery.[3]
The aim of this research was to assess the feasibility of introducing a new bolus technique using 3D printing into a radiation oncology department.
Methods: Prior to setup and integration of a large-scale 3D printer, the study involved the use of personalised bolus produced at a commercial printer. A human substitute was scanned and relative air gaps created in cavities were quantitatively measured. Dosimetric impact of these airgaps was assessed including depth dose at specific depths, overall airgap in percentage volume, dose max, dose mean, dose min and D 90%. Financial feasibility was also assessed using estimated patient numbers and cost analysis.
Results: The 3D printed bolus was able to more closely conform to airgaps in cavities with benefits to dosimetry better representing the plan from the treatment planning system. Assessing the potential patient numbers and doing a cost analysis of 3D printing it was determined it could be financially feasible and therefore be put into clinical practice.
Conclusions: Overall 3D printing has shown to be a feasible and potentially superior option to traditional bolus techniques.

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Multi-dose CT contrast system: cost analysis

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Introduction: The Transflux contrast delivery system is a multi-dose, multi-patient intravenous injection apparatus ultilsed during computed tomography (CT) contrast examinations. It is designed to produce improved cost, waste and time efficiencies between patients when compared to conventional, single-use systems.[1] This study was conducted to calculate the total volume and monetary savings of the Transflux implementation at the Logan Hospital Emergency Department (ED) and compare the findings to a previous study performed by the hospital's main outpatient department. Furthermore, the study also attempted to ascertain the most cost-efficient 12-hour timeframe to utilise the Transflux.
Methods: Four weeks of data from emergency CT contrast examinations were collected over a 4-month period. Recorded parameters included the time of the scan, the amount of contrast injected and the size of the single-use syringe that was used for any pre-filled injections. Karisma RIS was used to collect the studies and Google Sheets was employed to record the data. The Transflux data was then compared to existing, single-use injection parameters to compare efficiency in addition to outpatient department data.
Results: The ED Transflux demonstrates a cost saving and contrast volume saving of $1812 and 8239 mL compared to the outpatient department savings of $739 and 3353.5 mL over the 4 weeks of data collection. The most cost-efficient timeframe to implement the Transflux system in the ED is between the hours of 12:00 and 00:00.
Discussion/Conclusion: The data has shown the ED Transflux has significantly improved cost savings than the outpatient department with the comparable data. The existing, implemented timeframe the Transflux being used is justified as the most cost efficient and clinically appropriate given the increased patient volume and staffing presence.

3D printed bolus for chest wall irradiation – from vision to reality

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Objectives: Three-dimensional printed bolus (3DPB) is becoming standard of care in radiotherapy due to improved clinical fit compared to materials such as superflab and wax.[1,2] This study evaluated the implementation of 2 mm thickness 3DPB to enable a single plan solution for chest wall radiotherapy (CWRT).[3]

Methods: 3DPB using poly-lactic acid (PLA) was created by exporting the planned bolus structure into 3D bolus software (Adaptiiv, Halifax, Nova Scotia, CA) to create the STL file required by our N2 Plus 3D printer (Raise3D, Irvine, CA). To remove user influence adversely affecting 3D print quality, semi-automated post-processing removed CT markers from the body structure. Based on a 10 patient trial, bolus print fidelity was assessed by CT-scanning the prints and rigidly fusing them to the planning CT. Accuracy on treatment was evaluated using pre-treatment imaging and in-vivo film dosimetry.[4,5]

Results: PLA bolus prints with an in-fill density of 83% were found to be dosimetrically water-equivalent. To enable 2 mm thickness bolus prints, CT scan resolution was increased to 1024×1024. Bolus prints showed no gross defects with sub-millimetre print fidelity. Only one patient had an air gap >5 mm which was outside the target region. In-vivo measurements showed surface doses under the bolus were within 2% $\pm$ 4% ($k = 1$) of that planned for all patients.

Discussion/Conclusion: We have successfully produced 2 mm thickness 3DPB to facilitate a single plan solution for CWRT. Improvements in fit conformity and accuracy compared to superflab/wax,[1] and reduction in mould room burden, have also been achieved.

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Radiation therapy reimagined: investigating an upright solution

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Clinicians have recognised the importance of delivering radiation therapy (RT) upright for a sub-group of patients, when lying supine or prone is unachievable or unfavourable, ever since the early days of linear accelerator (linac) use.[1–3] Upright positioning has demonstrated clinical benefits, including increased lung volume as well as superior comfort for patients experiencing dyspnoea and saliva accumulation when lying down.[4]

While upright treatments were once popular, the introduction of computed tomography (CT) based 3D dosimetry necessitated image acquisition in a horizontal position (supine or prone), significantly reducing options for alternative patient positioning and upright techniques. However, upright techniques have still been utilised where clinically indicated for palliative and novel approaches.[5–7]

Our presentation will highlight the innovative use of commercial linac to acquire diagnostic quality 3D imaging for dose calculation. The promise of acquiring planning quality cone beam CT (CBCT) in an upright position could open new possibilities for patients where a vertical position is indicated, to take advantage of favourable anatomical changes or increased comfort. Our preliminary findings show similar results to planning-CT when dose calculated on HU calibrated CBCT for a simulated lung tumour.[8] This novel use of traditional linac could facilitate the development of new treatment techniques that employ patient rotation instead of gantry for planning data acquisition, dose delivery and organ at risk sparing. Our research also carries the potential to inform low-cost mobile RT solutions such as linac on a truck, making RT more accessible in rural and remote locations.

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The role of radiographer reviewing in forensic post-mortem computed tomography

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The application of post-mortem computed tomography (PMCT) is a recent inclusion for imaging in forensic medicine.[1–3] The implementation assists forensic pathologists in the process of identifying the cause of death of an individual referred to the coroner. Throughout Australia the use of PMCT varies per site. This presentation describes how NSW Pathology is supporting radiographers to assist the forensic pathologists address coronial directions, in the form of radiographer reviewing.

NSW Pathology has three CT scanners dedicated for post-mortem cases. Cases are imaged by radiographers or appropriately trained mortuary technicians (supported by radiographers) along with limited radiographic coverage. NSW undertakes PMCT on most coronial cases, once objection status is cleared, prior to the application of a coronial direction. With over 5000 cases involved in the coronial process each year it is impossible for all imaging to be reported on by a radiologist. NSW Pathology's radiographer reviewing approach allows for all cases that have been imaged to be provided with a radiographer review, which is within the radiographer scope of practice.[4] High profile, complex and forensic pathologist referred cases, which are also radiographer reviewed, are reported on by a radiologist. Radiographer reviewing is currently relatively informal, ranging from a verbal comment through to a written review that, despite having no legal standing, forms part of the final documentation provided to the Coroner by the allocated forensic pathologist.

This presentation looks at the application of the radiographer reviewing approach, the evolving implementation as well as the challenges and opportunities for the future.

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I see dead people: an overview of post-mortem CT imaging

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The first post-mortem computed tomography (CT) scan was reported in the 1970s.[1] Now forensic departments either have dedicated CT and/or MR scanners in their institutes or they establish relationships with local clinical centres.

At Royal Darwin Hospital we are one of the lucky ones. Forensic radiology is a specialised area of medical imaging using radiological techniques to assist pathologists in determining cause of death and anthropologists to identifying remains. Our scans assist in documenting anatomy and pathology for forensic purposes, generate insight into the deceased's mortal circumstances and allow for re-evaluation of the evidence over the years to come. This presentation will open your eyes to the Royal Darwin Hospital post-mortem CT procedure and explore the differences in seeing the scans of dead people compared to the scans of the living.

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Raising concerns: a qualitative study investigating student experiences of reporting practitioner professionalism lapses

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Objectives: Medical radiation practitioners (MRP) experience challenges raising concerns about their peers' professionalism lapses.[1] The literature highlights barriers such as fear of adverse consequences as influencing healthcare students' decisions whether or not to raise concerns about practitioner performance.[2,3] However, to date, this has not been investigated in MRP students.
Aim: To investigate the challenges associated with students raising concerns about practitioners after experiencing professionalism dilemmas while on clinical placement.
Methods: Ethics approval was granted and seventy students from six Australian universities were recruited to participate. Flyers, email and snowballing techniques were used for recruitment, through student, academic and administrative staff facilitation. Interviews were digitally recorded, transcribed and anonymised. Participants provided accounts of their experiences related to raising concerns about practitioner professionalism lapses. Team-based framework analysis was used to code and theme the data. Team reflexivity was employed to add rigor to the study.
Results: The following themes were identified: Fear of repercussions (alienation, burning bridges, assessment failure, tarnishing reputation), Inexperience, Confidence, Power/Hierarchy and Resolution 'know how'.
Discussion/Conclusion: Fear about the consequences of raising concerns/reporting and lack of 'know how' about the processes involved were commonly experienced. Curricula should be developed to ensure students are equipped with knowledge about the processes, confidence and skills to communicate concerns. Clinical organisations should provide a supportive, confidential environment to encourage and support students who wish to raise a concern. Non-discipline related practitioner advocates could be identified to support this process.

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Application of reflexivity in qualitative research: a vision for enhancing practice

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Background: Qualitative research focuses on understanding people's lived experiences. Although long recognised as important in our profession qualitative approaches are emerging albeit slowly. Qualitative researchers need to be transparent and recognise their own perspectives and biases and how these can influence study design, conduct, data collection, analysis and interpretation. Reflexivity increases the rigour of the research,[1,2] however its use is seldom reported in the methods of qualitative medical radiation practice studies.
Methods: Using an exemplar study, this paper provides an evidence-based discussion and synthesis of researcher experiences of integrating reflexivity into qualitative research design. The exemplar study investigated student experiences of professionalism dilemmas. Reflexivity was applied in different ways throughout:
1. team reflexivity prior to study
2. reflection during data collection
3. reflection during data analysis
4. post-study reflexivity.

Discussion: To reach a common understanding of the research problem and design, reflexivity allowed all team members to acknowledge any biases or lenses of their own context through which they were viewing the research question. Team diversity and the collaborative nature of project work can add to the richness and depth of data analyses promoting robust debate around theming and interpretation. This contributes to the rigour and truthfulness of the findings, with the integrity of the research resting on disclosure of differing perspectives of the researchers.
Conclusion: Reflexivity is a valuable aspect of the qualitative research process, increasing rigour through openness of the researchers. It is applicable to qualitative medical radiation practice research and team-based clinical practice, warranting further investigation.

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'20/20 vision' – a snapshot of radiation therapy practice in Australia

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Background: This study is a cross-sectional census aimed at the current radiation therapy treatment techniques, the number of patients treated and cancer tumour site categories across Australia. Radiation therapy is a fast-paced technology driven profession with approximately 68,000 Australians accessing radiation therapy treatments with Medicare subsidised services costing $454,131,927 in 2017.[1] Findings of a national single-day audit conducted on radiation therapy practice across Australia in 2020 will be presented.
Methods: The study design is a census method using Qualtrics (an advanced web-based application for online surveys) with all radiation therapy centres in Australia being invited to provide quantitative summary data relating to patient case mix and technology use on a randomly selected, but common date. Anonymous and demographic-free data will be analysed using descriptive statistics. Ethical approval is currently underway for this data collection. This data will be compared with the research of Bridge et al,[2,3] and Batumalai et al.[4]
Results: Results of this census are pending as the survey is not yet closed.
Conclusion: Discussion of the findings will focus on treatment techniques, case mix and technologies available.

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Investigating the New Zealand radiation therapy curriculum: how we got here, where are we going?

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The well-designed education of radiation therapy practitioners is required to support growing demand on oncology services.
In New Zealand, a range of stakeholders lay claim to a say in curriculum design for student radiation therapists. Universities expect graduates to display certain attributes; educators hold views on an appropriate learning environment; clinical leaders need good employees to deliver services and adapt to ever changing clinical practice; professional bodies seek to advance the profession and its members; a regulatory body must protect the public by ensuring those who use protected professional titles are quantifiably competent to do so; and students expect their learning experience to be engaging and prepare them for practice in their chosen field. This scenario could be applied equally well across other healthcare disciplines.
Arguably those voices will have competing if not conflicting interests. All are valid and their expectations must be met at some level. Although current education provision successfully produces competent practitioners, no formal collation of the various perspectives has occurred nor has any theoretical underpinning been documented in the New Zealand context. A qualitative project, following a constructivist grounded theory design, is currently underway which aims to do just that. The study should generate a set of guiding principles to guide radiation therapy curriculum development now and in the future to meet changing needs.
Initial results will be reported in this presentation, indicating the perspectives of a range of the stakeholders around the past, present and future state of radiation therapy education in New Zealand.

Rapid access palliative radiotherapy service at SA Health: now and a vision for the future

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[1]*Royal Adelaide Hospital, Adelaide, Australia*

Traditionally, palliative cases have been required to undergo at least two or three visits to receive their radiation therapy treatment, consisting of an initial consultation, computed tomography (CT) simulation, dosimetry and treatment. The Rapid Access Palliative Radiotherapy Service (RAPRS) has been implemented at the Royal Adelaide Hospital to provide prompt management for patients suffering with advanced cancer.

The RAPRS clinic is run weekly with an initial consultation, followed by CT planning and treatment performed in single departmental visits with a duration of less than 2 hours. The service aims to provide patient centred care, minimising the requirements for subsequent visits.

The Royal Adelaide Hospital commenced the first CT planned RAPRS treatment in August 2019 and is continuing to develop and expand. The service has a vision to use linear accelerator-based cone beam CT imaging for planning and treatment, generating a streamlined automated workflow for treatment delivery, further reducing the time that the patient is required in the department.

To date, seven patients have received treatment via the RAPRS clinic, and the numbers continue to increase. This presentation is to share the experiences of implementing the RAPRS clinic at the Royal Adelaide Hospital and provide a roadmap for the deployment of the automated protocol.

Using telehealth to support education of prostate cancer patients receiving radiation therapy

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Objectives: Evidence suggests that variable bladder and bowel-filling results in increased prostate motion during radiotherapy.[1–3] Furthermore, rapid dose fall off between prostate and adjacent critical structures generates greater susceptibility to small deviations in planned radiotherapy. The aim of this study was to determine if a radiation therapist (RT)-led telehealth consultation prior to CT simulation for prostate cancer patients leads to improved patient bladder/bowel preparation compliance.

Methods: Participants (N = 50) were randomised to receive bladder/bowel preparation information via an information sheet and follow up phone call (standard of care [SOC]) or a telehealth consultation (intervention). The telehealth consultation requires an RT-led video consultation via an interactive web-based platform. Patient compliance to bladder/bowel preparation was captured at planning CT, together with health literacy and patient satisfaction measures.

Results: To date, 18 patients (nine SOC; nine telehealth) have been recruited to the study. One patient withdrew post-consent due to technical difficulties with the telehealth platform. Compliance to bladder filling instructions was equivalent for both patient cohorts (62.5%). Interestingly, rectal filling compliance was present in all SOC participants, compared to 75% of the telehealth cohort. Perceived improvements to bladder/rectal filling requirements and improved patient satisfaction were witnessed in the telehealth cohort.

Conclusion: Telehealth offers a convenient face-to-face alternative to written instructions and may enhance patient understanding and procedural compliance. Our preliminary findings are encouraging. There remains an exciting opportunity to extrapolate this technology beyond prostate cancer and even radiotherapy in the setting of patient education.

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Results of SABR and SRS dosimetry audits in Australia and New Zealand

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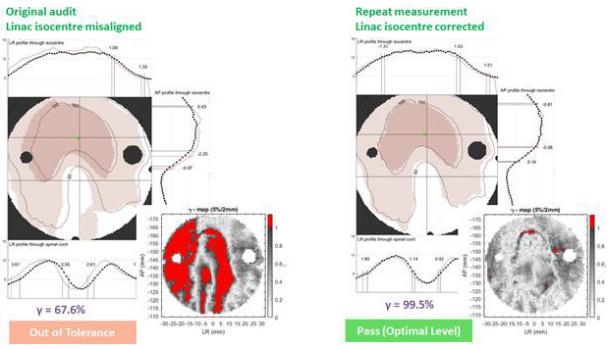
Introduction: Stereotactic ablative radiotherapy (SABR) and stereotactic radiosurgery (SRS) techniques present an increased risk to patients due to the increased dose per fraction and high geometric precision. Specialised planning, treatment and quality assurance practices are needed to ensure patient safety.[1–3]

Method: The ACDS offers end-to-end dosimetry audits of SABR and SRS techniques to radiotherapy facilities across Australia and New Zealand. The SABR audit utilises a thorax phantom to measure dose in lung, spine and soft tissue targets. The SRS audit utilises a cranial phantom to measure dose in multiple metastases, simple SRS targets and targets that are visible on MR imaging only. Gafchromic film is used to measure 2D delivery accuracy, along with point dose verification in centre of PTVs.

Results: The SABR dosimetry audit has been performed in 42 radiotherapy facilities, with over 200 plans measured. The SRS audit has been performed in six radiotherapy facilities, with 18 plans measured. Plans that were assessed as out of tolerance in the audits will be discussed as case studies. The Figure shows the effect of linear accelerator isocentre misalignment in a SABR spine delivery.

Other case studies to be presented include incorrect prediction of dose at the periphery of lung tumours, incorrect IGRT, limitations of Exactrac imaging in extra cranial targets, differences between single and multi-isocentre treatments for multiple brain metastases and limitations of planning system calculation algorithms.

Conclusion: The ACDS has developed a comprehensive audit for SABR and SRS treatments, highlighting areas for improvement in current clinical practice.



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Optimising on-board imaging techniques and workflows for SRS/SRT intrafraction verification

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Patient positioning verification for intracranial stereotactic radiosurgery (SRS) and stereotactic radiotherapy (SRT) treatments always begin with the initial setup of the patient prior to the beginning of treatment, however clinical utilisation of intrafraction position verification varies.

Currently, in our centre, patient positioning is required to be within 0.7 mm, 0.7 deg for all axes. An analysis of positioning data from ExacTrac® (Brainlab AG, Munich, Germany) for 102 patients showed that 42.3% required an intrafraction translation of 0.7 mm or greater and 24.7% required an intrafraction rotation of 0.7 deg or greater. This analysis highlights the need for intrafraction image guidance.

For intrafraction image guidance, kilovoltage cone beam CT (CBCT) cannot be used when large couch rotations are introduced. When utilising CBCT for initial setup, various intrafraction verification techniques exist including no intrafraction verification, 2D planar MV at all other couch positions, and orthogonal pairs where possible with 2D planar imaging where restricted.

To compensate for patient movement, we are investigating on-board imaging techniques that are available on a standard TrueBeam® (Varian Medical Systems, Palo Alto, USA) with advanced imaging. OBI utilising kV and MV planar imaging with box-based 6D automatic registration is promising compared to other systems.[1] However, before implementing on-board imaging verification for this patient cohort clinically, validation should not only include accuracy and precision tests, but also simulate treatment workflows. This will enable refinement and optimisation for quality and efficiency while minimising collision risk for SRS/SRT treatment delivery.

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Automated non-co-planar stereotactic treatment of multiple brain metastases: a case study

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Introduction: This case study describes our clinic's first use of the Varian Hyperarc platform to deliver automated stereotactic treatment of multiple brain metastases simultaneously.
Case Presentation: A 40-year-old woman with a history of metastatic colorectal cancer presented for treatment of an intracranial surgical cavity and two de novo lesions. 24 Gy in three fractions and 27 Gy in three fractions was prescribed to the cavity and lesions, respectively. Permission was granted by the patient for details of her treatment to be presented.
Management/Outcomes: Treating staff completed training material and conducted an end-to-end procedure and dry run prior to treatment delivery. Planning CT and MRI were acquired at 1 mm slices in the treatment position using a specialised stereotactic mask system. A single non-co-planar plan for all three targets was generated using the custom Hyperarc workflow and met clinical constraints. Automated treatment delivery was utilised with a maximum treatment duration of 14 min and maximum intrafractional motion of 0.2 mm and 0.1°. Only minor treatment-related symptoms were experienced post-treatment.
Discussion: Our team successfully treated a first case of multiple intracranial lesions using the Hyperarc platform. The patient was happy with the procedure and voluntarily filmed her experience and shared this publicly to raise awareness of radiation therapy as a treatment modality.

Code for radiation protection in medical exposure (2019): what do regulators expect from workers and organisations?

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The idea is to start to 'socialise' the concept of a documented set of expectations of radiation regulators for the various regulatory obligation that are imposed on licence holders across the country. In this case, we are talking about the expectations in relation to the newly published Code for Radiation Protection in Medical Exposure. I'll present some of the thinking that is going into these documents.

The halo effect

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Our initial vision of students will impact them through time.
In 1920, psychologist Edward Thorndike released a paper titled 'A constant error in psychological ratings'. Thorndike noted the lack of objectivity when rating separate qualities of an individual. He observed that people who were judged as a 'rather good person' would also rank highly in areas such as perceived intelligence, character and physical qualities. He termed this phenomenon the 'halo'.[1]
The halo effect has been noted in various studies including those on clinical education. Students perceived as outgoing and personable are more easily accepted by the department and are viewed as genuinely better students, regardless of their actual technical knowledge. This encourages staff to be more willing to give their time to the students and involve them. The reverse is likely for a student who may be perceived to be difficult, regardless of the reason. Irrespective of their technical knowledge, these students would be labelled as poor or struggling students and may find suitable teaching scarce. This will obviously impact the quality of student placement.
This presentation reflects the insight of a new clinical educator in a large public hospital. The halo effect is difficult to evaluate and recognise but can have a profound impact on a student's placement.
The aim of this presentation is to provide insight into the halo effect and brings the phenomenon into light for all those involved with the clinical education with students.

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Clinical educators' attitudes towards educational technology: a mixed methods study

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Introduction: In healthcare, there is ongoing flux in expectations for students and practitioners. Establishing integrated systems of monitoring and evidencing students' development is imperative. With current trends towards the use of technology in tertiary education, online learning environments (OLEs)[1-3] could constitute more effective evidencing of student progress in the clinical environment. However, there is little research exploring clinical educators' experiences with implementing technology in clinical education.
The research aimed to:

- examine clinical educators' attitudes towards technology and its use in clinical education
- explore clinical educators' experiences of implementing technologies in a clinical environment.

Methods: A mixed methods approach was taken to explore the aims. A previously validated technology attitude survey was used with slight modifications, as well as open-ended qualitative responses. These explored clinical educators' experiences of the implementation of one specific OLE (PebblePad™) in their clinical environments. The survey was sent to clinical educators involved in the supervision of Medical Imaging students on clinical placement.
Results: Clinical educators play pivotal roles in students' professional development and, given current trends in tertiary education, are under increasing pressure to utilise OLEs. This poses particular challenges in clinical environments. Irrespective of the challenges, successful implementation of technology in any environment is dependent on the attitudes of the users.
Conclusions: Clinical environments have specific challenges when implementing technology such as access to computers and time constraints on practitioners. Even with positive attitudes towards technology, a change in pedagogical outlook when using technology in clinical teaching is necessary.

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Ottawa Ankle Rules: adequacy of clinical information in X-ray referrals for traumatic ankle injury

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Ankle and foot injuries are the most commonly presented musculoskeletal injuries in Australian emergency departments,[1] with 4667 such presentations in South Australia in 2017–2018.[2] The Ottawa Ankle Rules (OAR) are part of a clinical decision-making tool to help clinicians accurately rule out ankle fractures and hence preclude the need for diagnostic X-ray imaging of ankle trauma.[3] This instrument has a sensitivity of almost 100% across various studies.[3] The rules state that ankle X-rays are only required if the patient experiences malleolar pain and bone tenderness of the posterior distal tibia/medial malleolus tip, the posterior distal fibula/lateral malleolus tip or an inability to weight bear for four steps both immediately and in the emergency department.[4]

In this study, we undertook a retrospective clinical audit of 300 ankle imaging referrals to (i) assess the current usage of the OAR in ruling out ankle fractures in a major metropolitan emergency department in Australia; (ii) evaluate the current concordance rate of scoring with positive findings on radiography and (iii) report on referring trends between professions, including consultants, registrars, physiotherapists and nurse practitioners. Ethics review was not sought because the study met criteria for exemption from such review according to an institutional policy.

The outcome measures are characteristics of the included patients, compliance rate with the OAR, overall prevalence of ankle fractures, referring trends and sensitivity, specificity, positive likelihood ratio and negative likelihood ratio of the OAR in this study. Formal results are pending but will be available at time of presentation.

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Anatomical side markers – a future vision for a perennial problem

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This proposal introduces a simple, innovative, cost-effective and error reducing solution to the ongoing problem of image mislabelling and its associated life threatening and medico-legal consequences.[1] Published audits have shown that missing or incorrect side marker events can occur in nearly 6% of medical images acquired, and in some more acute scenarios may exceed 50%.[2] Most attempts to reduce these rates focus on further training and auditing,[2,3] but can realistically only hope to achieve incremental improvements while human fallibility remains a factor.

The introduction of a digital photographic image acquired simultaneously and archived with the medical image could provide widespread benefits including unequivocal side and position identification, eliminating the risk of human error. This concept could be easily applied across all modalities where side specificity and patient orientation is of concern.

Multiple additional advantages include time and dose saving benefits through reduction in retakes and improved follow-up reproducibility of images. It could also become an invaluable education and teaching tool, leading to improved radiology reporting accuracy (with an increase in available clinical information and patient identifiers) plus improve accuracy in forensic applications.

A literature search revealed prior implementation and application of the same basic concept, though primarily focussing on patient identification rather than the potential elimination of side and orientation marker errors. This indicates that further study is required regarding the potential benefits in error elimination. Discussion regarding the feasible implementation of this simple technology, and the case for its mandatory inclusion into all imaging equipment, is raised.

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Alternative positioning approach to a true lateral wrist

Nicole Peacock,[1] Adam Steward[1]
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Radiographic positioning has largely remained unchanged in description over time, rendering a myopic approach to methodology with little adaption.

Positioning for planar radiography of a lateral wrist projection is often inappropriately described in textbooks and some literature. These describe a method of positioning that requires the rotation of the radius over the stationary ulna from the posterior-anterior projection with little other stipulation.

This presentation provides a review of the article published in the July/August edition of *Radiologic Technologist* by the authors. The article describes the criterion and specifications of radiographic images in the diagnosis and management of wrist pathology that referrers and radiologists require.

This presentation will describe the principles directing patient positioning in wrist imaging, conventional lateral wrist positioning for plain radiography, and an alternative positioning approach for a true lateral radiograph of the wrist joint; and provides a clear and considered vision for patient positioning in general, and specifically for the lateral wrist.

Ethical considerations for radiotherapy projects. Is it quality improvement or research and does it matter?

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Technology, techniques and patient processes are constantly evolving and becoming more complex. With the vision of improving patient outcomes, patient experiences and workflow efficiencies, Radiation therapists are increasingly undertaking research studies and quality improvement (QI) initiatives. Research and QI have subtle differences, which can make it challenging to clearly identify the appropriate pathway to investigate a clinical problem. Clarity regarding appropriate pathway is further clouded by ethical implications of both forms of investigations, and the frequent blurring of projects that may start as one type of project and evolve into the other over time.

QI projects typically evaluate or audit implemented changes in patient care processes in a specific healthcare setting.[1] Research projects are typically investigations that test/compare different groups, and are often designed to develop or contribute to existing knowledge, or generate new understanding.[2] According to the National Health and Medical Research Council, irrespective of whether a project is classified as research or QI, staff involved in conducting the project must consider whether the participants involved (staff, patients, and community) will be exposed to any risks, burden, inconvenience or breach of their privacy and ensuring the activities are conducted in way that is ethical.[1]

The aim of this work will be to review national guidelines and discuss in the context of typical radiation therapy projects and activities describing the appropriate oversight and or ethical review. We will also describe departmental initiatives on QI and research projects aimed to ensure appropriate ethical oversight and governance.

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A cyber-attack in a paperless department

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In October 2019, a ransomware attack hit Eastern and South Western Victoria, affecting 44 health services. Some of these health services included radiotherapy departments, affected to different degrees. Our department was one hit by the attack.

Our centre is a contemporary regional centre with two linear accelerators, a superficial X-ray machine and dedicated planning CT. With the significant push towards electronic medical records (EMR) across health services, we have invested significantly in the development of an EMR and consider ourselves a paperless department. At the time of the cyber-attack, all servers were rendered inoperable with zero access to electronic data across the entire service. Redundant data systems were also affected meaning risk management mitigation processes were flawed.

As a result of the attack there was no access to the radiation oncology system for 6 days and considerable ongoing outages. All staff in the organisation rallied to ensure patient safety and care was maintained throughout the event, and no patients had their treatment compromised. While there had been a great vision for a paperless department the unthinkable happened and the department was vulnerable.

Additional processes are being implemented to ensure enough access to information should this type of situation recur. While the benefits of electronic systems are evident, risk management strategies should pay due consideration to events such as the one experienced at our centre.

Establishing baseline measurements of safety culture and incident learning systems in radiation oncology

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Background: Practice standards stipulate a safety and quality management (SQM) strategy within radiation oncology, ensuring quality improvement (QI), risk management, incident reporting, staff training and appropriate resources reducing risks proactively.[1] Implementation of a new radiation oncology-specific incident learning system (ILS) began in 2019. ILS should include reporting, analysing and developing QI interventions with appropriate feedback loops.[2] Before implementation, baseline measurements around safety culture (SC) and ILS occurred. This presentation examines baseline investigations that were found.

Methods: A 28-question e-survey was distributed to medical radiation oncology staff within one local health district between September and October 2018. The survey was based on similar surveys used to measure the SC and ILS.[3–5]

Results: The survey was completed by 70 staff, an overall response rate of 64%, demonstrating varied levels of understanding and utilisation of ILS. 24% of respondents could identify all incident reporting systems in use, a distinct difference between the three professional groups around knowledge and use of reporting was revealed. 67% of respondents identified barriers to reporting an incident and 61% of respondents perceiving a no-blame culture. Overall, results influenced an appropriate, relevant and robust ILS within our department.

Conclusion: Results identified areas for SC improvements, and suggested staff should be receptive of the new ILS. It was imperative to quantify the baseline culture and understanding before implementation to measure the QI success and areas for continued QI within our SQM.

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Radiation therapist-led patient specific QA-building: a model to sustain rapid access to treatment

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IMRT and VMAT techniques are the standard treatment approach for approximately 90% of all patients treated across the network. Completion of patient specific quality assurance (QA) was a source of stress for both radiation therapists and physicists. With planned expansion of stereotactic services set to further increase the demand on the teams a refreshed approach to patient specific QA was required. New software using EPID based measurements to verify the dose from the linear accelerator against dose from the treatment plan was adopted.

The aim of radiation therapist-led VMAT/IMRT QA was to implement a streamlined process that enabled faster access to treatment. The new workflow would remove bottlenecks and provide flexibility to complete QA throughout the day therefore reducing delays.

After successful adoption of EPID QA by the physics team plans were put in place to transition this work to the radiation therapist. This was planned in two phases: Phase 1 was QA treatment capture and Phase 2 QA analysis and reporting. Tasks were managed via a Mosaiq IQ scripted workflow.

Radiation therapists now complete over 98% of VMAT/IMRT QA. RT-led patient specific QA has enabled QA to be shared across centres with beam matched linear accelerators and across the course of the day to reduce bottle necks in the pre-treatment process. The change has ensured that when unplanned events such as machine breakdowns occur the network is able to support the completion of QA. Staff have reported over 85% satisfaction with the ease of the system for both capture and analysis.

Evaluation of a deformable image registration quality assurance tool for head and neck cancer patients

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Objectives: A challenge in implementing deformable image registration (DIR) in radiation therapy planning is effectively communicating registration accuracy to the radiation oncologist. This study aimed to compare qualitative user ratings of DIR accuracy with quantitative metrics as well as inter-observer reliability when using a new quality assurance (QA) rating tool.

Methods: A retrospective DIR was performed on the diagnostic and planning CT images for 35 head and neck cancer patients. The QA tool was used to rate DIR accuracy as good, fair or bad. 30 deformed images were assessed by three operators and a further five deformed images were assessed by five operators. Ratings were compared with quantitative metrics calculated for anatomical regions on the deformed images. Inter-operator reliability was assessed using Krippendorff's alpha test.[1] Rating time and volume measures for each rating were also calculated.

Results: Volume variation metrics and Jacobian determinants for most anatomical sub-regions assessed reflected expected values for good, fair and bad registrations. Highest inter-operator reliability was observed in the good ratings and within the left and right parotids, while inter-operator reliability varied the most in regions of dental artefact. Average rating time was 33 minutes. Overall, good ratings were applied to the greatest volume of the image with fair ratings to the lowest volume.

Conclusion: Results from qualitative and quantitative data, rater differences and rating time suggest that highlighting only bad regions of DIR accuracy and implementing clinical guidelines and RT training would be required for consistent and efficient use of the QA tool.

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Validation of the Ottawa Knee Rules in adults: a single centre study

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Acute knee pain is a common complaint in emergency departments, for which plain radiography has long been implemented to diagnose.[1] However, despite the popularity of radiographs, studies show knee fractures occur in only 5.2% and 6% of patients.[2,3] To combat this overuse, Stiell and colleagues in Ottawa, Canada, derived specific decision rules to justify knee radiography, later entitled the 'Ottawa Knee Rules' (OKR).[2] The rules state that knee radiographs are indicated if at least one of five criteria is met, including age 55 years or more, isolated patella tenderness, tenderness at head of fibula, inability to flex knee to 90 degrees and inability to weight-bear more than four steps.[2] Patients meeting at least one of the criteria are highly suspected of having clinically significant knee fracture, and the rules themselves have established over 99% sensitivity across various studies.[1]

This presentation will reflect a clinical audit performed in December 2019. The audit will evaluate the appropriateness of referrals for knee radiography in acute knee injury with reference to the OKR. This retrospective audit aims to analyse 300 knee X-ray referrals that presented to the medical imaging department at a major public hospital in South Australia. The authors anticipate an accuracy of up to 100% for OKR in detecting knee fractures. The overall prevalence of knee injuries, including sensitivity and specificity, and referring trends between professions will also be evaluated in this study. Results of the final analysis will be reported in the presentation.

This abstract is taken from the published manuscript, which can be found in the *Journal of Medical Radiation Sciences* https://doi.org/10.1002/jmrs.411.

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Seeing the end-goal in paediatric image-guided radiation therapy: imaging parameters and matching accuracy

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Objectives: Approximately 800 paediatrics will be diagnosed with cancer in Australia in 2019;[1] 5-year survival is 84%.[1] Paediatrics are 7–15 times more sensitive to radiation than adults.[2] Therefore, image-guided radiation therapy (IGRT) should be optimised. The aim of this quality improvement project was to determine if, the accuracy of IGRT for paediatric patients can be maintained using reduced radiographic dose exposures instead of vendor pre-sets.[3]

Methods: A table of low-dose radiographic exposure factors for paediatric IGRT was determined through a phantom study on a linear accelerator. This table was evaluated against the linear accelerator manufacturer pre-sets, in terms of exposure dose and user accuracy when matching. Four anatomical sites, head and neck, pelvis, abdomen and thorax were included. Matching accuracy was assessed in a simulated clinical situation, where participants anonymously recorded their matched moves in an online survey.

Results: 12 radiation therapists or radiation oncologists completed the image matching task and survey. The low-dose exposure table reduced imaging dose by 20–94% compared to manufacturer pre-sets (Table). No significant difference was observed in the accuracy of image matching (head and neck $P = 0.82$, thorax $P = 0.15$, abdomen $P = 0.33$, pelvis $P = 0.59$). Participant image exposure preference was largely equivocal.

Conclusions: Optimising radiographic exposures in paediatric IGRT is feasible, logical and therefore reasonably achievable. Implementation of the low-dose exposure table should be considered by paediatric radiotherapy departments wishing to image gently without compromising the potential to detect setup errors.

Table 1: Dose Comparison Between Factory and Low-dose Pre-set Exposure Recommendations

Exposures	Factory (mGy)	*Low-dose* (mGy)	Dose reduction (mGy)	Dose reduction (%)
Lateral pelvis	10.692	0.668	10.024	94
Anterior pelvis	0.684	0.171	0.513	75
Lateral abdomen	3.544	0.886	2.658	75
Anterior abdomen	2.506	0.251	2.255	90
Lateral thorax	4.415	1.104	3.311	75
Anterior thorax	0.342	0.274	0.068	20
Lateral head and neck	0.295	0.236	0.059	20
Posterior head and neck	0.975	0.78	0.195	20

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Deformable dose accumulation for adaptive radiotherapy and interpretation of clinical outcomes

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Online cone-beam computed tomography guided radiotherapy has demonstrated how patients dynamic actually are and revealed limitations of the current static, plan-and-treat paradigm. Radiation therapists have observed positioning variations, substantial organ motion and deformation, progressive weight loss, and changes in tumours which can respond or progress. These scenarios cannot be simply corrected online and impact treatment quality by introducing uncertainties in the doses actually delivered and how individual patients respond to treatment. Accurately monitoring and tracking these changes using deformable image registration techniques to accumulate dose can inform clinicians of relevant dosimetric changes and potentially the need for treatment adaptation with higher specificity than simple visual review of imaging.

Research using records of accumulated-delivered doses has also enabled the creation of more accurate dose-response models of tumour response and normal-tissue toxicities that differ significantly from current models based solely on planned doses. This has the potential to further tailor treatment strategies at the individual patient level.

Rigours validation of these processes are required prior to implementation to ensure new sources of error are not introduced into clinical processes. Additionally, they will require radiation therapists to develop new technical skills and clinical judgement. Moving towards a more explicit dose-driven radiotherapy process using deformable dose accumulation will allow for more appropriate evidence-based decision-making and precise cancer treatment that will improve outcomes for patients.

Vision for planning automation to support quality, safety, access and efficiency

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Background: Planning automation is widely used to improve productivity and standardisation, attributing to increased practice safety and quality. The research aimed to develop headless platforms which deliver automated planning which enables effective, highly focussed use of resources.

Aims: Develop a supported headless planning system for VMAT plans across multiple platforms using a centralised team and infrastructure. Additionally, the team looked to develop a sustainable team of software developers with the skills required to support and innovate with links to experts within the field.

Methods: The team integrated the planning systems with IT infrastructure to gather plan information from multiple systems. The system compiles a list of instructions to deliver to the TPS to complete plans and evaluate end points against established benchmarks to ensure plan quality. Initial tests were completed retrospectively to ensure quality met or exceeded dosimetrist completed plans.

Results: The result was either a completed, headless plan with passing quality metrics or a plan failure that required manual intervention. Over 50% of plans completed by the system for each TPS, met or exceeded expectations and could be clinically delivered. The system proceeded to clinical use with QA and governance procedures in place.

Conclusion: Highly automated and headless systems capable of developing plans that meet or exceed plans completed by dosimetrists have been introduced clinically across three countries. This has allowed planning teams to focus on developing stereotactic services and plans for sites where automation fails, and user input is required.

Shared vision for a state-wide patient data exchange solution

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Radiation oncology has undergone a rapid evolution over the last few decades. Complexity of patient treatments have increased, where once reserved for complex cases, it is now the standard of care.

The continual development of radiation therapy technology and increased plan complexity makes the accurate sharing of a patient's previous treatment information more important than ever. Current methods of sharing previous treatment information rely on sending a broad snapshot using a few 2D images of the radiation plan. This information is generally shared via email or fax. Faxing this information results in degradation of the images through imaging artefacts and conversion of coloured isodoses to grey scale. When using these methods of data sharing it is impossible to accurately model dosimetric overlap.

The Leader of Planning Services at a Victorian public provider identified the need for a universal request and data sharing solution to enable sharing of DICOM plan data. They began a quest to build a sharing platform that would facilitate safe, accurate and appropriate radiation therapy re-treatment decisions for all Victorian radiation therapy providers.

This presentation will detail the steps undertaken to initiate a secure cloud-based platform for sharing radiation treatment information. Steps included initial proposal, securing Department of Health and Human Services funding, consensus on system requirements, development sprints and acceptance testing. Key recommendations and lessons learnt will be shared, such that others can learn from our experience.

A vision splendid: forming a collaborative New South Wales knowledge-based planning consortium

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Knowledge-based planning has been described in the literature for several years, however utilising new technologies such as this is often difficult. There are many real and perceived barriers to development in different centres and there is often a sense of reinventing the wheel.

Such barriers include:

- lack of staff or other resources
- lack of local expertise or support
- limited pools of particular patient and planning data
- geographical isolation
- competing clinical priorities.

To overcome many of these barriers, it makes sense to collaborate with like-minded individuals and institutions toward a common goal. In August 2018, the vendor of our knowledge-based planning system (Varian) hosted a meeting of users to discuss such co-operation.

Since then, several face-to-face meetings were independently held. Engagement with the Cancer Institute of NSW, NSW Ministry of Health and TROG was also instigated, and overseas and interstate consortium models were investigated. By October 2019, a steering committee was formalised and the path forward was set with regular physical and teleconferencing and an annual meeting organised.

While this paper seeks to describe the journey of the New South Wales (RapidPlan) Consortium – some of the particular challenges and considerations that were faced, as well as several achievements, it also seeks to describe the broader outcome of the process, which is a general model for collaboration and progress. It is certainly a 2021 vision splendid.

Proposing the next generation of imaging agents: targeted to a disease and for a purpose

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Background: Intravascular contrast agents are commonly used in medical imaging. They travel throughout a patient's body with the intent of improving imaging of pathology. These can be non-specific; the same contrast agent can be used for imaging an oncology condition, infection or other disease processes. The question remains; have we seen all sites of pathology?

Aptamers are oligonucleotide or peptide molecules[1] capable of binding with high specificity to a specific target molecule.[2] Aptamers are smaller than antibodies, can infiltrate tissues and cells, are non-toxic and non-immunogenic.[3]

If aptamers can be chelated to an isotope, then aptamers can carry these isotopes to target sites for diagnostic (gallium-68 gamma ray emitter) or theranostic (lutetium-177 simultaneous gamma ray emitter and beta-particle emitter for therapy) applications.

Objectives: To propose a new approach to developing contrast material that can target specific disease processes for either diagnostic or theranostic (diagnostic and therapeutic) purposes.

Method: High performance liquid chromatography (HPLC) was used to identify the aptamer used, with the chelating agent and the isotope.

Results: Proof-of-principle data from HPLC analysis was able to measure each component (aptamer, chelator, isotope) when transmitted individually and also when combined (chemically bonded) as one complex (an aptamer chelated to an isotope).

Discussion/Conclusion: This new chemical arrangement can realistically be translational and introduce a class of agents for imaging and theranostic applications for patients. If we can modify our training to prepare these in a hospital laboratory, we can forge a new path of advanced practice.

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Towards a shared vision – emotional intelligence among radiation therapists

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Background: Rapid advancements in technology, prolonged treatment regimens, changes to the healthcare settings and increased patient care responsibilities has resulted in an increase of emotional struggle among radiation therapists (RTs). Therefore, a shared vision on developing the emotional intelligence (EI) among RTs is important for effective clinical practice, delivery of patient-centred care and for the RTs' mental-social health performance.

Objective: The objective of this study was to explore the demographic predictors of EI among RTs working in cancer care centres in New South Wales, Australia.

Methods: A cross-sectional self-administered survey using the Trait Emotional Intelligence Questionnaire–Short version (TEIQue-SF)[1] was used to measure EI. Multiple regression analysis was used to identify the demographic predictors of EI among RTs.

Results: A total of 205 RTs participated in this study. The mean score for global EI was 5.16 (SD = 0.6) and the scores for the emotionality, self-control, wellbeing and sociability dimensions were 5.3, 4.9, 5.7 and 4.7 respectively (maximum attainable score was 7). The predictors of global EI were younger age and higher levels of current employment. Higher levels of employment were also a significant predictor of the sociability dimension. Gender was a significant predictor of the emotionality dimension and higher levels of education was a significant predictor of the emotionality and sociability dimension.

Conclusion: As level of education and level of employment are both amendable demographics factors, strategies to improve these EI predictors among RTs are required.

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Vision for the next generation: better together

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During 2019, a shared undertaking between Peter MacCallum Cancer Centre (PMCC) and Ourschool – a not-for profit program linking Victorian public high schools and alumni communities – was initiated to deliver a careers seminar to Year 10 students. The objective of the seminar was to enable students to hear from different professionals associated with PMCC, and the many pathways that had led them to the state-of-the-art centre, with the intent to inspire future career decisions. The seminar provided the opportunity for students to develop a greater awareness of eight different professions available in a health service, including allied health, medical radiations and medical options. The aim of this presentation is to describe the vision, collaboration, and outcomes of the careers seminar, and future directions.

Approximately 115 students from eight Ourschool partnered schools who were interested in pursuing health associated careers attended PMCC for the seminar. Students travelled from metropolitan and regional Victoria. An evaluation following the session indicated that students were more informed about the diverse health and medical pathways and were inspired to strive for the very best outcomes at school.

It is believed that continuing to promote career pathways to students earlier in their learning will broaden awareness of the plethora of health professions, aid students' decision making, lift aspirations, and inspire future cohorts into our professions. It is hoped that these inaugural and future attendees will continue to share their own journey with students once they too become alumni, developing an ongoing collaboration between the two organisations.

Future vision: casting light into CT simulation education

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Objectives: Computed tomography (CT) simulation offers educational opportunities outside traditional learning environments. Building on research presented at ASMIRT conference 2018, this study compared the academic outcomes of two high-fidelity simulation environments: remote-access (with peer-assisted learning (PAL)) versus locally accessed (with facilitation) CT scanners for undergraduate radiography students and sought to understand the student's perspective.

Methods: Using a pragmatic approach with multiple methods, third year university radiography students ($N = 62$) were randomly assigned into two groups. Group 'remote-access' ($N = 31$) completed workshop tasks in pairs using a remotely accessed CT scanner (NETRAD CT) for 1.5 hours (minimum) and were offered additional log on opportunities if so inclined. Group 'local-access' ($N = 31$) completed the same tasks in a facilitated 1.5-hour small group workshop at a locally accessed CT scanner with no additional logon opportunities. All students were assessed pre- and post-clinical placement on core CT knowledge. Students were surveyed on their learning experiences.

Results: Student test results demonstrated no significant difference in core CT knowledge between the groups ($F(1,60) = 0.3$, $P = 0.6$), however significant improvement was found in test scores across the pre to post-clinical period for both student groups ($F(1,60) = 37.4$, $P < 0.001$). Four themes emerged: remote versus local-access capabilities, facilitation versus PAL, use of a real scanner, and preparedness for the learning activity. Remote access students reported reduced confidence and enjoyment compared to local access students.

Discussion/Conclusion: Both simulation environments provided equivalent academic outcomes, however the perceived confidence and satisfaction differences between the two groups can be used to help shape how emerging education technologies are best implemented.

Using simulation-based learning to enhance students' knowledge and confidence in clinical skills

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In medical radiation education, students learn and develop theoretical concepts and decision-making skills in the classroom setting. In the ideal world, students will further develop these capabilities in a fast-paced clinical environment. However, this experiential learning opportunity depends heavily on the 'right place and time' and patient presentations.

Simulations, or problem-based learning addresses this challenge by offering students unique, structured, and non-threatening learning opportunities where they can practice their clinical skills and develop their understanding. Students are also introduced to realistic clinical environments where radiography images or computed tomography scans can be produced without the use of ionising radiation. These simulations add another layer to the student's learning environment where they can apply complex theories and participate in scenarios that mimic clinical experiences. In today's pedagogy, simulated learning is no longer a new trend in higher education.[1] It is often an integral component in healthcare education that comes in varying forms, including computer, and cloud-based techniques.[1]

This presentation provides perspectives from the tertiary educator and the students on simulation-based education. This includes discussions on the use of virtual radiography and cloud-based computed tomography software in medical radiation science courses. Student feedback indicates that simulation-based learning can enhance students' medical radiation knowledge and improve their confidence in clinical skills.

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A snapshot of current radiographic practice for planar radiography

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Objective: International research has identified large variations in radiographic technique for the same body areas.[1] This study investigated what radiographic techniques are currently used in clinical practice in Australia and what factors influence technique selection.

Methods: An online survey was distributed to Australian diagnostic radiographers to determine radiographic techniques currently utilised for four common X-ray examinations (chest, pelvis, abdomen and knee). Descriptive and inferential statistics were applied. University ethics approval was granted.

Results: Responses were 644 diagnostic radiographers. Digital radiography (DR) is the primary imaging modality in current use, as sole planar modality (N = 372, 57.2%) or in combination with computed radiography (CR) (N = 205, 31.8%). There is wide range in equipment across Australia, resulting in large variation in exposure index (EI), deviation index (DI) and radiographer uncertainty. While selection of SID and kVp showed little variation for the same size patient, mAs was shown to have considerable variance. When DR data was examined, difference in mAs was statistically significant for health sector (mAs public, mAs private, P value) for chest (2,3, $P = 0.003$), abdomen (20,25, $P < 0.001$), pelvis (20,25, $P = 0.01$), knee (4,5, $P < 0.001$).

Discussion: Private health sector respondents consistently report using a higher mAs value than their colleagues in the public sector for the same examination. Uncertainty of EI and DI parameters indicates this is an area for professional development.

Conclusion: There is a need for workplaces to review exposure protocols, in particular mAs, to support ALADA (as low as diagnostically acceptable) principle in planar radiography. Implementation of the universal exposure index may assist in improved assessment of required exposure for diagnostic imaging.

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A&E clinicians' satisfaction and perception survey on the radiographer commenting system, Singapore

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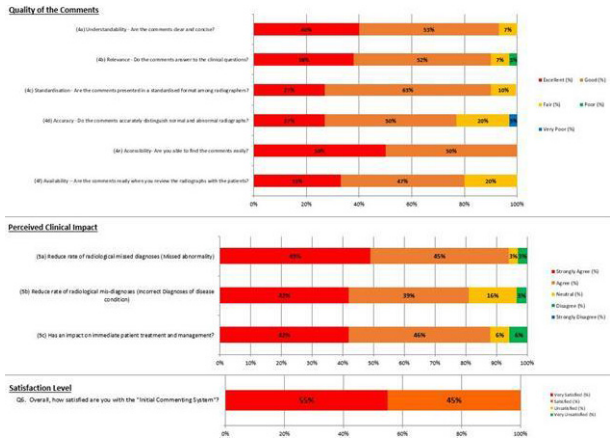
Objectives: The Radiographer Abnormality Detection Scheme has evolved from the red dot system to radiographer commenting, where radiographers provide a brief comment instead of a red dot on review of a radiograph.[1] Our hospital adopted the 'commenting model' and the system was implemented in 2012. A&E clinicians' satisfaction level, perception and feedback are crucial as a performance indicator and for improvement of the system.
Methods: An online survey was distributed to the A&E clinicians. The survey was made up of 15 questions on a 4 or 5-point Likert scale and one open-ended field for additional comments. The survey contained six themes: awareness, frequency, quality, perceived clinical impact, satisfaction level and recommendation for implementation.
Results: The overall response rate was 38% (32 out of 84 participants); 87% of the clinicians often or always used the system; 83% frequently used the system to confirm their own normal and abnormal findings; 77–100% rated good and excellent for the quality of the comments; 87% and 93% agreed or strongly agreed that the system has a positive clinical impact and reduces radiological misdiagnoses respectively; 100% are satisfied with the system; and 94% thought that the system should be implemented nationwide. The Figure shows an overview of quality of comments, perceived clinical impact and satisfaction level.
Conclusion: The system has yielded mostly positive feedback and comments, and overall satisfaction level was high among the A&E clinicians, which reflected well on the effectiveness of the system.



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Quantifying beam divergence

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Background: It is a commonly accepted principle of general radiography that the central ray should be directed to the region of interest in order to obtain optimal positional image quality. Non-central rays will be subject to a phenomenon known as beam divergence, causing distortion in the image. The concept of beam divergence is somewhat vague, with many radiographers being aware of its existence but generally unsure of the magnitude of its effects. An example of this is a common protocol of performing a lateral forearm X-ray centred midway between the elbow and wrist and then performing an additional lateral elbow X-ray centred on the elbow joint, a common request from referrers. In light of the ALARA principle, how appropriate is such a protocol or request?
Aims: The purpose of this study is to define and quantify beam divergence by examining how drastic its effects are, and its consequential clinical impact.
Methods: Radiographic phantoms were imaged at different central ray points to measure beam divergence. Source-image-distance (SID) an object-image-distance were also varied to examine their effects on beam divergence. A 'perfect' image with maximum elbow joint space was used as a baseline.
Results: At a SID of 100 cm, beam divergence is clinically inconsequential at central rays 3–4 cm off-centre. This increases to approximately 7–8 cm for off-centred positioning for larger SIDs. These results were made by comparing images to the perfect lateral elbow. The presentation will discuss the clinical impact of these findings.
Conclusion: Beam divergence is insignificant at larger SIDs.

Are radiation therapists ready for MRI – looking into the future

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Background: The introduction of MRI technology in radiation oncology departments brings a significant change in roles and competencies required for radiation therapists (RTs).

MRI in radiotherapy planning is considered standard practice in many disease sites and RTs) have become competent in image fusion and delineation of many normal tissue volumes. Although the use of MRI in RT planning is established, scanning of patients and developing image protocols has always been carried out in the medical imaging department.

Discussion: This presentation will discuss some of the differences between diagnostic scans and treatment planning scans as well as some of the competencies required by RTs in the MRI domain.

Points to consider when implementing new MR roles for therapists include:

- access to education
- experience and time spent with competent radiographers
- mutual teaching of radiographers and RTs in radiotherapy MR simulation
- legislation and registration requirements for MR operators
- MR safety training for the wider interdisciplinary staff group.

Conclusion: While it is anticipated that RTs will develop skills required to operate the MRI scanner in context of radiation therapy, the support from an experienced MRI radiographer will ensure safe and effective implementation as well as an opportunity to collaborate in all aspects of imaging in the department. Investment in education of trained radiation oncology staff to bring them up to a competent and safe level for operating an MR scanner will need careful consideration.

Clearer vision using MRI for radiotherapy planning: experience of integrating a dedicated MRI simulator

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Magnetic resonance imaging (MRI) is increasingly being integrated into radiation therapy (RT) planning owing to it superior soft tissue contrast compared to computed tomography. MRI has more degrees of flexibility, and by varying different parameters, MRI sequences can be tailored to visualise anatomical and functional aspects of organs and tumours. These benefits can help us develop a more personalised approach to care.

Despite these advantages, the integration of MRI into the RT planning can be challenging, and careful considerations is required to ensure appropriate integration. Adapting MRI examinations to the RT treatment position may involve compromise in image quality, as a result of immobilisation devices, placement of coils to avoid external anatomy deformation, as well as clearance through MRI bore. System and patient related factors cause geometric distortion which is undesirable for RT planning and it is important to quantify and minimise these. In addition, safety and educational requirements for both patients and staff need to be incorporated into the integration process. In our department a dedicated MRI simulator has been utilised since 2013, for both research and clinical purposes.

In this work we will be describing the department's experience of integrating MRI into clinical workflows. This will include safety requirements, educational needs, development of site-specific imaging protocols, and adaption of existing planning workflows to accommodate MRI integration. We will also discuss research utilisation, as well investigation of novel MRI sequences and potential application for RT planning.

See better to treat better – challenges of MRI technology in a radiotherapy environment

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Background: Magnetic resonance imaging (MRI) in radiotherapy offers superior soft tissue definition, functional information about the disease and the possibility of online adaptive radiotherapy however, there are challenges to overcome when introducing this technology into a radiation oncology department.

Radiation safety within a radiotherapy department has always been a priority and is assessed with every change in technology. With the introduction of MRI equipment into the simulation and treatment environment, a new challenge of magnetic safety needs to be considered.

Not only does the radiation equipment interact with the MR image, but the magnetic field interacts with the radiation treatment beam. The treating team are also not familiar with the MR environment, the usual positioning devices are not compatible, and the quality assurance procedures are significantly different. How do we plan for this new paradigm in radiotherapy?

Discussion: The presentation will discuss themes to consider when designing a MR service within a radiotherapy department including:

- radiation/magnetic physics – implications for radiotherapy
- construction implications
- MR safety zones
- equipment considerations
- education
- roles within the team
- clinical considerations – referral pathways, patient selection, models of care.

Conclusion: MRI offers exciting opportunities in the way we deliver radiotherapy treatment but also brings new and unique challenges. Radiotherapy departments can incorporate this new technology with careful planning and working in partnership with people who have experience and expertise in MRI.

Factors affecting clinical information errors in medical imaging

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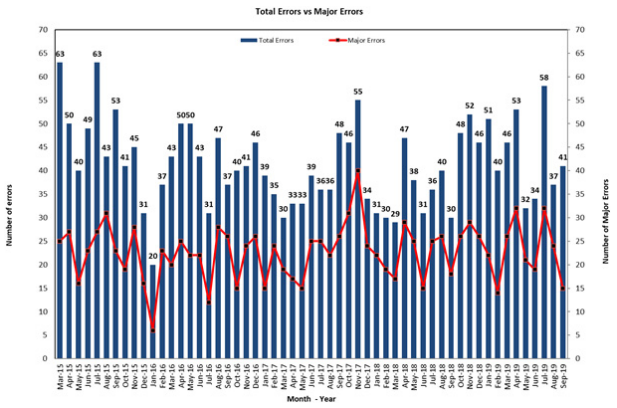
Background: Clinical information errors in medical imaging can lead to a significant impact on a patient's care.[1] The medical imaging department at Toowoomba Hospital has undergone a quality activity since 2015 collecting data around clinical information errors. The aim of this study was to identify factors that are associated with clinical errors in the medical imaging department.

Method: Relevant factors such as study time, modality, error type and category of error were collected for all clinical information errors occurring between March 2015 and September 2019. Data was also collected from clinical staff on their impression of the importance of each error type, years of experience as well as fatigue factors. Binary logistic regression analysis was used to determine the probability of a particular factor being associated with an error occurring. An exemption from ethical review was granted by the institution's Hospital Research Ethics Committee.

Results: Over the study period, 2277 errors occurred. The preliminary analysis showed several factors were significantly associated with error occurrence: 39% of errors occurred when the radiographer was on an evening shift and 48.3% of errors occurred following a late or call shift. The percentage of errors that occurred from a radiographer with three or less years of experience was 24.6%. The most frequent error (26%) was incorrect paperwork on PACS.

Conclusion: Clinical information errors in medical imaging are multifactorial. The study will assist management in understanding why errors occur and inform a program that will allow for a reduction in these occurrences.



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Journal of Medical Radiation Sciences – reporting success and the vision of the future

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The *Journal of Medical Radiation Sciences* (JMRS) is co-owned by the Australian Society of Medical Imaging and Radiation Therapy and the New Zealand Institute of Medical Radiation Technologists. As such, it is your professional journal. Since 2013, JMRS has been publishing peer reviewed scientific articles across a range of topics from the field medical radiation sciences.

Discoverable in all the major scientific databases such as PubMed, Medline and Scopus and following the open access model, our reach extends to 150 different countries globally and we are experiencing an annual growth in readership of around 30%.

The editorial team is a volunteer workforce drawn from all parts of Australia and New Zealand comprised of individuals working at all levels of clinical and academic practice. The editors are backed by a professional team of people working at Wiley (JMRS publishers). Our partners at Wiley provide the infrastructure and support needed to produce a top-class international journal.

Senior members of the editorial team wish to take the opportunity presented by this joint conference to report to delegates on the success your journal has been achieving in disseminating evidence around good practice in medical imaging and radiation therapy. We also wish to discuss how you can become involved and contribute to the future vision of JMRS.

Randomised clinical trial investigating dose escalated prostate stereotactic body radiotherapy: seeing beyond the obstacles

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Objectives: A recent systematic review supports stereotactic body radiotherapy (SBRT) as a standard treatment option for prostate cancer.[1] Increasing dose to ≥40 Gy has been shown to improve local control but can be at the expense of increased toxicity.[2] We wish to report the preliminary feasibility of delivering dose escalated SBRT, with and without fiducial markers.

Methods: All 29 patients from the dose escalated SBRT arm of the OPTIMAL trial (NCT03386045) comparing five versus 20 treatments were selected.[3] Radiation oncologists used prostate-specific membrane antigen (PSMA) scans and magnetic resonance imaging (MRI) scans to delineate a dominant nodule gross tumour volume (GTV) boost which received a dose of 45 Gy/5Fx while the PTV received 36.25 Gy/5Fx.[4,5] Urethral sparing was mandated. Clinical trial constraints for target coverage and organs at risk were reviewed (Table). Planning challenges such as lack of hydrogel, the presence of prosthetic hips and no fiducial markers for intrafraction monitoring on treatment were reviewed.

Results: The dose constraints were regularly met with the exception of gross tumour volume primary (GTV P) when close to the rectum or urethra, and urethra sparing which needed to be covered by 36.25 Gy (Table). An intrafraction motion monitoring technique was successfully implemented for patients without fiducial markers.

Conclusion: Early analysis of SBRT prostate radiotherapy has demonstrated a high level of planning constraint compliance. PSMA scanning has allowed treatment doses to be boosted to 40–45 Gy in these patients. Patients without hydrogel, fiducial markers and with prosthetic hips have been successfully treated.

Table 1: Results of dose escalated SBRT prostate radiotherapy review.

General Information			
	Number and percentage of all patients		Number and percentage of all patients
Hydrogel	16/29 (55%)	Lymph nodes treatment	12/29 (41%)
Fiducial Markers	19/29 (66%)	IMRT plan	3/29 (10%)
Prosthetic Hips/Pin	3/29 (10%)	VMAT plan	26/29 (90%)
Planning Constraints			
Structure	Planning Constraints	Constraint met (Percentage of all patients)	Mean (SD) (All patients)
GTV P	D95% > 45Gy	57%	44.77Gy (1Gy)
CTV HD	D95% > 40Gy	69%	39.91Gy (1.12Gy)
CTV Prostate	D95% > 36.25	100%	37.38Gy (0.51Gy)
CTV SV	D95% > 36.25	100%	37.35Gy (0.50Gy)
PTV Prostate	D95% > 36.25	100%	36.75Gy (0.28Gy)
PTV SV	D95% > 36.25	90%	36.61Gy (0.42Gy)
Rectum	V25Gy < 15Gy	90%	11.28Gy (7.15Gy)
	D1cc < 36Gy	97%	33.28Gy (2.81Gy)
Bladder	D10cc < 37Gy	97%	31.61Gy (4.20Gy)
Urethra	D0.1cc < 37Gy	10%	37.63Gy (0.66Gy)
Urethra PRV	V40Gy < 95%	100%	4.70% (5.25%)
Small Bowel	D100cc < 20	92%	17.17Gy (5.89Gy)
	D2cc < 25Gy	85%	22.50Gy (6.58Gy)
	D0.1cc < 27	92%	23.24Gy (6.71Gy)
Sigmoid	D1cc < 30Gy	76%	22.67Gy (12.21Gy
Femoral Heads	V24Gy < 10%	100%	0.04Gy (0.11Gy)

Abbreviations: IMRT = intensity modulated radiotherapy, VMAT = volumetric arc radiotherapy, SD = standard deviation, Gy = Gray, GTV P = Gross tumour volume primary, CTV HD = clinical target volume high dose, CTV = clinical target volume, SV = seminal vesicles, PRV = planning risk volume

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Day 1 stereotactic ablative radiotherapy image matching – are radiation oncologists needed?

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Objectives: In our department, stereotactic ablative radiotherapy (SABR) lung treatments require daily image verification by the radiation therapists (RT) using cone beam CT (CBCT) with the radiation oncologist (RO) reviewing the match at the treatment console on the first fraction. Consecutive treatment verifications are completed by the RT only. To assess consistency of image matching relative to tumour location in the lungs, we compared pre-treatment day 1 CBCT image matches by the RT and RO, to the actual treated day 1 position.

Methods: Day 1 pre-treatment CBCT images for 40 lung SABR patients (N = 20 peripheral, N = 10 mediastinal and N = 10 inferior) were retrospectively matched using the current departmental SABR image matching guidelines. One RO and four RT (varying years of experience) completed the matches. Results were compared for inter-user variability.

Results: The median deviations for the RT and RO matches were 0.36 mm and 0.97 mm respectively. Splitting the data by location of the tumours we found that lowest variability of deviations between users was for inferior tumours (average st dev 0.46) followed by mediastinal tumours (0.58) and peripheral tumours (0.60).

Conclusion: The data shows that RTs perform matches with a higher degree of consistency and accuracy than the RO when using deviation from the day 1 match as a measure, particularly when matching inferiorly positioned tumours. This opens the door for practice change concepts[1] to be discussed with the ROs regarding options for future management of day 1 image matching for SABR lung patients, particularly in areas of less movement and more certainty.

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Implementation of stereotactic body radiotherapy for high-risk pancreatic cancer: the SPAN-C clinical trial

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Background: Despite advancements in the management of pancreatic cancer, clinical outcomes remain poor.[1,2] With 20% of patients eligible for surgery,[3] chemo radiotherapy assists the inoperable and borderline resectable patients. RT improves the rate of negative margin resection, a strong predictor for overall survival.[4,5] Research in stereotactic body radiotherapy (SBRT) for pancreatic cancer is growing due to higher biologic dose and greater patient convenience, revealing encouraging results for overall survival.[6] There is currently limited local data on SBRT feasibility and deliverability, with AGITG guidelines and a multi-centre Australian trial soon to be launched.
Objectives: SBRT for high-risk pancreatic cancer (SPAN-C) is a non-randomised phase II study primarily investigating freedom from local failure in 40 patients, with secondary assessments on safety, efficacy and feasibility of SBRT.
Methods: The RT prescription aims to deliver 30–45 Gy in five fractions (2 weeks) with fiducial markers to facilitate motion management. Simulation consists of a 4DCT and expiration breath hold (EBH) CT with contrast. Treatment planning utilises RapidPlan™ and delivery on Varian Truebeam™ linac with intrafraction imaging.
Results: Seven patients (four men, three women) with a median age of 59 years have been recruited to SPAN-C. Of those evaluated (six), median planning target volume was 141 cc (56 cc–233 cc), with no major violations. Patients received treatment via IMRT (two) and VMAT (four) with 10 MV-FFF in EBH, with no grade 3 toxicities reported.
Conclusion: Preliminary results of SPAN-C for patients with high-risk borderline resectable and locally advanced pancreatic cancer show SBRT can lead to reduced toxicities, increased patient convenience and local control.

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Marvel: MRI only planning for anal canal, rectum, cervix and endometrium radiation therapy treatments

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Objectives: Previous studies have shown the viability of producing synthetic CT (sCT) scans from conventional magnetic resonance imaging (MRI) scans, for the purpose of MRI only radiation therapy treatment planning for prostate cancer.[1] This study aims to apply this same method for creating sCT scans, for the purpose of MRI only planning, for anal canal, rectum, endometrium and cervix sites. Given the volumes for these patients are comparatively larger than prostate treatments, the anatomy is more variable from day-to-day. Additionally, there is the requirement for gender specific sCT creation methods to cover both men and women with these tumour types.
Methods: This is a single arm, single centre study. 20 male and 20 female patients with cancers of the anal canal, rectum, endometrium and cervix were recruited for the study.
Participants underwent a CT and planning MRI in the treatment position. sCT scans were generated using a hybrid atlas-voxel based generation method. The radiotherapy plan was generated on the simulation CT scan and then transferred to the sCT. Analysis will include 3D gamma dosimetric analysis and dose volume histogram analysis between the CT and sCT data sets.
Results: Recruitment is closed. Preliminary analysis has begun, with encouraging results thus far. Full results will be ready by the time of the meeting.
Conclusion: The outcomes of this study are technical in nature. The primary endpoint of this study is to demonstrate the dosimetric agreement between conventional CT and MRI-generated sCT scans for radiotherapy planning for the greater pelvic region.

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Does clearer vision lead to differences in target and OAR doses in partial breast irradiation?

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Objective: Integration of magnetic resonance imaging (MRI) into workflows for breast cancer radiation therapy has gained increased interest due to clearer resolution between glandular breast and adipose tissue.[1,2] Investigations have found seroma volumes derived from MRI to be smaller than the conventional computed tomography (CT).[3] This increased image clarity and reduction in size may be beneficial when using a partial breast irradiation (PBI) technique. This study aims to evaluate the effect of integrating MRI derived target volumes (when compared to CT), and patient position (supine and prone) on target and organ at risk (OAR) doses for external beam PBI.

Methods: Following ethics approval, an analysis of retrospective data included 24 PBI eligible patients which had CT and MRI data in both supine and prone positions. Four plans were created for each patient. Plans were generated using 6 MV external beam radiotherapy using a three non-coplanar beam arrangement. 38.5 Gy in 10 fractions was prescribed for all cases. Plans were assessed based on TROG 06.02[4] criteria and assessed as compliant or non-compliant.

Results: No statistically significant difference was found in OAR doses based on imaging modality. Both CT and MRI groups resulted in an equal number of compliant plans, (36 compliant and seven non-compliant plans). OAR compliance is outlined in the Table.

Conclusion: Plans derived showed no statistically significant differences in rates of plan compliance and OAR doses between imaging modalities. This supports further investigation in establishing MRI integration and application to future applications in MRI only workflow.

Table 1: Dose Metrics.

		Imaging Modality (n=86)					Position (n=76)				
		MRI		CT			Supine		Prone		
Structure	Metric	Mean	±SD	Mean	±SD	P value	Mean	±SD	Mean	±SD	P value
Contralateral Breast	$V_{5\%}$	0.14	0.62	0.24	0.55	0.4	0.10	0.35	0.33	0.78	**0.011***
	$V_{5\%}$	0.05	0.33	0.04	0.14	0.33	0.03	0.13	0.07	0.36	0.979
Contralateral Lung	$V_{5\%}$	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	
CTV	$V_{95\%}$	97.03	4.06	96.84	4.30	0.64	97.33	4.32	96.50	4.24	0.15
Heart	$V_{5\%}$	3.83	7.39	4.34	8.95	0.97	5.18	10.44	3.62	6.32	0.889
Ipsilateral Breast	$V_{30\%}$	36.45	11.23	38.77	10.55	0.38	37.29	10.40	35.75	10.86	0.228
	$V_{95\%}$	11.90	5.60	12.29	6.46	0.94	11.17	6.07	11.75	5.55	0.329
	$V_{100\%}$	3.67	3.67	3.98	3.80	0.75	3.37	3.29	2.96	2.86	0.506
Ipsilateral Lung	$V_{30\%}$	7.20	9.12	7.26	8.40	0.89	10.85	11.37	3.41	3.93	**<0.001***
Normal Tissue	Max	39.89	0.53	39.95	0.58	0.43	39.85	0.50	39.83	0.57	0.95
PTV_EVAL	2cc	103.27	1.08	103.58	1.07	0.11	103.19	1.07	103.43	1.11	0.301
	$V_{120\%}$	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	
	$V_{90\%}$	98.16	2.92	97.77	3.12	0.53	98.18	3.01	97.38	3.24	0.11

OAR: organ at risk, CTV: clinical target volume, PTV EVAL: planning target volume used for evaluation, IpsiLung: ipsilateral lung, IpsiBreastPRV: ipsilateral breast planning reference volume excluding the PTV structure, Normal Tissue: Patient excluding PTV, $V_{X\%}$: the dose received to X% of the structure, as a percentage of the prescribed dose, *: statistical significance.

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Human versus the machine: a volumetric and morphological analysis of the hippocampus using automated segmentation

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Objective: Temporal lobe epilepsy (TLE) is the most prevalent form of focal epilepsy, and the hippocampus is the vital linking structure between the temporal lobe and the deep brain.[1] Sclerosis of this structure can be a strong indication of underlying epileptic changes. Recent advancements of technologies and segmentation capabilities of structures allow a critical analysis of the hippocampus.[2] In this age of artificially enhanced segmentation, it is hypothesised that the data produced must be cross-checked before being used with absolute confidence in the clinical setting.

Method: Isotropic volumetric neurological magnetic resonance imaging datasets (N = 10) were analysed with Intellispace Discovery platform. Once the automated segmentation was complete, a series of manual measurements were completed and applied to a three-dimensional mathematical model to give the manual representation of the structures. A control model of known values was evaluated as an 'absolute truth' value for direct comparison.

Results: Initial results indicate that the automated volumetric and morphological analysis of the structure had a higher margin of error. Further results will hope to prove that the automated analysis is within reasonable limits to proceed with clinical use of this artificial segmentation technology.

Discussion: The aim was to produce reliable metrics for both hippocampal and temporal lobe cortex analysis, which can give an early indication of TLE in the case of the first presentation of seizure-like activity. The long-term aim would be to employ these quality assured metrics in the development of predictive artificial intelligence to identify early changes to deep brain structures.

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Necrosis or recurrence? Using delayed-contrast MRI post-stereotactic radiosurgery for brain metastases

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Brain metastases (BM) are the most common malignancy of the central nervous system, occurring 2–5 times more often than primary malignant brain tumours.[1] Of patients with BM, 20–50% have a solitary BM, 20–30% have 2–3 BM, and more than 30% have more than three BM.[2] Stereotactic radiosurgery (SRS) plays an important role in BM management. Consequently, with longer median survival due to improved response rates to modern systemic therapies, the incidence of brain radio-necrosis (RN) is increasing- typically presenting 3–6 months post-SRS.[3] While commonly asymptomatic, symptoms vary, and are RN location dependent.

Delayed-contrast MRI (DCMRI) presents a new paradigm in neuro-oncology, where the clearance of contrast agent has shown a clear tumour/non-tumour tissue differentiation in both primary and secondary malignancies of the brain.[4] Furthermore, DCMRI possesses some notable patient and operational benefits compared to performing additional diagnostic imaging with the additional MRI scan (10 minute duration) taken on the same day as their routine follow up MRI (1 hour after), with no additional contrast administration required. However, further corroborating evidence supporting the usefulness of this technique is still lacking.

The Peter MacCallum Cancer Centre, which delivers in excess of 100 SRS courses annually, recently undertook an ethics-approved 10 patient post-SRS pilot study to investigate the utility of the Brain Lab Contrast Clearance software solution. This presentation will outline initial clinical and operational experiences, and share preliminary clinical observations surrounding the utility of DCMRI in the differential diagnosis of tumour recurrence and RN.

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Understanding the haemodynamic response curve and blood oxygenated level dependency

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3.0 Tesla magnetic resonance imaging (MRI) scanners have increased in popularity, along with imaging techniques based on the blood oxygenated level dependency (BOLD) phenomenon, however, not all practitioners are fully aware of physiological intricacies relevant to the haemodynamic response (HDR) curve following a neuronal stimulus. Further education is needed to understand the interplay between neuronal and vascular activities.

The aim of this presentation is to improve practitioners' understanding by providing a comprehensive explanation of the BOLD phenomenon and the corresponding HDR curve. Graphs and images will be used to demonstrate the link from the BOLD phenomenon and HDR curve, to the initiating stimulus, glucose fuel burning at a cellular level, the microvascular activity and the corresponding MRI signal changes.

The initial stimulus can either be sensory, visual, auditory, motor or cognitive.[1,2] The brain region responsible for interpreting stimulus input will demonstrate a BOLD contrast response.[1–5]

The responding brain region requires an energy source to support this metabolic process, therefore, glucose and oxygen are extracted from arterial blood.[1,2,4] An increase in neuronal activity is supported with a corresponding increase in blood flow.[1–5] This BOLD contrast reflects the total ratio between consumed oxygen and supplied oxygen, when graphed, the HDR is effectively determined by the stimulus and the underlying neuronal activities and associated vasodynamic activity.[1,3,4]

MRI provides an indirect visualisation, where electrical activity is measured via the vascular response to neuronal activity, that is, images are created of physiological activity that correlates with the underlying neuronal activity, hence its 'indirectness'.

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Looking within – development of preliminary image evaluation self-audit

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Preliminary image evaluation (PIE) is a useful tool to improve patient safety in the emergency department. It has been demonstrated that radiographers can maintain a reasonably high diagnostic accuracy,[1] but there are anatomical regions that could be improved on.[2] Previous studies have demonstrated that self-audits can stimulate learning and quality improvement in clinicians.[3] These studies also noted the need for guidance in self-auditing, including tools and training.[3] The objective of this project was to create an effective and efficient tool for radiographers to self-audit their PIEs.

A personalised worklist was created to filter emergency examinations belonging to a specific radiographer. Radiographers used this worklist to compare their PIE to the radiologist report. The data collected was inputted into the audit tool using a predefined excel template. The audit tool recorded the agreeance of the PIE with the radiologist report, anatomical region reviewed, and month examination was performed. This tool automatically calculated the specificity, sensitivity, positive and negative predictive values and the overall accuracy of the radiographer's PIE.

Additionally, this tool was designed to highlight the anatomical regions where the accuracy was lower in comparison to other regions. This was to encourage radiographers to focus on their individual learning needs to provide more accurate PIEs. This tool also allowed radiographers to compare individual results to those of the departmental audit undertaken separately to this audit. This tool can be used to encourage radiographers to review their performance when completing a PIE and highlight areas for further education.

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Experiences of radiographers working in remote locations: observational-ethnographic study in Far North Queensland

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Background: The National Medical Radiation Practice Board of Australia (MRPBA)[1] expect radiographers to recognise and convey significant findings in order to facilitate optimal patient care. Radiographers employed in remote locations such as Far North Queensland (FNQ) often perform both radiographic and sonographic imaging without onsite radiologists' services. Most patients presenting to these sites are Indigenous. Radiographers can be faced with unique sets of challenges which to date have received little attention.
Objective: This ethnographic[2] study aimed to observe radiographer interactions with patients and interprofessional staff during routine radiographic and sonographic examinations.
Methods: Non-participant observations[3] and semi-structured interviews were held at two FNQ hospitals. Radiographer-patient interactions observed were recorded on checklists. Interviews were held with the radiographer at each site. Each interview was audio recorded and transcribed for thematic analysis.
Results: Across both sites 24 patients were observed with the majority of Aboriginal and Torres Strait Islander status (N = 17/24 (70.8%)). In total 27 examinations were observed. Acute radiographic and sonographic findings were conveyed verbally to referring practitioners. Semi-structured interviews highlighted complex issues such as radiographer communication in local dialect with Indigenous patients, the need for interprofessional collaborations to overcome a lack of immediate radiologists' support, and isolation with regard to professional development opportunities.
Conclusions: The study confirmed that radiographers acquire unique radiographer skills, complementing them when dealing with complex issues including provision of radiographic and sonographic reports without availability of radiologists' reports. This study provides evidence that culturally competent radiographers are capable of undertaking reporting roles to facilitate patient management.

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Comparative dosimetry of superficial nose lesions: HDR brachytherapy and VMAT – future vision

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Objective: To compare the dosimetry for nose surface mould high dose rate (HDR) brachytherapy with external beam radiotherapy (EBRT) volumetric-modulated arc therapy (VMAT), to determine if EBRT VMAT is a feasible alternative to surface mould HDR brachytherapy for superficial nose lesions.
Methods: Six previously treated HDR brachytherapy nose surface mould (N = 6, three basal cell carcinoma and three squamous cell carcinoma) treatment plans were retrospectively selected. One plan was generated for brachytherapy Iridium 192 HDR (Brachyvison 13.7, TG-43) and one plan was generated for external beam therapy 6 MV photon VMAT (Pinnacle 9.10).
Target volumes and organs at risk (OARs) were contoured on a simulation computed tomography (CT) scan. Bolus, build up and backscatter material were utilised as necessary for optimal treatment plan generation. VMAT plans were optimised using an additional 5 mm setup margin on the clinical target volume (CTV) of the contoured HDR plans.[1]
Ethics approval has been submitted and will be obtained prior to the conference.
Results: Once ethics approval has been granted, target volume dose, dose homogeneity and mean, minimum and maximum doses to OAR will be evaluated.
Conclusions: This presentation will provide insight into treatment modality selection for extensive superficial lesions with complex surfaces, irregular contours and close proximity to OAR.[2] With an increase in skin cancer across Australia, along with the complexity that arises with superficial lesions located on the nose, ensuring we are offering the best treatment available moving forward with the advances in treatment techniques and modality options.

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Pencil beam proton comparative planning for variation in size and location of paediatric cranial tumours

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Objectives: Proton therapy has superior dose distribution compared to photon therapy, reducing normal tissue complication probability for organs at risk (OARs). Previously published 3D-conformal comparative planning studies have been superseded by intensity modulated radiation therapy (IMRT). The aim of this study was to compare scanning beam proton therapy to IMRT with respect to target size and location for paediatric cranial tumours.

Methods: Six gender-matched paediatric cranial datasets (5, 9 and 12 years) were planned in Varian Eclipse treatment planning system (version 13.7). Up to 108 scanning beam proton plans and 108 IMRT plans were retrospectively optimised to treat supratentorial (ependymoma) and infratentorial (medulloblastoma) target volumes, including simulated variations in size (ranging from 1–3 cm in diameter) and position (central, 1 and 2 cm shifts). Dose and volume data were extracted for the comparative plans to assess the impact size and position of the target volume on OAR outlined by radiation oncologists.

Results: 216 plans were created by a single planner with proton and photon planning training and experience. Planning objectives were achieved for all plan pairs as per clinical protocols. Preliminary results average mean dose to selected OARs are shown in the Table.

Conclusion: The study compared latest clinically relevant proton and photon treatment techniques across a large range of simulated clinical scenarios demonstrating a dose reduction to normal tissues for proton plans across supratentorial and infratentorial tumour sites. These findings inform the next phase of research related to modelling intrinsic radiosensitivity of OARs.

Table 1. Mean dose (D_{mean}) difference (Δ photon - proton) in Gray for selected organs at risk averaged across 6 patient plans collected for two clinical scenarios.

	Supratentorial Ependymoma (Δ D_{mean})				Medulloblastoma (Δ D_{mean})			
	Small target		Large target		Small target		Large target	
	Central	2cm lateral shift	Central	2cm lateral shift	Central	1cm superior shift	Central	1cm superior shift
Brainstem	6.65 Gy	1.45 Gy	9.33 Gy	5.88 Gy	6.46 Gy	1.02 Gy	6.8 Gy	7.6 Gy
Left optic nerve	6.99 Gy	1.15 Gy	7.68 Gy	5.00 Gy	10.53 Gy	1.61 Gy	11.50 Gy	3.19 Gy
Left cochlea	12.78 Gy	0.57 Gy	12.34 Gy	1.38 Gy	12.56 Gy	0.58 Gy	13.17 Gy	1.42 Gy
Chiasm	7.88 Gy	2.72 Gy	9.50 Gy	18.00 Gy	10.59 Gy	2.30 Gy	12.63 Gy	12.54 Gy
Pituitary gland	8.49 Gy	1.01 Gy	9.29 Gy	4.44 Gy	11.76 Gy	0.83 Gy	10.86 Gy	3.80 Gy

A novel tangential VMAT technique versus unilateral continuous arcs for breast and regional nodal irradiation

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Objectives: Irradiation of regional lymph nodes in early stage breast cancer patients has demonstrated a positive effect on overall patient survival.[1] As survival rates rise, reducing dose to surrounding organs at risk (OAR), namely the heart and lungs, is paramount.[2] Historically, the approach to breast radiotherapy planning has been static tangential fields. However, using this method when including regional lymph nodes, results in compromises to target coverage in order to achieve OAR constraints. Inverse planning techniques utilising continuous volumetric modulated arc therapy (VMAT) produce highly conformal plans but can consequently give rise to higher integral dose.[3] There are indications that utilising tangential VMAT fields in this setting can achieve similar target dose coverage and tight OAR dose constraints.[3]

Method: This study comprised 20 breast cancer radiotherapy patients, 10 left sided and 10 right sided, all with regional lymph node involvement. Comparative analysis occurred between a novel tangential VMAT technique and a unilateral continuous VMAT technique for each patient. Evaluation occurred for target dose coverage, heart dose, contralateral breast dose, ipsilateral and contralateral lung dose for both plans.

Results: The tangential VMAT technique suggested greater consistency in achieving strict dose constraints of the OARs considered, specifically the mean heart dose less than 3 Gy and the volume of the ipsilateral lung receiving 5 Gy. Target dose coverage remained comparable between both techniques.

Conclusion: Applying a tangential VMAT technique for breast and regional lymph node irradiation consistently achieved conformal target dose coverage and tighter OAR constraints when compared with a unilateral continuous VMAT technique.

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Dosimetric impact of changing gas volumes seen throughout treatment on pancreas volumetric modulated arc therapy

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Objectives: Air cavities result in deviations from planned dose.1 However, current literature on how this impacts volumetric-modulated arc therapy (VMAT) for long-course pancreatic treatment is limited.[2,3] This retrospective study aimed to assess consistency of gas presentation and determine impact on the delivered dose distribution of VMAT delivery for pancreatic radiotherapy.

Methods: Eight patients were included for analysis. Three reference plans were created per patient based on planning computed tomography (CT), with density overrides of 0.0, 0.5 and 1.0 applied to gas volumes. Cone-beam CT datasets were obtained and density overrides were applied to enable fractional dose calculation. Variation in gas volume relative to initial volume on CT was assessed. Dose metrics for target and organ at risk (OAR) structures were compared between the delivered CBCT dose and the planned dose of the three reference plans for each patient.

Results: There was a significant decrease in gas present from CT to treatment, with an average decrease in volume of 48.6% for the entire cohort. Dosimetrically, all target volume and OAR parameters, aside from the kidneys, exhibited the smallest average deviation from the 0.0 gas density override reference plan, as shown in the Table. The difference in mean delivered dose to the three reference plans was only deemed statistically significant for planning target volume D95.

Conclusions: While significant variation in gas volumes from planning to treatment can occur, VMAT has shown to be a robust treatment modality against changing gas volumes such as routinely seen in pancreatic cancer radiotherapy.

Table 1

DVH parameters (mean and range over all 8 patients) for the three reference plans ($Ref_{0.0}$, $Ref_{0.5}$, $Ref_{1.0}$) and CBCT plans.

		Mean planned dose/volume [range] (%)			Mean delivered dose/volume [range] (%)				
Volume	DVH parameter	$Ref_{0.0}$	$Ref_{0.5}$	$Ref_{1.0}$	CBCTs	Δ from $Ref_{0.0}$	Δ from $Ref_{0.5}$	Δ from $Ref_{1.0}$	Closest plan
CTV	D50	104.2 [102.7-105.7]	103.5 [102.1-105.1]	102.8 [101.1-104.9]	105.0 [103.4-108.6]	0.8 [-1.1-3.3]	1.4 [-0.1-3.6]	2.1 [0.3-3.7]	$Ref_{0.0}$
	D95	99.4 [97.2-101.5]	98.8 [96.9-101.3]	98.0 [96.0-100.9]	100.1 [97.0-102.4]	0.7 [-1.7-2.7]	1.4 [0.2-3.4]	2.1 [0.6-4.0]	$Ref_{0.0}$
PTV	D50	103.4 [102.1-104.7]	102.8 [101.6-104.3]	102.1 [100.4-104.0]	104.2 [102.5-107.6]	0.8 [-0.6-3.1]	1.4 [-0.2-3.4]	2.1 [0.2-3.6]	$Ref_{0.0}$
	D95	98.0 [95.2-100.4]	97.5 [94.8-100.0]	96.4 [94.2-99.9]	98.5 [94.4-101.4]	0.5* [-1.2-2.3]	1.1 [-0.4-2.8]	2.1* [0.2-3.8]	$Ref_{1.0}$
Spinal Cord	Max	51.0 [9.4-81.1]	50.6 [9.4-80.6]	50.3 [9.4-80.1]	51.5 [10.1-81.5]	0.5 [-1.3-2.0]	0.8 [0.2-2.0]	1.2 [0.3-2.3]	$Ref_{0.0}$
Liver-GTV	Mean	25.4 [9.4-40.9]	25.3 [9.4-40.9]	25.2 [9.4-40.9]	25.7 [9.8-41.4]	0.3 [-0.1-0.6]	0.4 [-0.0-0.7]	0.5 [0.0-0.8]	$Ref_{0.0}$
	V33	8.7 [0.8-16.5]	8.6 [0.8-16.4]	8.6 [0.8-16.3]	9.0 [1.1-17.0]	0.3 [-0.1-1.1]	0.3 [-0.0-1.1]	0.4 [0.0-1.1]	$Ref_{0.0}$
Right Kidney	Mean	20.4 [4.5-36.1]	20.3 [4.5-35.8]	20.2 [4.5-35.6]	20.3 [4.6-36.0]	-0.1 [-0.7-0.2]	-0.0 [-0.4-0.4]	0.1 [-0.3-0.6]	$Ref_{1.0}$
	V33	2.8 [0.0-8.8]	2.7 [0.0-8.5]	2.6 [0.0-8.2]	2.7 [0.0-8.6]	-0.1 [-0.9-0.5]	-0.0 [-0.7-0.5]	0.1 [-0.4-0.5]	$Ref_{1.0}$
Left Kidney	V6	61.6 [0.4-100.0]	61.5 [0.4-100.0]	61.5 [0.4-100.0]	61.3 [0.3-100.0]	-0.3 [-5.3-2.7]	-0.2 [-5.3-2.6]	-0.1 [-5.3-2.5]	$Ref_{1.0}$
Small bowel	Max	100.3 [94.3-105.1]	99.4 [93.8-103.4]	99.0 [93.2-102.6]	101.6 [96.5-104.9]	1.2 [-1.3-2.8]	2.1 [-0.5-3.5]	2.6 [0.2-4.4]	$Ref_{0.0}$
Stomach PRV	Max	105.3 [102.4-106.9]	104.5 [102.4-106.2]	104.0 [101.9-106.0]	106.9 [104.5-109.3]	1.7 [-1.2-3.9]	2.4 [1.5-4.0]	3.0 [1.5-4.1]	$Ref_{0.0}$
Duodenum PRV	Max	105.8 [104.5-107.3]	105.3 [104.5-106.1]	104.9 [104.2-105.9]	107.3 [105.0-109.4]	1.5 [-0.4-4.2]	2.0 [0.5-4.2]	2.4 [0.8-4.2]	$Ref_{0.0}$

DVH, dose volume histogram; $Ref_{0.0}$, reference plan where gas has been overridden with a density of 0.0; $Ref_{0.5}$, reference plan where gas has been overridden with a density of 0.5; $Ref_{1.0}$, reference plan where gas has been overridden with a density of 1.0; CBCT, cone beam computed tomography; Δ, absolute change in value of DVH parameter; CTV, clinical target volume; PTV, planning target volume; GTV_gross tumour volume; PRV, planning organ at risk volume; D50, dose to 50% of the volume; D95, dose to 95% of the volume; V33, volume receiving 33% of the prescribed dose; V6, volume receiving 6% of the prescribed dose.
*Δ from $Ref_{0.0}$ is significantly different from Δ from $Ref_{1.0}$ ($p < 0.05$).

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A new spin on life: 3D imaging in the treatment of paediatric osteosarcoma

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Osteosarcoma is a malignant or benign bone tumour that can occur at any age but typically peaks at adolescence, coinciding with rapid bone growth. It characteristically occurs at the end of long bones, affecting the joint and the functionality of the limb with the potential for metastases.[1]

Historically, patients with this condition had a poor prognosis. This is partly due to the potential for tumour cells to remain post-surgery or conversely more bone than necessary may have been removed.[2] These two factors were primarily due to the inability to conclusively delineate the margins of tumours at the time of resection.

Today, with the innovation of new technology (Siemens/Brainlab), the Queensland Children's Hospital is the first paediatric site in Australia to have a dedicated and permanent 3D imaging navigation system. The mobile C-arm fluoroscopy system (Siemens CIOS Spin) is enabling the paediatric Orthopaedic oncology team to surgically resect osteosarcomas with pinpoint accuracy.[3]

The presentation will review the implementation of this visionary equipment, including the multidisciplinary team approach. This has resulted in the best possible surgical and overall outcomes for a patient group which previously did not have a positive prognosis.

Approval to include cases as part of this presentation has been provided by the local HREC Chair.

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Consumer-led changes in radiation therapy

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At the beginning of radiation therapy, patients are often given a considerable amount of information regarding their treatment from many members of the multidisciplinary team. This may lead to difficulty with information retention, possibly resulting in a negative impact upon treatment experience. This project was designed to gain a better understanding of the patient's perspective and priorities while undergoing radiation therapy, in terms of information provision. Critically, this project was consumer led with the aim of implementing changes to current practice.

Patients (N = 17) were recruited at the beginning of their radiation treatment. The patients' satisfaction and recall of information was measured by means of a consumer-reviewed written survey, followed by an interview.

Overall, patients were satisfied with the information given at the radiation therapists' (RTs) first day chat. However, participants noted they were overwhelmed and had little to recall other than to stay still. These results correlated with the experiences of the consumers.

From these results the RTs have adapted the way the first day chat for both planning and treatment are delivered. Only essential radiation therapy information is now provided during the first day chats. After commencement of treatment, RTs provide an optional appointment for patients to receive additional non-essential information. The effectiveness of these changes to practice are currently under evaluation.

Implementation of patient-reported outcome measures into standard practice during breast radiation therapy

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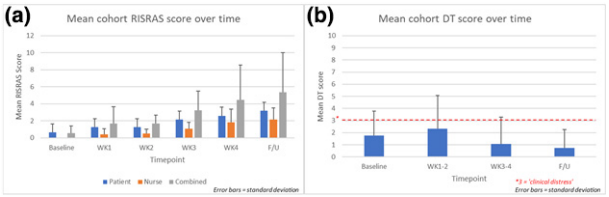
Objectives: The individuality of each cancer patient's experience presents a continual challenge in identifying, and responding to, physical and psychosocial care needs. Patient-reported outcome measures (PROMs) capture subjective patient perceptions of their health.[1] This study describes the implementation and preliminary evaluation of PROMs for patients undergoing breast radiation therapy (RT).

Methods: The Radiation-Induced Skin Reaction Assessment Scale (RISRAS) and Distress Thermometer (DT) tools were selected as validated PROMs to implement. RISRAS includes four patient- and four nurse-reported domains (scored 0–3, total = 24). The DT is scored by the patient (0–10) and identifies specific factors contributing to distress. PROMs were completed at baseline (planning CT), weekly (RISRAS) or bi-weekly (DT) during RT, then 1-week post-treatment. Cohort assessment scores were analysed across the reported time-points.

Results: Interim analysis included 13 consecutive patients (71 RISRAS and 48 DT assessments). Mean (±SD) combined RISRAS score was 2.9 ± 3.1. RISRAS scores increased over time (Figure 1a), with good correlation bet2 two weeks of RT, and then progressively decreased (Figure 1b). Considerable interpatient variation was seen in both RISRAS and DT scores as evidenced by large standard deviations. Fatigue was the most frequently reported factor contributing to distress (48% of assessments) followed by skin (33%).

Discussion/Conclusion: PROMs has enabled us to benchmark patient wellbeing throughout RT and compare perspectives from patients and staff. Reassuringly, overall distress levels were low, and decreased throughout RT. Several opportunities have been identified for ongoing practice development.



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Acute toxicity and patient reported outcomes in anal canal cancer

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Objectives: Anal canal cancer (ACC) is uncommon. The gold standard of care is chemoradiotherapy treatment.[1,2] However, this treatment is associated with considerable acute and late side effects. The aim of this pilot study was to prospectively collect and compare toxicity and patient reported outcomes (PRO) to determine if any potential relationships exist.

Methods: 16 patients were recruited to this prospective longitudinal observational study from March 2015 to December 2017. All patients received volumetric modulated arc therapy (VMAT) in 30#. Toxicity data was graded by a radiation oncologist using the Common Terminology Criteria for Adverse Effects (CTCAE) version 4 at planning, weekly during treatment, 6 weeks and 3 months post-treatment. PRO data was collected using the EORTC QLQ C30 and CR29 questionnaires completed by patients at planning, mid and end treatment and 3 months post-treatment.

Results: The majority of toxicity and PRO items peaked in severity at the end of treatment (week 6). Skin was the only item where >50% of patients had ≥ grade 2 toxicity at any point with 75% having ≥ grade 2 at week 6. Patient-reported embarrassment significantly increased over time ($P < 0.001$). No significant relationships were found between PRO and CTCAE results.

Conclusion: After reaching their maximum at the end of treatment, the majority of toxicity and PRO items approached baseline levels by 3 months post-treatment. The results of this study suggest that PROs are an important complementary tool to CTCAE and provide greater vision of patient's perception of treatment side effects.

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Overview of medications used for patient preparation in cardiac CT

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Optimal image quality in cardiac computed tomography often relies on pharmacological preparation of the patient to lower and/or stabilise the heart rate and dilate the coronary arteries. This presentation will provide an overview of four types of drugs commonly used for patient preparation in cardiac computed tomography: beta blockers, calcium channel blockers, ivabradine and glyceryl trinitrate. Each drug will be briefly discussed, including what they are used for, how they work and patient safety aspects for their administration.

Diagnostic accuracy of CTCA in patients with high heart rates: systematic review findings

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Introduction: Patients with high heart rates (HR) are frequently referred for CT coronary angiography (CTCA). In this group, motion artefact can negatively impact image quality and resultant diagnostic accuracy. Several technological advancements in scan hardware and software have been implemented to mitigate difficulties in scanning patients with high HR.[1 2] However, no previous reviews have examined the diagnostic accuracy of CTCA using current generation scan technology. The aim of this systematic review was to investigate the diagnostic accuracy of CTCA in current clinical practice, for patients with high HR.

Methods: A systematic search was performed of PubMed, CINAHL, Embase and Scopus, as well as unpublished database sources and reference lists. Titles and abstracts were screened by two independent reviewers. Full-text screening was then performed by the reviewers for all studies that met the inclusion criteria at the title and abstract level. Studies that were included in the review underwent critical appraisal using the QUADAS-2 tool.[3] Data extraction was undertaken by the lead reviewer and results were collated and analysed through narrative synthesis and meta-analysis.

Results: 12 studies were included in the systematic review, with 11 included in a meta-analysis. Meta-analysis produced pooled sensitivity 99% (95% CI 0.98–1.00) and pooled specificity of 0.79% (95% CI 0.72–0.85).

Conclusion: Diagnostic sensitivity of CTCA remains high at higher HR, although specificity may be reduced. Therefore, where standard HR control is contraindicated or ineffective, CTCA is still recommended in current generation scanners, however positive results should be treated with increased scepticism.

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The efficacy of dual energy chest X-ray in the screening and monitoring of tuberculosis

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Introduction: Dual energy radiography (DE) enables the selective visualization of soft tissue from bone via exploiting the energy dependence of attenuation coefficients of materials.

Aims: This literature review was performed to evaluate the clinical benefit of dual exposure (DE) radiography in comparison to digital radiography (DR) in the context of migrant screening for tuberculosis in Australia. Our vision with the review was to ensure that the current migrant screening protocol meets current evidence-based practice.

Methods and Results: A review of current literature has found multiple studies comparing DE and DR which concur in findings of equivocal or improved sensitivity for calcified and non-calcified nodules >10 mm and those located in the apical region of the lung.[1] Other advantages of reduced reading time, improved intra-observer agreement (irrespective of expertise level) and improved detection of other thoracic pathology,[1,2] support its implementation in the context of migrant screening. Although variation exists among studies in the degree of advantage, no disadvantage to sensitivity in nodule detection was found.

Conclusion: The demonstrated trend of advantage DE poses in nodule detection compared to DR stands to justify the small increase in radiation dose to patients and thus its implementation in clinical practice for migrant screening.

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Aortic dissection case studies (type A & B): diagnosis and management

Andrew Pidgeon[1]
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Introduction: In 2019 approximately 4 months apart, two patients presented to a large rural medical imaging department with similar pathologies. The diagnosis of the two patients were aortic dissections that extended from the thorax through to the abdomen, and one into the lower limbs.

On initial viewing it appeared that there was only one course of action open to both patients, however the treatment and management were vastly different and resulted in very different outcomes for each patient.

Case Study: 1) A 67-year-old man was referred for CT imaging which revealed an aortic dissection starting from the descending aorta, through the abdominal aorta and into the coeliac and superior mesenteric arteries. This was classified as type B aortic dissection. 2) A 49-year-old man was referred for CT imaging of his thorax. Subsequent imaging revealed an aortic dissection from the aortic root through the abdominal aorta and into the left common iliac artery. This was classified as a type A aortic dissection.

Management: The management of both patients was different, with one undergoing medical management through antihypertensive therapies and the other undergoing complex surgical treatment.

Outcome: One patient is still alive and being monitored for his stable aortic dissection, the other was not able to be saved.

Discussion: Which patients should receive a medical treatment pathway, and which should receive a surgical treatment pathway all depends on the type of aortic dissection.

How 20/20 vision demonstrated pericardial effusion on a chest X-ray: a case study

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Pericardial effusion (PE) is a potentially life threatening condition where fluid accumulates in the pericardium, the fibro-elastic sack that surrounds the heart.[1] PE varies in severity from chronic fluid accumulation that is initially asymptomatic, through to acute, where fluid accumulates rapidly in a short period of time.[2]

The patient in this case study lives in rural Northland, New Zealand. He had several presentations to his GP over the course of several months for complications related to congestive heart failure. He had been diagnosed with atrial fibrillation and on one occasion had self-discharged from hospital. Due to a fortuitous timing of chest X-ray examinations, a chronic PE was able to be identified due to a significantly increasing heart size. He was eventually transferred to Whangarei Base Hospital where he was treated with a pericardial tap.

This presentation will look at the timing of his chest X-rays and how the benefit of 20/20 vision affected his treatment and outcome.

The patient concerned gave permission for his images and clinical information to be used in this case study and presentation.

References

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CTA chest on a paediatric ECMO patient. What could possibly go wrong?

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When a request for a computed tomography angiogram (CTA) is considered and the patient is on extracorporeal membrane oxygenation (ECMO) a list of questions should be thought through before the patient even leaves the confines of their hospital room to ensure that the clinical question at hand can be answered and that the risk of moving such a precarious patient will be beneficial. Such questions include but are not limited to: the location of peripheral IV access if available; whether the flow rate of the ECMO circuit can be slowed or stopped during the CTA; what additional volume of blood has been added to the circuit which affects how dense the IV contrast will eventually be.

This presentation will discuss the many facets of CTA ECMO cases. Some of the points for consideration include staff availability and skill mix to support the complex needs of such patients as they are moved from the ICU ward to CT; knowledge of the ECMO circuit and what aspects to discuss to tailor the situation to optimise the IV contrast timing; knowledge of congenital cardiac anomalies and the corrective surgical stages which affect many of these patients to help understand the expected blood flow and anatomy; how best to communicate with colleagues during these cases to mitigate risk to the patient.

Increasing vision with daily breast CBCT: 12-month post-implementation experience

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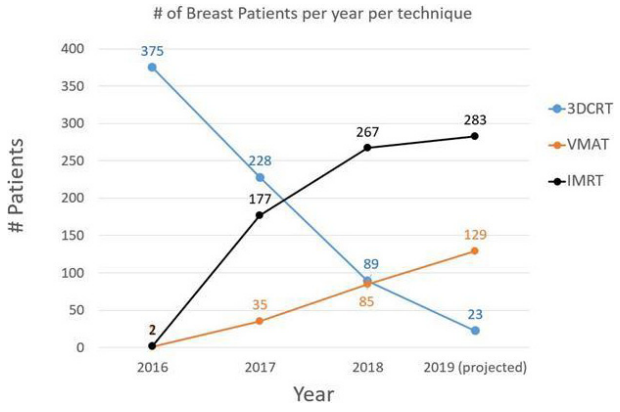
Cone beam computed tomography (CBCT) is a common tool used in image guided radiotherapy (IGRT). Traditionally, breast verification imaging has been performed within our department using a combination of treatment field electronic portal images and/or orthogonal images.

This presentation will describe the implementation of daily pre-treatment 3D CBCT verification for all breast treatments. The impetus for CBCT verification for breast was the implementation of IMRT simultaneous integrated breast boosts, the increased use of DIBH, and the growing use of VMAT planning techniques within our department (Figure). A number of factors needed to be taken into consideration prior to implementation including: the formation of a multidisciplinary project team, the investigation and creation of new, low-dose imaging pre-sets specific for breast, and staff training and education. An assessment of CBCT dose versus current practice was also considered.

Benefits seen post-implementation include improved visualisation of patient setup, bolus placement and anatomy changes, consistency in imaging protocols across differing breast treatment techniques and efficiency gains. Challenges include perceived benefits versus contralateral breast imaging dose, limited evidence on the necessity of daily CBCT imaging and the impact of CBCT positioning corrections on a traditionally field-based treatment technique. Future plans for evaluation include quantifying imaging shifts and assessing the number of replans instigated due to changes seen on CBCT.



Clinical experience in the implementation of surface guided radiation therapy

Ellyott Rouse[1]
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Surface guided radiation therapy (SGRT) provides a method for accurate setup of patients for their radiation therapy treatments. Using surface scanning, it allows for continuous monitoring of patient movement during imaging and treatment to ensure accuracy of radiation delivery.[1]

The utilisation of Catalyst HDTM has the potential for the department to move to tattoo-less setups and monitored breath hold gating. Before implementing these techniques clinically, staff needed to be trained. Often we have a need for new techniques to be clinical very quickly, and little time to practise. Our experience with Catalyst HDTM offered us the rare opportunity to have in depth practise and experience before the equipment was needed, allowing staff to become confident and experienced with problem-solving.

This presentation discusses the initial experience of clinical staff as they became confident with the use of Catalyst HDTM. Staff training was undertaken with an anthropomorphic phantom, allowing for the full workflow to be practised, along with some problem-solving situations. Several patient sites were then setup with the Catalyst HDTM system, verified daily by CBCT imaging. Staff encountered some initial challenges such as establishing optimal reference image and camera optimisation settings. Interpretation of the moves required and workflow was clearer once written resources were created, allowing for reliable and quick patient setups.

SGRT techniques have the potential to radically change our patient positioning and improve accuracy. This was our first clinical experience with exploring the possibilities SGRT can offer.

Reference

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Does perirectal hydrogel spacer live up to its vision of dose and toxicity reduction?

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Objectives: When delivering radiation therapy for prostate cancer, rectal toxicity is the primary dose-limiting variable.[1] Hydrogel spacers (SpaceOAR) injected via trans-perineal approach to establish prostate-rectum separation have been introduced into clinical practice in the past decade, facilitating dose fall-off between competing adjacent structures. This literature review analysed the effectiveness of SpaceOAR with respect to rectal dose, acute and late toxicity, and cost-effectiveness.

Methods: Relevant studies were sourced from databases Medline, Embase and Pubmed. Key word searches included SpaceOAR, hydrogel, spacer, polyethylene glycol, prostate cancer, prostatic neoplasm, prostate tumour, or prostate carcinoma. Articles were excluded if published earlier than 2009, not in English, or the analysed treatment modality was brachytherapy or SABR, which were outside the scope of this review.

Results: 26 articles were reviewed, pertaining to anorectal dosimetry, acute and late rectal toxicity, procedure-related adverse events and cost effectiveness.

Rectal dose reduced significantly in all studies.[2,3] However, acute toxicity reductions were not significant in randomised clinical trials.[2] Late grade 1 toxicity rates were lower in SpaceOAR patients after 15 months follow up,[3] however research beyond this period is insufficient. The predicted late grade 2–3 toxicity reduction[4] is inconsistently demonstrated[5] and therefore cannot be conclusively determined from currently available literature. Consequently, cost effectiveness is not possible to establish.

Conclusion: Current literature indicates an ongoing role for SpaceOAR due to its ability to significantly reduce rectal dose. However, further research is required to evaluate acute and late toxicity reduction, and to accurately model cost effectiveness.

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Adaptive CBCT acquisition for personalised thoracic imaging (ADAPT) in radiotherapy: phase 1 pilot initial experience

Andrew Wallis,[1] Ricky O'Brien,[2] Owen Dillon,[2] Armia George,[1] Sandie Smith,[1] Sarah Alnaghy,[2] Paul Keall,[2] Shalini Vinod,[1,3] Jan-Jakob Sonke[4]
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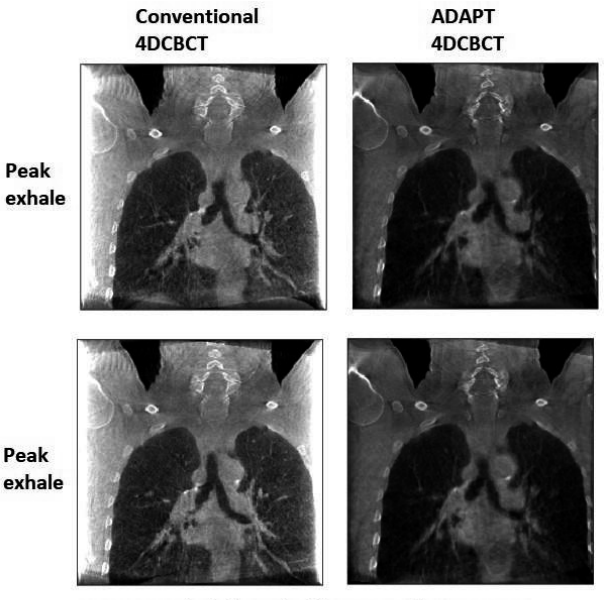
Introduction: Four-dimensional cone beam computed tomography (4DCBCT) is used for patient positioning for lung cancer. However, scan times are long (4 min), imaging doses are high with inconsistent image quality between patients. To enable time and dose efficient 4DCBCT scans, we have developed a system that adapts the gantry rotation speed and projection acquisition in response to the patient's real-time respiratory signal. In this study, we report on the initial experiences of this phase 1 pilot study utilising adaptive 4DCBCT.
Methods: In this ethics-approved study, an Elekta Versa linear accelerator was modified to acquire patient adaptive 4DCBCT images. In-house circuitry was integrated to control the gantry rotation speed and suppress kV triggers to the kV generator during acquisition. A respiratory sensor was used to monitor the patient's breathing in real-time. Each patient is treated as per department protocol and then two ADAPT scans were acquired with 20 projections in 10 breathing phases across 20 breathing cycles were acquired. The projections were reconstructed with the motion compensated FDK algorithm available in the reconstruction toolkit. Comparisons were made with the conventional 4DCBCT reconstructed with the FDK algorithm.
Results: Four patients have been scanned using the ADAPT protocol. A reduction in both imaging dose (85%) and acquisition times (75%) were achieved compared to the conventional scan. Image quality was acceptable for patient positioning (Figure).
Conclusion: The initial experiences with adaptive 4DCBCT imaging protocol has been acquired showing large reductions in scan time and imaging dose.



Note: Couch shift applied between the two scans

Figure 2: Scans at peak inhale and peak exhale for the first patient in the ADAPT study.

Accuracy and intrafractional stability of deep inspiration breath-hold using a wireless visual coaching device

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Objectives: Deep inspiration breath-hold (DIBH) is an effective technique to reduce cardiac dose to patients undergoing radiation therapy (RT) for left-sided breast cancer.[1] However, patients can find it challenging to accurately perform DIBH.[2] We implemented a wireless visual caching device (VCD) to guide patients during DIBH. This study analysed the accuracy and stability of VCD-guided DIBH among an initial patient cohort.
Methods: 20 consecutive left-sided breast patients were treated with VCD-guided DIBH. An infrared marker-block was used to track DIBH depth during treatment. Marker-block position data (captured every 0.015s) was analysed for agreement relative to each patient's planned DIBH depth. Mean, systematic error (Σ), and random error (σ) were calculated for the cohort. MV images acquired during treatment delivery were similarly analysed to correlate intrafractional motion with marker-block position.
Results: 2934 seconds of DIBH data across 100 treatment fractions (five per patient) were analysed. Mean marker block deviation from planned position was –0.4 mm (Σ = 0.7 mm, σ = 0.9 mm). Pooled analysis of marker-block data showed 91% and 56% of beam-on time to be within $\pm$ 2 mm and $\pm$ 1 mm of the planned DIBH depth, respectively. High patient compliance was shown with 99.5% of fields delivered within a single breath-hold. Mean intrafractional motion on MV imaging was <1 mm (Table). A limited correlation between VCD and MV imaging data was seen.
Discussion/Conclusion: VCD-guided DIBH treatments show a high level of accuracy, stability and compliance. This provides a baseline for on-going development in improving the accuracy and ease of RT under DIBH.

Table 1. Intrafractional motion based on MV imaging during treatment

	VRT (mm)	LNG (mm)	LAT (mm)
GRAND MEAN	0.5	-0.2	-0.4
SYSTEMATIC ERROR (Σ)	0.6	0.6	0.5
RANDOM ERROR (σ)	0.9	1.1	0.7
PTV MARGIN (2.5Σ+0.7σ)	2.2	2.3	1.8

(20 patients, 237 images)

References

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Clinical outcome of patients treated with DIBH

Harish Sharma,[1] Arnold Ng,[1] Elizabeth Brown,[1] Nakia Beaton,[1] Patricia Browne,[1] Sharon Watson,[1] Cathy Hargrave,[1] Jennifer Harvey,[1] Tao Mai,[1] Margot Lehman[1]
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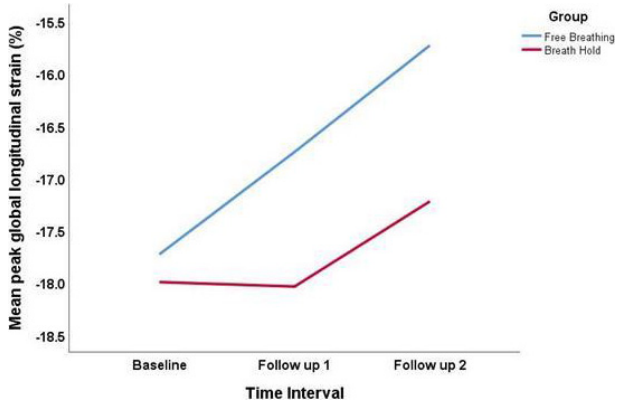
Objectives: Cardiac toxicity is a potential side effect following radiotherapy (RT) to the chest.[1,2] For left-sided breast cancer RT, deep inspiration breath hold (DIBH) has demonstrated superiority in reducing RT doses to the heart as measured by planning dosimetry especially when compared with free-breathing (FB).[2,3] This study aimed to investigate whether these dosimetric improvements translated into improvements in clinical outcomes as measured by echocardiography strain imaging.

Methods: 40 patients treated with curative intent adjuvant RT for left-sided breast cancer were prospectively recruited. Echocardiography strain imaging was conducted at baseline, during RT treatment, and at 6 months post-RT completion. 10 patients were treated in FB, while 30 patients were treated in DIBH.

Standard echo and strain parameters were measured, with left ventricular global longitudinal strain (LVGLS) analysed to investigate any cardiac dysfunction between the FB and DIBH groups.

Results: Baseline comparisons showed no significant differences between the two group of patients in terms of left ventricular (LV) volume, ejection fraction, and GLS ($P > 0.2$). There was a significant difference in LVGLS over time between the two groups ($P < 0.05$). The Figure demonstrates how LVGLS worsens as FB RT progresses, with the trend continuing 6 months after RT completion.

Conclusion: This study demonstrated the changes that occur in myocardial tissue as measured by echocardiography strain imaging in patients undergoing RT for left sided breast cancer. DIBH significantly reduced LVGLS measurements as compared with patients treated in FB, confirming the protective benefit of DIBH.



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Comparing BodyFIX Bag and Butterfly Board for immobilisation in gynaecological radiotherapy

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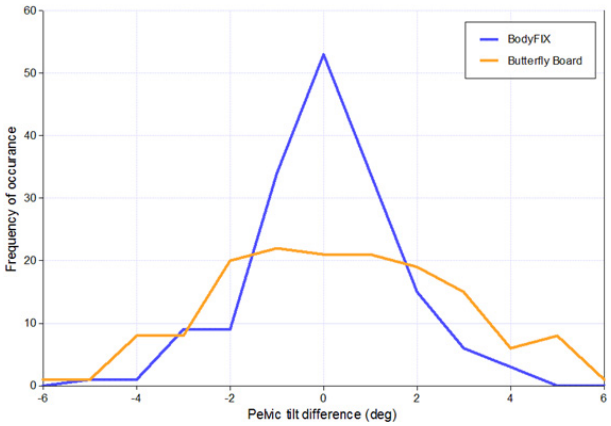
Background: Pelvic tilt and rotation (spinal curvature) are common immobilisation challenges encountered in patients undergoing gynaecological radiotherapy which includes lymph node irradiation. Our aim was to compare reproducibility of patient setup between two stabilisation devices.

Methods: The complete archived image sets of 16 patients were retrospectively reviewed. Eight were stabilised using the BlueBAG BodyFIX (BF) system (BodyFIX®, Elekta, Sweden) and eight using a dedicated couch-mounted Butterfly Board (BB) (Bionix Radiation Therapy, USA), SofTouch™ knee wedge and foot block (QFix, USA). Pelvic tilt and rotation were measured offline by comparing the bony anatomy alignment in the planning computed tomography (CT) scan with daily kilovoltage and cone beam CT images taken during treatment. Inter-fractional differences between the two immobilisation devices were analysed.[1]

Results: 400 treatment fractions were analysed. Overall systematic error was the same for both cohorts (0.1°). The standard deviation (SD) of systematic error was 1.1° and 1.6° for the BF and BB cohorts respectively. The SD of the random error was similar with 0.3° and 0.5° respectively. The frequency and variation in pelvic tilt is displayed in the Figure. There was no significant difference in the average inter-fraction tilt between patient setup in BF vs. BB ($P = 0.2$), however use of BF significantly reduced the variance ($P < 0.0001$).

Conclusion: Variation in pelvic tilt between the planning CT and daily pre-treatment imaging was decreased by using the BF setup.



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The emergence of CT perfusion: added value or waste of time?

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Computed tomography brain perfusion has been a staple examination for the imaging evaluation of acute stroke for over a decade. However, it requires sophisticated equipment and software, which may not be readily available in some geographical locations, it delivers a relatively high radiation dose, and some studies question its utility for the selection of treatment method for certain cohorts of patients. This presentation will explore current evidence on the appropriateness of computed tomography perfusion in the setting of acute stroke.

Melbourne Stroke Unit: computed tomography scanning in the F.A.S.T lane

David Johnson,[1] Francesca Langenberg,[1] Skye Coote,[2,3] Henry Zhao,[2,3] Patricia Desmond,[1,3] Damien Easton,[2] Michael Stephenson,[4] Lindsay Bent,[4] Shane Foster,[4] Karen Smith,[4] Bernard Yan,[2,3] Bruce Campbell,[2,3] Mark Parsons,[2,3] Geoffrey Donnan,[2,3,5] Stephen Davis[2,3]
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Stroke is a major cause of death and disability in Australia.[1] As such, prompt diagnosis and treatment of stroke is critical. It is, therefore, essential that the type of stroke is established accurately and quickly to allow correct treatment to be commenced and clinical decisions to be made.

Australia's first dedicated Mobile Stroke Unit (MSU) ambulance was introduced to the streets of Melbourne in November 2017[2] and provides direct, at-scene triage, CT scanning and reperfusion therapy by a multidisciplinary team of health professionals.[3]

The radiographer's role within the MSU team, from dispatch to scan, will be introduced. In particular, the challenges and technical aspects of obtaining diagnostic cross-sectional imaging in a timely manner and within an on-road ambulance will be discussed. In addition, case studies will be reviewed to demonstrate the value of time-critical CT scanning remote from the familiarity of the hospital environment.

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Beyond 2021: a vision for adaptable, person-centred radiation therapy

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The increasing individualisation of cancer treatment and patients' expectations for more seamless, personal care has put greater demands on radiotherapy practice. Radiation therapists often specialise in specific technical procedures for many patients, such as treatment planning or delivery, resulting in fragmented care provided by many staff over the patient's journey. Reconfiguring this traditional model may improve patient experiences and facilitate more complex treatment strategies such as adaptive radiotherapy.

Our institution is developing a new person-centred model-of-care that partners patients with a primary radiation therapist who performs all the key technical procedures and supportive care for their patients. The primary therapist works within the clinical team to perform education, CT-simulation, dosimetry, quality assurance procedures, treatment delivery as well ongoing supportive care for their assigned patients.

Early experience has resulted in meaningful improvements for patients versus standard practice, including enhanced continuity-of-care and personal support, in additional to strengthening technical skills of staff and clinical processes. Multidisciplinary stakeholders have also perceived improvements in patient support, with resource needs and workflow impact as potential challenges that need to be addressed. Prospective clinical studies are underway to measure impact on patient outcomes as is staff training and deployment to implement this model routinely. This flexible model-of-care is independent of advance practice training or costly technologies, yet it will enable Therapists to seamlessly perform imaging, planning and delivery procedures for their patients within the existing scope of practice. Personalising patient experiences, coupled with improvements in treatment quality and supportive care, may improve clinical outcomes of radiotherapy.

Revising department seminars: creating a department CPD website instead

Nick Maddock[1]
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Continuing professional development (CPD) seminars within imaging departments are useful for staff to learn about new concepts, cover new policies and further advance their skills. But what happens when they are all cancelled? This presentation will outline how to create a department CPD website within 15 minutes and discuss the production of content using free online resources.

To create a department CPD pseudo-website, storage and accessibility options will be explained in order to create restricted-viewing pages that can be accessed on personal mobile devices. These settings are important for the development and security of a department website.

Developing a slideshow presentation with accompanying audio is a way of recreating a seminar session. This session will show how to produce video versions of a seminar session, and how to upload them in a private-viewing-only format, and how to publish these onto a CPD website.

Engaged learners learn more.[1] By engaging learners during CPD education, educational outcomes can be improved. Online resources to promote more engaging educational activities on your website will be demonstrated, which will also assist in documenting participants of online activities.

Creating a CPD website for staff to access on personal devices can be done quickly and with relative ease. Developing and uploading engaging educational content for your department's use can help overcome issues arising from the age of social distancing, but the legacy and usefulness of creating a mobile resource for radiographers will be longer lasting.

Reference

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Imaging of the pelvis for pre-operative assessment and planning for hip arthroplasty

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Background: Pre-operative templating using digital radiography is an effective method of planning for total hip arthroplasty and requires a generalised fixed magnification factor (MF) or external calibration markers (ECM). The effect on image magnification when changing source-to-image distance, object-to-image distance (OID) and different imaging conditions is not well-described.
Methods: A simple phantom study was performed. A 25 mm ECM was placed at eight different OID values along the anterior-posterior phantom plane at three different SID values and imaging conditions, and X-rays were obtained. On each radiograph, the ECM was measured using a line caliper tool by three radiographers and recorded. The MF was calculated and recorded.
Results: The smallest observed image MF was 1.16, for an 8 cm OID, 120 cm SID with the ECM placed within the central ray and the X-ray detector in bucky underneath the X-ray table. The largest image MF was 1.40 for a 15 cm OID, 100 cm SID with the X-ray detector placed underneath an emergency department imaging trolley.
Conclusion: Digital pre-operative templating for total hip arthroplasty relies on accurate radiographic positioning and is dependent of the patient body habitus, radiographic parameters and imaging conditions selected by the radiographer. Based on the findings of this study, we believe that the use of a generalised MF does not account for deviation of these factors, and hence can be inaccurate. The use of appropriately positioned ECMs – placed medially between the patient's internally rotated legs at the level of the greater trochanter – lowers the potential for magnification inaccuracies.

Correlation of the BI-RADS assessment categories of Papua New Guinean women with mammographic parenchymal patterns, age and diagnosis

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Objective: Women with increased breast density are at increased risk of breast cancer. The aim of this research is to evidence for the first time the mammographic breast findings of Papua New Guinean (PNG) women and the relationship between Breast Imaging-Reporting and Data System (BI-RADS) assessment, mammographic parenchymal patterns (MPPs) and age.
Methods: A retrospective analysis of 1357 mammograms of women imaged at the Pacific International Hospital from August 2006 to July 2010 was undertaken. Mammographic findings were categorised using the BI-RADS Atlas® 5th edition. MPPs were recorded for each woman using the Tabar Pattern I-V classification system. Age was recorded in years. Statistical analysis was by descriptive analysis and Kruskal-Wallis with Dunn's post-test and Spearman's rho correlation for inferential analysis.
Results: True pathological findings (benign and malignant); BI-RADS 2–5 were noted in 111 women (8.2%); 1242 (91.5%) were negative. BI-RADS categories for malignancy were reported in 16 (88.9%) of women aged 30–60 years. The lower risk Tabar type I, II and III MPPs were associated with 94.4% (n = 17) of malignancies. Linear correlations between variables were weak and not statistically significant: age and Tabar pattern $r = 0.031$, $P = 0.0261$; age and BI-RADS $r = 0.018$, $P = 0.517$; Tabar pattern and BI-RADS $r = 0.020$, $P = 0.459$ (n = 1357).
Conclusion: There was no correlation demonstrated between BI-RADS category, age and MPP. Importantly, there was no correlation demonstrated between BI-RADS categories 4 and 5 for breast malignancy and high-risk Tabar type IV and V MPPs. The results of this study again reflect that the incidence of breast cancer in PNG cannot be explained by breast density and suggest that any formalised screening program in PNG has a target age group aimed at women younger than that of Western screening programs.

Does an educational intervention impact barriers and radiation therapists' role in symptom and distress screening?

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Objectives: An online symptom and distress screening tool (PROMPT-Care)[1] identifying patients' physical and psychosocial concerns is administered by radiation therapists (RTs) at two radiation oncology departments in New South Wales.
We explored the impact of a communication skills and emotional cues training program (RT Prepare CST)[2] on RTs' perceptions of their role and barriers in providing patients with distress screening and psychosocial care.
Methods: RT Prepare CST was delivered to all RTs employed at the two radiation oncology departments. Questionnaires were completed at three time points pre-, post- and three months post-training. Semi-structured interviews were conducted with RTs six-months post-training.
Results: 36 RTs completed questionnaires, and interviews were conducted with eight RTs who attended RT Prepare CST. Although there were no significant changes in RTs' opinions of their role in patients' psychosocial care following training, during interviews, RTs described the positive impact of training on patient interactions and skills to support a more active screening role. RTs also highlighted numerous barriers within the screening process that made it difficult to perform this role, including time pressures, the influence of managers and peers in providing psychosocial care, and the limited role of the RT when administering PROMPT-Care.
Conclusion: RT Prepare CST has enhanced the role of RTs by providing them with the skills and abilities to provide emotional care to patients, including symptom and distress screening. RTs feel patients' psychosocial care is an important aspect of their role and want to be more active in reviewing and actioning screening results rather than only administering PROMPT-Care.

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Revolutionising total body irradiation – departmental change and clinical implementation

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In 2019, an era of change saw the implementation of the Eclipse™ planning system and Varian TrueBeam® linear accelerators within the department. The changes meant that the conventional total body irradiation (TBI) technique protocol in place, requiring 18 MV energy and extended distances, was no longer viable. Research and implementation of a modernised technique was required.
A practical review of available literature was undertaken late in 2019 to determine the clinical picture of TBI worldwide that would be feasible within the new infrastructure and systems within the department. Requirements included viability in smaller treatment rooms, use of 6/10 MV energy, minimal extra custom equipment and feasible for paediatric treatment under general anaesthetic.
The resulting depiction in the literature of TBI is of variable methodology with no evidence based best practice or standardisation since conventional techniques were originally introduced. Several studies have shown the heterogeneity and inconsistencies of the technique between departments.[1,2] Protocols and techniques are department based; dependant on availability of equipment, software systems and resources. Several multidisciplinary discussions were required to formulate a new suitable technique considering the available literature and the structure, requirements and limitations of our department.
The technique deemed most suitable for our department was a multi-isocentric volumetric modulated arc therapy technique with a custom-made turntable.[3] 2020 saw significant effort in protocol development, end-to-end testing and rigorous quality assurance processes to allow for clinical implementation in January 2021. The newly implemented technique will modernise and align TBI with the current landscape of advance radiotherapy planning and treatment.

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CT guided cryoablation therapy – a cutting edge technology to freeze renal cell carcinoma in its track

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Background: Cryoablation therapy of renal cell carcinoma (RCC) is an emerging procedure that is seldom utilised in the Australian setting.[1] It is a minimally invasive technique that involves less recovery time, better quality of life and less complications for patients.[2] The procedure is heavily dependent on computed tomography (CT) imaging where the radiologist relies only on CT guidance to target the cryoablation probe. This means extensive involvement from the medical imaging team is required within the multidisciplinary team during the procedure.

Objective: The purpose of this systematic review is to introduce cryoablation therapy to medical imaging professionals and students in Australia. The efficacy and limitation of this procedure will be discussed, as well as the medical imaging involvement in the multidisciplinary team involved with the procedure.

Summary: In studies outside Australia, cryoablation therapy has shown to have comparable results to the gold standard procedure, partial nephrectomy, in treating renal mass while yielding a lower complication rate.[3] Cryoablation technique destroys tumour cells by freezing and thawing them. This causes apoptosis, leading to targeted destruction of tumour, providing pain relief for RCC patients.[2] The procedure utilises CT guidance to position the probes in strategic areas that targets tumour the most, and affects surrounding organs the least.[2] This is beneficial to both patients and hospitals, as it presents a fast recovery time while preserving patients' quality of life.[4] However, the cost of probes can be problematic for short term healthcare, as seen in Australian Medical Services Advisory Committee report.[1]

Conclusion: This review shows that cryoablation can contribute to better patient care. CT radiographers will be heavily involved in these procedures as part of a multidisciplinary team, and therefore it outlines the importance of imaging professionals understanding their role in this procedure. The initial finding shows the procedure will be beneficial to Australian healthcare as the reduced recovery time provides less pressure on hospital resources while providing better quality of life for patients. Studies with a longer follow up period should be utilised to show its efficacy within Australia and further research the long-term effects of this procedure.

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A cost-effectiveness analysis of hydrogel spacers for Australian prostate cancer patients

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Objectives: Recent published data on hydrogel spacer use for prostate cancer external beam radiotherapy (EBRT) has demonstrated significant reductions in chronic rectal toxicities.[1–3] While other published studies have demonstrated its cost-effectiveness internationally, no published evidence exists for Australia.[4,6] Therefore, we investigated the cost-effectiveness of hydrogel spacers for prostate cancer EBRT patients in the local setting.

Methods: A state-based model was developed to determine cost-effectiveness and net-monetary benefit at three published willingness-to-pay thresholds. Outcome data and treatment costs were collected locally where possible. Standard care without a hydrogel spacer was compared with both selective and widespread use of hydrogel spacer in this cohort. The impact of a co-payment strategy from a healthcare provider perspective was also investigated. Probabilistic sensitivity analysis was then performed to evaluate model uncertainty.

Results: Hydrogel spacer use was most cost-effective when applied to a selective cohort, however this was not below the reported willingness-to-pay threshold for a healthcare provider in Australia.[7,8] Sensitivity analysis identified large parameter uncertainty, with transition probability and utility value having the greatest impact on model results. Improvements in cost-effectiveness could potentially be realised through the introduction of a co-payment strategy.

Discussion/Conclusion: Cost-effective use of hydrogel spacer in the Australian healthcare setting is currently limited by parameter uncertainty. Where possible clinical application should be target at individuals with higher rectal toxicity risk. Combining this approach with a co-payment strategy would improve the likelihood of cost-effectiveness to an acceptable level and should be explored further.

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Implementing radiation therapy advanced practice: an uncertain process

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Introduction: Radiation therapy advanced practice (RTAP) has been implemented in several international jurisdictions, however it is yet to be systematically integrated into Australian radiation oncology services.[1] A doctoral research study was undertaken by the first author to elucidate the factors that may be influencing the scattered implementation of radiation therapy advanced practitioners in Australia. This paper will present the outcomes of this research.
Methods: Ethics approved data collection occurred via national online (video mediated) focus groups, and during interviews and observation at five purposively selected clinical case study locations. Qualitative data analysis was informed by constructivist grounded theory methodology.
Results: Results indicated that the implementation of RTAP was an uncertain and socially complex phenomenon. It appeared that although the broad concept of RTAP was understood, its interpretation within the local context can vary between individuals, professional groups and workplaces. Furthermore, integrating RTAP into a workplace was influenced by uncertain practical, conceptual and contextual factors. Additionally, the social integration of the advanced practitioner among peers and professional colleagues was highly influential on the outcome. The process of the advanced practitioner managing changes to internal self-concept and professional identity was a key feature.
Conclusion: This research has demonstrated that the implementation of RTAP into Australian radiation therapy services is a contextually defined process of 'navigating uncertainty', reliant on the creativity and flexibility of practitioners to progress. There is a need for a national implementation strategy to mitigate uncertainty if broader implementation is to be achieved.

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Mechanical standardisation of mammographic compression using Volpara software

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Introduction: Although breast compression is required in routine mammographic practices, current subjective protocols enforcing 'breast tautness' have minimal clinical reproducibility. While objective target force (daN) guidelines do not consider breast volumes, new pressure (kPa) measures account for associated variations. The study aims to determine characteristic compressive forces applied at an Australian diagnostic breast clinic, thereby establishing performance success in achieving ideal pressures of 10 kPa.

Methods: Parameters of 1972 mammograms were analysed retrospectively from a South Australian diagnostic breast clinic. Raw data were processed using VolparaDensity software; applied compression (force/pressure), breast thickness/volume/density and average glandular dose estimates were investigated based on breast/paddle contact areas.

Results: Distributions of applied average forces is large, yet distributions of applied average pressures are larger; this is internationally comparable. Regarding force-compressions, 98.6% are >5 daN, 16.6% are >10 daN and 0.0% are >15 daN. Regarding pressure-compressions, 94.5% are >5 kPa, 36.0% are >10 kPa and 6.3% are >15 kPa. Measures of average breast thickness/volume/density show anatomically consistent trends, with average glandular dose values constant, albeit high.

Conclusions: Applied compression forces varied significantly in relation to breast/paddle contact area; applied pressure varied to a greater extent. This is comparable with existing literature. Real-time compression pressure standardisation may benefit examination consistency. Relationships between breast volume, contact area, compression force and resultant compression pressure may aid in developing objective clinical compression protocols. Practical guidelines may increase image acquisition reproducibility, optimise patient discomfort and minimise radiation dose. Patient compliance may increase in accordance with perceived advantages of mechanical standardisation, ultimately assisting early-stage breast cancer detection.

Only the lonely – a vision of modern management

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Peer support is an important element for consideration in the quest for leadership. The medical radiation practitioner senior clinician who wishes to obtain clinical recognition while climbing the ladder towards a management position will experience many challenges. Sometimes these appointments are 'accidental', and the practitioner is not prepared or ready for the new vision of the department. One of the most significant identified challenges is the lack of support, guidance and mentorship to ensure success.[1]

Being in management is tough, and loneliness is a recognised element of the equation that can lead to poor performance and affect the individual's physical health and well-being.[2] Leadership requires independence and vision and those wishing to move from a senior clinical practice role into management need to have solid foundations to support this career move.

This case-based presentation has been designed to provide some key strategies to assist those practitioners who are considering this type of career move and is the first step towards the vision of modern management.

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Optimal arc selection from class solution geometries for solitary intra-cranial radiotherapy

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Objectives: Preliminary planning at our institution using HyperArc™ (Varian Medical Systems, Palo Alto, USA) identified the optimal beam energy of 10 MVFFF. Evidence suggests that single target plans do not require as many arcs as single isocentre, multiple target plans but there are trade-offs.[1,2] The aim of this study was to determine the optimal arc selection from HyperArcs class solution beam geometries for post-surgical cavities for stereotactic radiotherapy (SRT).

Methods: For 16 retrospective solitary post-surgical cavity cases, HyperArc plans comprising different arc geometries were generated. Prescribed dose for all plans was 24 Gy in 3 fractions with D99% $\geq$ utilising 10 MVFFF. Metrics analysed including indices: CI100 RTOG, CI50 RTOG, CI Paddick, GI Paddick, HI (ICRU 83) and plan complexity using modulation factor (MF) (MU/dose per fraction in cGy) comparing default arc selection versus varying arc selections.

Results: The mean CI100 RTOG for default arc selection was 1.10 (1.03–1.25) compared to 1.11 (1.05–1.24) for the comparison plans. The mean CI50 RTOG for default arc selection was 3.24 (2.70–5.44) compared to 3.25 (2.79–4.46) for the comparison plans. The mean MF for default arc selection was 2.74 (2.40–3.40) compared to 2.76 (2.40–4.00) for the comparison plans. Results from the complete analysis to be presented with additional metrics.

Discussion/Conclusion: Analysis highlighted minimal differences when comparing default arc selection to varying arc selection. Due to no clear benefit for either groups of plans, consideration in the decision making was given to both treatment time and isocentre verification at individual couch angles. Therefore, minimising arc angles for solitary intra-cranial lesions was the preferred option.

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Building a knowledge-based planning model for SABR spine

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Objectives: The SC-24 trial reported improved pain outcomes for patients with spinal metastases when receiving stereotactic ablative radiotherapy (SABR).[1] Therefore, an effective and efficient method for planning SABR spine is required. The aim is to develop a consistent method for SABR spine planning that will assist in the development of a knowledge-based planning model.

Method: 20 patients were retrospectively re-planned to test the impact on plan quality of different variables. Six plans (A, B, C, D, E, F) were generated:

- A: planning target volume (PTV) cropped from gross target volume (GTV)
- B: PTV cropped from GTV and spinal cord planning risk volume (PRV)
- C: PTV cropped from GTV and applying a generalised equivalent uniform dose (gEUD) constraint on spinal cord PRV
- D: Manually optimised using planner preference for settings
- E: PTV cropped from GTV and spinal cord PRV with an upper gEUD
- F: Ring structure added.

Metrics evaluated included D90% PTV (%), GTV min dose (Gy), D0.03cc (Gy) spinal cord PRV/cauda equina PRV, CI50 and modulation factor.

Results: 10 patients were planned 20 Gy in 1 fraction and 10 patients were planned 24 Gy in 2 fractions. Reported means for PTV D90% were 99.58% (105.97–88.62), 99.61 % (106.03–86.81), 99.69% (105.84–79.67), 99.70% (106.29–73.1), 99.9% (106.11–64.48) and 99.81% (106.12–96.5) for A, B, C, D, E and F respectively.

Conclusion: A systematic method can be used to ensure consistency with the aim of developing a standardised solution that can facilitate in the development of a knowledge-based planning model for SABR spine.

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A vision to identify the predictors of patient radiation dose during uterine artery embolisation

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Introduction: Uterine artery embolisation (UAE) is a safe and effective treatment for symptomatic uterine fibroids and/or adenomyosis.[1,2] However, UAE necessitates the use of ionising radiation where dose minimisation is important for this reproductive-age patient population.[3] Therefore, the radiographer and radiologist must have a clear vision of the predictors of patient radiation dose during UAE.
Aim: The aim of this study was to identify the predictors of radiation dose which can be controlled and optimised for UAE patients.
Methods: This study included a total of 150 patients having undergone UAE at a large teaching hospital between June 2018 and August 2019. Patient demographical information and dosimetric measurements were collected. A multiple linear regression analysis was performed to determine the predictors of dose, using dose-area-product (DAP) as the dependent variable.
Results: The analysis showed that total digital subtraction angiography (DSA), total conventional roadmap (CRM) and total last-image hold (LIH) were identified as determinants of dose for UAE ($P < 0.05$) and together accounted for 95.2% of the variance.
Discussion: The model identified total DSA, total CRM and total LIH as predictors of dose. These variables showed a greater impact on the outcome DAP compared to other demographic and dosimetric measurements.
Conclusion: This study shows a clear vision for the optimisation of these predictors during future UAE procedures to facilitate radiation dose reduction to the pelvis and reproductive organs.

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Mitigating the risk to radiation therapy services during the COVID-19 pandemic

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COVID-19, and subsequent government guidelines and restrictions implemented to mitigate the risk of virus spread, have forced radiation therapy departments globally to promptly adjust their models of service delivery to enable best clinical care. The inherent nature of the tri-partied radiation oncology professions relies heavily on multidisciplinary teamwork and patient-clinician interactions. Teamwork and patient interaction are critical to the role of a radiation therapist. Peter MacCallum Cancer Centre radiation therapy services made a number of changes during the preliminary stages of the COVID-19 pandemic to minimise risk to patients, staff and our clinical service.
Four critical areas were identified in developing risk mitigation strategies across our service: (a) workforce planning, (b) workforce communication, (c) patient safety and wellbeing, and (d) staff safety and wellbeing. Each of these initiatives had a focus on continuum of clinical care while minimising risk of cross infection for our radiation therapy workforce and patients alike.
The aim of this paper is to share our risk mitigation strategies established throughout the early stages of the pandemic, combined with the ongoing impact on our service during Melbourne's second wave on COVID-19 throughout the winter of 2020. The COVID-19 pandemic has dictated change in conventional radiation therapy practice. Some of this will remain for the betterment of our profession and its professionals. It is hoped that by sharing our experiences, the radiation therapy profession will continue to learn, adapt and navigate this period together, to ensure optimal outcomes for ourselves and our patients.

RT research capacity in different health settings: envisioning our future research needs

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Objectives: Determining the research capacity and culture of health professionals can ensure appropriate allocation of resources for those that wish to participate in research. This study aimed to measure radiation therapists' perceptions of their research skills and develop metrics to quantify if existing employment influences an individual's research capacity.

Methods: Practising radiation therapists in Australia were invited to complete the Research Capacity Culture Tool (RCCT)[1] in October 2020. The 14 Likert scale questions (each 10 points) relating to individual skill level were classified into four groups reflecting different aspects of research activity. Within each classification, individual research activity was dichotomised to either medium/low (ML: <7) or high (H: ≥7). For each respondent, the number of ML activities over the four groups was obtained and associations between these scores and site location: metropolitan, rural/regional, public and private hospitals were investigated.

Results: Of 122 RTs completing the RCCT, the need for substantial assistance within the different workplace institutions was: public 27/105 (25.71%); private 8/17 (47.06%); metropolitan 30/101 (29.70%); and rural/regional 5/21 (23.80%). Practitioners from all workplace institutions identified need for assistance in the following order: dissemination and promotion of research, tasks of initiating a project, performing a research project, and search and appraise the literature.

Conclusion: This project has used a strategic approach to analyse data from the RCCT into a structure that has identified the research needs of employees at different workplace institutions and can inform future research capacity building initiatives.

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Is digital radiography a more disruptive technology than we first thought?

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Introduction: Digital radiography has been in the imaging scene for a substantial period. Even with this we are finding that a range of users world over are still not understanding its operational requirements and how it has truly changed what must be done.

Methods: An electronic survey was undertaken on radiographers (n = 122) from a range of lengths of experience and environments. Questions relating to their understanding of certain characteristics and function of digital radiography settings was undertaken.

Discussion: There is a clear misunderstanding between users and the use of this technology. Persistent poor understanding of how to manipulate the technology beyond the simple acquiring on the image is evident. There is a disconnect between users understand of the function of exposure factors and digital radiography technologies at all levels of experience.

Conclusion: Further education models need to be developed to assist those in both educational and clinical settings. To best achieve a better understanding must move away from the adage that "I don't need to be told how to take an X-ray" . . . in some cases we do.

Fungating tumours: a breast cancer journey

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Introduction: Breast cancer is a worldwide health burden with a high incident and fatality rate. In 2021, it is estimated that 20,825 Australians will be diagnosed with breast cancer and is the most common cancer diagnosed in women in Australia. Some women diagnosed with early-stage breast cancer will develop metastatic cancer and may further develop a fungating tumour in the region of the breast.

Case Presentation: 'Hope' discovered a lump in her breast in 2013 and was diagnosed with early-stage breast cancer but declined treatment due to her beliefs on the harmful effects of conventional medicine. In 2018, she presented to a tertiary oncology hospital to receive treatment for a large fungating breast tumour.

Management: 'Hope' participated in a clinical trial and received treatment targeting her fungating breast tumour. She underwent CT and PET scans to measure and monitor her condition through the trial.

Outcome: 'Hope' was discharged after four months of treatment due to the decrease in her quality of life despite the positive response of the tumour to the treatment given.

Discussion: Fungating breast tumours are a debilitating development and greatly affects patients, both physically and psychologically. There are very few treatment options for patients with most treatments focusing on controlling symptoms rather than curing the tumour. By bringing more awareness to health professionals and patients about fungating tumours, it may lead to more research into prevention and encourage patients to seek treatment for their breast symptoms sooner.

ePortfolios: enhancing confidence in commenting on urgent radiographic findings. A mixed-methods study

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Objectives: Identifying and communicating urgent radiographic findings is within the scope of practice for Australian radiographers.[1] Despite this, radiographers' confidence in describing radiographic pathology and anatomy varies.[2] In 2018, Monash University implemented ePortfolios as an anatomy learning and assessment task. Students used digital media to demonstrate their understanding of pathology and anatomy. This research seeks to investigate whether ePortfolios enhance student confidence when articulating descriptions of urgent radiographic findings in academic and clinical settings.

Methods: A Qualtrics survey was distributed to Monash University radiography students who were involved in the creation of anatomy ePortfolios in their first year of radiographic studies (2018). After being collected anonymously, quantitative data was analysed using mean values and Pearson coefficients; Braun and Clarke's method was used to analyse qualitative data.

Preliminary results: Initial findings have been positive with 89% of respondents either agreeing or strongly agreeing that ePortfolio was useful in enhancing their confidence in commenting on radiographic pathology in the academic environment. This trend was not as strong in the clinical setting. Roughly 25% felt the ePortfolio was not as useful in helping them confidently identify and describe radiographic pathology respectively in their clinical placement. The clinical environment has unique challenges which affect student confidence, as evident in the qualitative findings.

Conclusion: Preliminary findings suggest that the ePortfolios have assisted in improving confidence in identification and description of abnormalities, particularly in an academic setting. A thematic analysis of the qualitative data will develop a deeper understanding of results.

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Understanding radiographic decision-making when imaging obese patients: a think-aloud study

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Introduction: The incidence of obesity has been steadily rising over the past few decades and is having a significant impact on the health system. In radiography, a particular challenge of imaging obese patients is implementing the 'as low as reasonably achievable' (ALARA) principle when determining radiation dose and little research has been conducted into the technical and patient-care adaptations that can be employed. This study aims to better understand the decision-making strategies of expert radiographers in determining imaging and exposure factor selection, in the context of obese patients.

Methods: The study employs a 'think-aloud' methodology – a qualitative technique used for investigating the cognitive processes of an individual.[1] Eight diagnostic radiographers, working in clinical education, were recruited to perform routine AP abdominal X-ray projections on an anthropomorphic phantom. They were simultaneously asked to verbalise emerging thoughts as they considered positioning, exposure selection and image evaluation. This process was repeated with three different phantom sizes, each representing an increased body mass index from 'healthy' to 'morbidly obese'. Audio files were transcribed verbatim and interpreted via Bowman's theory of radiographic judgement and decision-making which identifies three stages: segmental, holistic and environmental.[2]

Results/Conclusion: Preliminary analysis has demonstrated differences in radiographic concepts that are considered when imaging patients of different sizes. A general shift from segmental factors (e.g. positioning) to more environmental factors (e.g. patient comfort) with increasing patient size was observed. The findings will help inform future research, practice guidelines and learning resources to provide optimal imaging and care for obese patients.

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Phase-contrast CT: future of breast imaging

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Objective: Breast cancer mortalities compose of 15% of women's cancer deaths.[1] Current breast imaging modalities use absorption information that do not produce enough contrast for an efficient diagnosis. Propagation-based computed tomography (PB-CT) is a developing vision that exploits a more contrast-sensitive property of X-rays: phase-shifts, in addition to absorption.[2] Current research is being undertaken to optimise PB-CT for clinical implementation. A significant factor of PB-CT is the X-ray energy required to produce high-quality images. This study aims to explore the relationship between X-ray energy and radiological image quality in PB-CT imaging.

Methods: 39 samples were scanned at various energies of 26 keV, 28 keV, 30 keV, 32 keV, 34 keV and 60 keV, accumulating a total of 132 image sets. A visual grading characteristics (VGC) study was used to determine the highest quality radiographic image. Seven observers rated the radiological image quality of PB-CT images against a reference absorption-based (AB-CT) image on a 5-point scale.

Results: PB-CT images scanned at 28 keV, 30 keV, 32 keV and 34 keV displayed superior image quality than AB-CT reference images. PB-CT images scanned at 30 keV provided the most optimum images with the largest area under the curve of 0.754 ($P = 0.009$).

Discussion/Conclusion: Within an optimum energy range (30 keV), PB-CT technique may allow for advanced image quality at a dose comparable to conventional techniques. This vision enhances the justification of PB-CT and can potentially increase diagnostic efficiency. Thus, PB-CT may lead to a reduction in breast cancer mortalities and contributes to a higher standard of healthcare.

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An exploration into the emotional capacities of diagnostic radiography students

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Objectives: University clinical placements provide opportunity for radiography students to place theoretical knowledge into practice.[1] However, within healthcare environments emotional wellbeing is compromised when students are confronted with emotionally challenging situations.[2] Although various studies have identified clinical stressors and decreased emotional wellbeing in various health disciplines, little has been published within the scope of radiography clinical placements. Hence, this research study explores the lived emotional experiences of diagnostic radiography students on clinical placements and suggest improvements in practical interventions for enhancing emotional wellbeing.
Methods: This study employed a qualitative study design. Three online focus groups were conducted. A total of 13 participants were recruited from an undergraduate university diagnostic radiography program. Focus group data were transcribed verbatim. Thematic analysis was utilised to analyse participants' experiences. An inductive open coding approach was used, using NVivo 12. To improve rigour, interrater reliability was conducted, codes were discussed with three other project members until consensus was reached on themes.
Results: Five themes were identified through the focus group data: clinical environment challenges and adaptations, relationship between clinical staff and students, students and professional identity, university teaching and clinical practice gap, and student support systems.
Conclusion: The importance of emotional wellbeing throughout clinical placements was highlighted by the students through discussing the integral role of clinical staff relationships, professionalism and experiential learning. There is a need for closure of the theory practice gap as well as human interaction-based intervention strategies to improve emotional wellbeing for positive clinical experience outcomes.

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Academic impact of COVID-19 on radiography students

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Introduction: COVID-19 has affected the way radiography students learn in the absence of face-to-face classes. A rapid transition to online learning prompted teaching staff to plan and communicate cognisantly. Despite many challenges, COVID-19 provided educational institutions the opportunity to re-design learning and foster a safe online environment. This research aimed to highlight student learning during COVID-19 and inform the future of radiography education in an increasingly online world.
Methods: A qualitative study, which included second-year Monash University radiography students, was conducted in three online semi-structured focus groups using Zoom. Participants were recruited via Moodle and social media channels. An explanatory statement was provided to all potential participants. Participants used a pseudonym to preserve anonymity. Focus groups were recorded using the Zoom record facility and transcribed by the researchers. A thematic analysis was carried out on the data.
Results: Participants had a mostly positive experience with online learning. However, some technological concerns impacted students' confidence during assessments. Distractions, such as social media and family commitments, were the most predominant issues students struggled with when studying at home. Participation in classes was dependent on the scheduled class, subject and attendance of other students. Posture and eyesight were commonly affected due to the increased usage of technology.
Conclusion: COVID-19 presented many challenges for students in their academic learning, such as distractions associated with studying at home. However, students responded to the challenges and reported some tangible benefits to online learning with participants hopeful for a balanced integration of e-learning alongside in-person classes.

Has artificial intelligence reached the tipping point in breast imaging?

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Breast cancer is the most common cancer in women globally and the second leading cause of cancer death in Australian women. Breast screening was implemented to address this rising health concern through early detection but has since significantly increased the number of mammograms performed and reporting workload.

Limitations such as radiologist interpretation variability and high false positive rates has generated an interest and high demand for alternative computational methods of diagnosis, including artificial intelligence (AI). A review of the literature was performed to assess the diagnostic performance and socioeconomic impact of AI compared to radiologists to determine if AI has reached the tipping point in stakeholder acceptance and is ready for clinical implementation in breast screening.

Literature demonstrates that recent introduction of new deep learning algorithms in AI has significantly improved the diagnostic performance and accuracy of breast image interpretation, including sensitivity and cancer detection rates. Research suggests that the standalone performance of AI is significantly comparable to radiologists, and when used in combination as a second reader, is superior to radiologists alone. For clinical implementation, new technology must deliver comparable results more efficiently and cost effectively than the current standards in order to be accepted by the healthcare community. Literature has supported this positive socioeconomic impact in workflow including life years gained, suggesting it should be utilised in combination with radiologists, having reached a tipping point in stakeholder acceptance. However, future studies focusing on AI in breast imaging require prospective research within the clinical setting to confirm its readiness.

Adapted education strategies within multidisciplinary healthcare teams for adolescents and young adult cancer patients

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Background: The impact of cancer on adolescents and young adults' (AYA) psychosocial health can be significantly detrimental, as young people often face a range of important life events and decisions that could potentially impact their health and wellbeing in the long term. However, this group of patients often fall in the gap between paediatric or adult strategy of care. Therefore, it is necessary to establish dedicated units for AYA and provide adaptive care strategies to bridge the gap.

Objective: The purpose of this review is to explore the literature in order to identify the most effective and appropriate method to educate AYA patients before and during their radiotherapy simulation and treatments. The impact of establishing an effective and appropriate education method to AYA in a clinical setting will also be reviewed.

Results: Results from the studies indicate that having a dedicated care team for AYA and delivering adaptive education strategies during their course of treatment can provide positive impacts for these patients. AYA said that they felt more connected with healthcare professionals when there is a special AYA team that look after them.

Conclusion: There are many critical elements in providing effective and appropriate AYA support. Access to social events, fertility and sexuality counselling should be incorporated into standard care procedures. However, each patient is unique, so the AYA care team should always identify the specific needs of each patient and provide the most appropriate care based on these interventions.

Tangential VMAT arcs with DIBH for the treatment of left breast cancer

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The principal method of treating breast cancer (with nodal disease) after surgery is adjuvant radiotherapy, which lengthens survival and decreases rates of recurrence. Irradiation of the left breast can lead to unintended radiation exposures of the left lung, heart and contralateral breast, and is associated with long-term effects including increased rates of secondary malignancies and coronary and pulmonary complications.

Tangential volumetric modulated arc therapy (T-VMAT) for the irradiation of left breast cancers with nodal disease show significant advantages in achieving higher dose conformity and homogeneity. T-VMAT has proven to reduce doses to organs at risk compared to former techniques such as intensity modulated radiation therapy (IMRT) and/or electronic compensation planning.

The tangential partial arcs are applied at strategic angles to reduce cardiac doses, and when this is combined with the deep inspiration breath hold technique (DIBH), the doses to the heart and ipsilateral lung are further reduced. The efficacy of these techniques can be tested with its associated monitor units (MU), where T-VMAT utilises far less MUs than IMRT techniques, resulting in shorter treatment times and lower associated scatter doses.

This presentation will cover the rationale behind T-VMAT, the planning process, treatment delivery method and the comparison of dosimetry between T-VMAT and conventional left breast treatment techniques. The importance of T-VMAT for the treatment of patients suffering from left breast cancer (with nodes) both now and into the future, the advantages, limitations and anecdotal T-VMAT plans for left breast cancer will also be discussed.

Initial Australian experience with fully adaptive stereotactic prostate radiation therapy using a 1.5 T MR linac

David Crawford,[1] Michael Jameson,[1,2] Stacy Alvares,[1] Louise Hogan,[1] Conrad Loo,[1] Claire Pagulayan,[1] Urszula Jelen,[1] Tania Twentyman,[1] Zoe Moutrie,[1] Monique Henke,[1] Sandy Sampaio,[1] Jeremy de Leon[1]
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Background: MR linacs (MRLs) are being utilised more often within a radiation oncology setting. The use of this technology is changing clinical practice. Traditionally, SABR prostate treatments on a standard linac may require invasive procedures for placement of SpaceOAR and fiducials markers. Due to the enhanced soft tissue definition on MRI and daily replanning, the MRL can remove the need for these invasive procedures. We present the initial Australian experience of stereotactic prostate radiotherapy on the MRI linac using a fully adaptive workflow.

Method: Prostate SBRT patients undergo a CT and MRI for target and organ at risk delineation. A prostate membrane specific antigen and SpaceOAR are optional. Fiducials are not required. Each fraction is delivered using an adapt to shape workflow, which involves recontouring and plan re-optimisation. All patients underwent real-time image guidance through the use of cine imaging. A treatment handover document is used to inform planning each day to improve consistency and efficiency

Results: Since July 2020, eight patients have undergone treatment. Prescription was 36.25 Gy and 38–40 Gy to CTV delivered in five fractions on alternate days. Average treatment time was 45–55 minutes. Plan quality at each fraction was adequate.

Conclusion: Stereotactic prostate radiotherapy treated with the adapt to shape workflow is well tolerated. Plan metrics were consistently met and treatments times where acceptable.

Isotoxic planning and treatment using a 1.5 T MR linac

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Background: MR linacs are being utilised more often within a radiation oncology setting. The use of this technology is changing clinical practice. Isotoxic radiation therapy is a novel concept of adaptive personalised radiation therapy whereby the prescription a patient receives is determined based on the doses received by the surrounding critical organs at risk (OAR). This presentation will outline our experiences with simulation, planning and treatment of the first five isotoxic abdominal cases that were delivered on the MR linac utilising the full adapt to shape workflow and real time image guidance.
Method: All five isotoxic abdominal patents who underwent treatment on the MR linac received a 4DCT and MRI for target and OAR delineation for planning purposes. The planning team optimised the plan to the highest possible dose to the target while not violating OAR tolerances. Online, the adapt to shape workflow is utilised whereby the anatomy of the day is recontoured and a new plan is created.
Results: To date, a total of five patients have been treated with this isotoxic technique, the dose regimen varied from 30–35 Gy and from 3–5 fractions. Of the five cases, all were limited by OAR constraints.
Conclusion: Adaptive isotoxic treatments realise the full capability of MR linacs and enable maximal dose to be delivered to the tumour while not violating OAR constraints and not causing RT toxicity.

Radiation therapist perspective on fully adaptive workflows on the MRI linac: initial Australian experience

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Introduction: This presentation seeks to cover the radiation therapist's experience of the MRI linac's (Elekta Unity) online adaptive clinical workflow, including some key improvements that have been made since going live.
Discussion: A significant difference with the Elekta Unity's online adaptive clinical workflow is the use of the Adapt to Shape (ATS) workflow where a plan is adapted to the deformed anatomical structures on the day of treatment.[1] Although being resource intensive, this pathway accounts for inter-fraction variability in patient anatomy adjusting the target and organ at risk volumes and preparing a completely new adapted plan for each fraction. To date, 40 patients have been treated with over 300 fractions delivered. Treatment sites include prostate, prostate bed, bladder and oligometastases in the pelvis and abdomen.
Examples of clinical tools implemented through a continuous improvement process include:

- a handover document, detailing calculation properties, key dosimetry indices for targets and organs for previous fractions in order to inform the current team on clinical decisions made each fraction
- a timing procedure to identify specific parts of the process that could be improved.

Conclusion: The MRI linac system changes the practice of radiation therapy and allows radiation therapists to create personalised treatment plans to match patients' daily anatomy. Given how resource intensive the ATS workflow is, future avenues of improvements have been discussed. These include the use of remote desktop connections for the radiation oncologist to contour and review adapted plans. Additionally, preliminary work into an RT-led Unity workflow has begun.

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Can radiographer-led preliminary clinical evaluation of orthopaedic cases improve patient review? A pilot study

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Objectives: Patients presenting for imaging during orthopaedic review require prompt reporting of outcomes to provide optimal management; however, the radiologist reports are rarely available in a timely manner. The radiographer is uniquely placed to provide a preliminary clinical evaluation (PCE), but little is known about radiographer PCE accuracy in this setting. This study aims to evaluate the accuracy and potential clinical effect of radiographer PCE before and after receiving targeted education on traumatic appendicular orthopaedic injuries.

Methods: Seven radiographers participated in a targeted education program describing radiographic appearances of appendicular skeletal trauma. This comprised of 24 week online non-award image interpretation modules and a four-hour face-to-face seminar given by a consultant orthopaedic specialist. X-ray images of consecutive patients presenting in both the four weeks before and immediately following education delivery were retrospectively evaluated to compare radiographers PCE accuracy pre- and post-education against the radiologist report (gold standard). Images were scored between 1 and 3 (1 = identical to radiologists' reports; 2 = minor inaccurate PCE; 3 = inaccuracies, no effect on patient management) or 4 (inaccurate PCE, patient management affected).

Results: Participation in targeted education significantly improved the accuracy of PCE. The proportion of scores of 1 increased significantly from 39.1 to 64.2% ($P < 0.001$). The proportion of scores of 4 (inaccurate PCE affecting patient management) decreased significantly from 12.8% to 4.8% ($P < 0.001$).

Conclusion: Radiographers can provide accurate PCE for imaging of appendicular skeletal trauma following tailored education. This may improve workflow and reduce diagnostic errors when radiologists' reports are not readily available.

How are patients selected for proton therapy? Looking to the past to inform future practice

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Objectives: To conduct a scoping review exploring various clinical decision-making tools and dose comparison methods used globally for proton therapy (PT) versus photon therapy patient selection.

Methods: A literature search that followed defined scoping review methods was performed in Medline and Embase databases as well as grey literature sources for articles published from 1 January 2015 to 4 August 2020. Articles were eligible for inclusion if they clearly stated methods of patient selection and were in English.

Results: 321 studies were identified; 49 studies met the study's inclusion criteria, representing PT patient selection from 13 countries. Of these 13 countries, only nine of the 19 countries with PT clinically operational were represented. Six different clinical decision-making tools and 14 dose comparison methods were identified, demonstrating variability within countries and internationally. PT was indicated for all paediatric patients except those with lymphoma and re-irradiation where individualised model-based selection was required. The most commonly reported patient selection tools included the Normal Tissue Complication Probability model, followed by cost-effectiveness modelling and dosimetry comparison. Model-based selection methods were most commonly applied for head and neck clinical indications in adult cohorts.

Conclusion: While no gold standard currently exists for PT patient selection with variations evidenced globally, some of the patient selection methods identified in this review can be used to inform future practice in Australia. As literature was not identified from all countries where PT centres are available, further research is needed to evaluate patient selection methods in these jurisdictions for a comprehensive overview.

The impact of phantom vertical off-centring, tube voltage and phantom size on CT number accuracy

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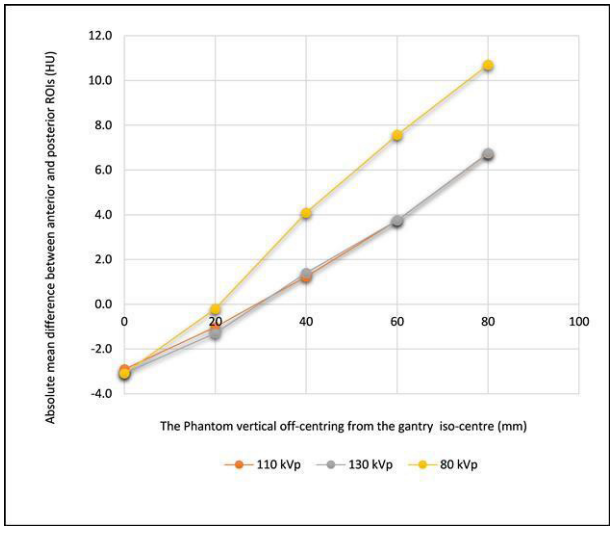
Objectives: This study explores the effect of phantom vertical off-centring on computed tomography (CT) numbers in combination with various tube voltages and phantom sizes.
Methods: A multi-sized CIRS Model 062 electron density phantom underwent imaging using a Siemens Emotion 16-slice CT. Scanning employing automatic tube current modulation was undertaken and images acquired with each phantom off-centred by 20, 40, 60 and 80 mm above gantry iso-centre at 80, 110 and 130 kVp. The uniformity was evaluated using the 18 and 30 cm phantom sizes. Anterior and posterior region of interests were identified for each image and CT number change was assessed by comparing the recorded CT number values for each scan as a function of vertical off-centring and tube voltage.
Results: As expected, consistency in uniformity across the scan field was observed for both phantom sizes at iso-centre. Both phantoms evidenced CT number variation at 80 mm off-centring for a maximum of 2 HU for the 20 cm phantom and 9.1 HU for the 30 cm phantom using 80 kVp. The absolute CT number variation between anterior and posterior ROIs was 13.7 HU.
Conclusions: This study further highlight the effect of poor patient centring on CT number evaluation. Variation was more evident at peripheral phantom areas, lower tube voltages and larger phantom size. Optimal patient centring must be considered fundamental to each examination, especially where clinical decisions are dependent upon CT numbers accuracy for tissue lesion characterisation. Raised awareness of this issue among radiographers, radiologists and physicians is urgently needed.



Oesophageal IGRT considerations for SBRT of LA-NSCLC: barium-enhanced CBCT and interfraction motion

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Objectives: To determine the optimal volume of barium required to maintain oesophageal visibility and minimise imaging artefacts on cone bean computed tomography (CBCT) for locally advanced non-small cell lung cancer (NSCLC) and quantify interfraction motion of the oesophagus relative to the tumour.
Methods: 20 patients were administered oral barium before every second weekly CBCT in one of four dose levels: 25 mL, 15 mL, 10 mL, 5 mL. Six observers contoured the oesophagus on each dataset and a consensus contour was generated and compared to each observer contour. Visibility was determined by how similar the observer's contours were to the consensus contour using a kappa statistic, dice coefficient and Hausdorff distance. Image artefact was scored by each observer. CBCT consensus contours were compared to the planning CT based off a soft tissue image registration to calculate interfraction motion. Correlations between displacement, oesophageal segment and other clinical variables were analysed.
Results: Barium significantly improved oesophageal visibility on CBCTs compared to CBCTs without barium. The poorer the visibility without contrast the greater the improvement barium provided. There was minimal difference between dose levels with only 10 mL producing a higher kappa and dice. Artefact occurred infrequently and had minimal impact on image guidance. The median interfraction Hausdorff distance was 4 mm, with 95% of oesophageal displacement within 15 mm. No trends in position variation were seen between clinical variables.
Conclusion: 10 mL of barium significantly improves visualisation of the oesophagus on CBCT with minimal image artefact. The oesophagus moves substantially and unpredictably over a course of treatment, requiring close daily monitoring in the context of hypofractionation.

Looking back on 2020: how COVID-19 impacted the humble chest X-ray

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Objectives: As the COVID-19 pandemic developed, many hospitals in Australia adapted their chest X-ray (CXR) protocol when imaging suspected and confirmed COVID-19 patients. Mobile CXRs became routine over conventional CXR to minimise transportation of COVID-19 patients. In each examination, full PPE was required to be worn, and sometimes exams were performed at increased source to image distance (SIDs). Our aim was to assess any change in demand of mobile CXR imaging in 2020, to measure any additional time required for PPE, and to review the impacts of performing CXRs at increased SIDs.
Methods: Mobile CXR data was retrospectively collected across four Melbourne hospital sites for the years 2018, 2019 and 2020. Data collected was total number of mobile CXRs per month at each site. Additionally, 50 mobile CXR examinations were evaluated, and data was collected regarding time required for the following factors: reaching ward, donning PPE, performing exam, doffing PPE and cleaning, returning to department and post-processing.
Results: When comparing 2018 and 2019 with 2020, an increase in total number of mobile CXRs was seen. The highest percentage increase in one month was 433%. Additional time was required for PPE, with an average increase in exam time of 31%.
Conclusion: A significant increase was seen in number of mobile CXRs performed in 2020 compared to previous years, as well as an increase in time to perform these exams.

Vision... not always what you want. My introduction to forensic radiography

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What happened on 15 March 2019 in Christchurch was not a day any of us ever expected. In the radiation therapy department on that Friday afternoon myself and fellow radiation therapist colleagues were in lockdown; fairly oblivious to the extent of what was happening elsewhere. Meanwhile, staff in the emergency department, theatres, intensive care unit and radiology were inundated with 50 seriously injured patients.
Saturday, however, was a different story. There were 51 victims who did not survive the terror attack, and sadly needed identifying and establishing a confirmation of cause of death. Our relationship with the radiology department meant an instant collaboration with the morgue, radiology, PACS, the New Zealand Army and the radiation therapy department. Post-mortem imaging is a concept we are not usually exposed to as radiation therapists.
This is a story of how we thought, initiated, improvised and worked together to help the families get their loved ones back as soon as possible. Helpful information we all hope we don't need.

Positive psychology strategies in a cancer care organisation – a coordinated response to COVID-19

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Literature demonstrates positive psychology plays a role at an individual, unit and organisational level. This presentation discusses the potential impact positive psychology strategies can have on productivity, culture and diversity, along with mental and physical health. The emergence of COVID-19 has meant organisations have had to be reactive and re-visit their approach to sustain a productive and happy workforce amid the challenges managing COVID-19.

A review of an organisations current positive psychology initiatives was undertaken followed by investigation into the group's response to COVID-19 with regards to workforce planning, employee wellbeing and communication mechanisms.

An employee survey was conducted to ascertain if additional strategies instigated during the onset of COVID-19 were of value in maintaining positive psychology currency. Employees included both clinical and non-clinical staff. Analysis was conducted on staff feeling supported to work remotely and ability to maintain a positive outlook during a time of instability. Data indicated there were differences in the uptake and value of initiatives implemented. There was notable variance in employee positivity in relation to working from home for extended periods. The desire for regular communication, leadership and teamwork was evident. Positive emotions can guide behaviour and signal emotional and physical wellbeing. This study demonstrated additional mechanisms instigated at short notice as a pandemic rapidly unfolded did support employees and allowed for revision in work practices.

Magnetic resonance imaging for the diagnosis and management of acute colonic diverticulitis: a review of current and future use

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Diverticular disease is one of the most common causes of outpatient visits and hospitalisations across Australia, North America and Europe. Approximately 33% of Australians over 45 years of age and 66% over 85 years of age have colonic diverticulosis.[1] Further inflammation of colonic diverticulosis can progress into acute colonic diverticulitis (ACD) and subsequent inflammatory attacks can lead to a 70–90% chance of additional complications and recurring infections throughout one's lifetime. Medical imaging is fundamental in the diagnosis, treatment and ongoing management of ACD and its complications, with computed tomography (CT) identified as the prevailing gold standard in the past few decades.[2]

Cross-database searching highlighted a large gap in the literature regarding the effectiveness of magnetic resonance imaging (MRI) as a non-ionising radiation alternative imaging tool for ACD imaging after the mid-2000s, despite ongoing technological advancements in this modality.

This narrative review identified 13 key publications (11 primary prospective cohort studies, one systematic review and one meta-analysis) that evaluate MRI for ACD imaging, of which five were published within the past decade. Several existing MRI protocols were deemed suitable for ACD imaging and it is recommended they be re-evaluated in larger cohorts. Future studies should consider the rapidly growing technological improvements of MRI, its cost efficiency and its applicability in modern day healthcare settings when addressing ACD management. This is especially important considering the gradual rise in radiation dose among the Australian population attributable to increased CT referrals, alongside increased reporting of ACD cases in younger individuals.

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Implementing online adaptive radiation therapy for rectal cancer: a radiation therapist's perspective

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Online adaptive radiation therapy (oART) is a novel solution to account for inter-fraction anatomical variation. oART enables the reduction of margins required for day-to-day anatomical variation, resulting in reduced treatment volumes. Our department has completed significant preliminary work to implement oART using the first artificial intelligence driven CBCT based radiation therapy system, Varian's Ethos™. Following collaboration with and contribution to the international Adaptive Intelligence Consortium (AIC), we first treated with oART in March 2020. In September 2020 the department was the first in the southern hemisphere to treat rectal oART. Three neoadjuvant long course rectal patients have completed treatment with oART.

The introduction of a new planning system required multidisciplinary collaboration to develop auto-plan templates which generate plans that match or exceed current departmental plan quality. Sixty automatic treatment plans were generated for recently treated rectal patients and over 100 fractions were treated in the test environment.

Throughout implementation, technical challenges were encountered that included the impact of inter and intra-fraction anatomical changes on imaging, structure propagation and plan generation, as well as practice changes due to software differences and limitations. Subsequently, numerous quality control processes were revised and developed to ensure safe and efficient treatment. The departments' initial experience demonstrates that rectal oART is feasible and may be delivered safely and accurately.

Impact of COVID-19 on clinical learning for undergraduate radiography students

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Background: Work integrated learning is an integral aspect of learning in undergraduate radiography curricula. The COVID-19 pandemic challenged the way radiography students have received their clinical education and will continue to impact future placement experiences. This research investigates radiography students' perspectives of clinical learning experiences during the pandemic. It will inform educators how to effectively support students in future clinical placements.

Methods: Twelve radiography students ranging across second to fourth year were recruited using an online learning management system and Facebook. Semi-structured focus groups were conducted via Zoom. Open-ended questions were used as prompts for discussion. Anonymity was kept using pseudonyms. Focus groups were recorded and transcribed. Thematic analysis was carried out on the data.

Results: Four main themes emerged from the analysis. These included infection control, interactions with patients, the impact on the individual student and workflow across varying clinical sites. Despite changes in learning opportunities available, students found that placements were an invaluable aspect for their learning during critical events. PPE training before entering placement was emphasised through frequent discussion of its usage and availability by participating students. Changes made to the traditional curriculum influenced by COVID-19 were seen to have both beneficial and adverse outcomes on the student experience. This contrast allowed for stressors to be identified and analysed further.

Conclusion: This study highlights the importance of infection control education prior to placement but juxtaposes the challenge of doing so in a remote learning environment. It also exposes student stresses associated with entering clinical placements during high-risk periods of infection.

Retrospective dosimetric analysis of bone marrow sparing volumetric modulated arc therapy in gynaecologic patients

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Objectives: The myelosuppressive effects associated with concurrent chemoradiotherapy (CRT) for locally advanced cervical and vaginal cancer can lead to treatment interruptions. The aim of this study was to investigate whether an emerging technique, known as bone marrow sparing (BMS) volumetric modulated arc therapy (VMAT), can effectively reduce dose to active bone marrow (ABM) while maintaining acceptable clinical objectives for targets and organs at risk (OAR).
Methods: Ethics approval was obtained. Twenty gynaecological cancer patients treated with definitive CRT from our department between 2015 and 2020 were retrospectively included. ABM was delineated based on fluorodeoxyglucose-positron-emission-tomography (FDG-PET) imaging. Weekly blood tests and ABM dose parameters at the V10 Gy, V20 Gy, V30 Gy, V40 Gy, and Dmean were assessed on original plans for any potential correlation with grade 2+ HT. BMS plans were all replanned with VMAT, and various dose parameters were compared with the original plan to assess for any significant differences.
Results: ABM doses were significantly reduced ($P < 0.001$ for all parameters) in BMS-VMAT plans, and significant improvements in target and OAR coverage was found compared to the combined original plans. Compared to VMAT-only, target and OARs were comparable. No significant correlations between HT and ABM dose were found.
Conclusion/Discussion: BMS-VMAT can significantly reduce dose to the ABM while maintaining acceptable target and OAR doses. A future prospective trial is planned to investigate the clinical impacts of BMS-VMAT on HT.

Clinical reasoning – making it visible to RT students

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Objectives: Clinical reasoning (CR) is a complex skill considered essential for health practitioners. It is a skill that must be developed but is often not visible to novice practitioners, nor easily articulated by experienced practitioners. This research sought to investigate how radiation therapists (RTs) describe CR, how they make their thinking visible and the strategies they use to cultivate CR skills in RT students.
Methods: Participants for this constructive descriptive study were recruited to complete an anonymous survey via a snowball method. The sample was purposefully selected to be RTs who currently supervise students on clinical placement. The survey consisted of open and closed questions. Closed questions provided demographic information. Thematic analysis was applied to the open questions to identify major themes within the data.
Results: 24 RTs responded to the survey. Major themes identified from the responses were the tools for CR, supervisor attributes, skill development and the learning environment.
Conclusion: The participating RTs use forward-reasoning based on protocols to decide the course of a patient's treatment but importantly incorporate experience and reflection to personalise the patient's care. This study confirmed that communication is key to role-modelling CR to students, and to assessing the development of their CR skills. The participants emphasised the need to establish an open environment where discussions and questions are welcome from all members of the team. Acknowledging uncertainty in decision making is encouraged to promote CR.

Is deep inspiration breath hold feasible in lung cancer patients, and does it reduce toxicity?

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Background: Deep inspiration breath hold (DIBH) offers potential improvements to radiotherapy for lung cancer patients, however significant debate exists among the oncology community regarding the capacity of these patients to perform the necessary breath hold due to tumour-related symptoms.[1,2]
Methods: A search of the litwerature published prior to August 2019 was conducted via PubMed, using synonyms of the key terms 'deep inspiration breath hold', 'lung cancer' and 'accuracy'. The search returned 110 results. An inclusion criterion was applied to the results and 10 papers were included in the final review.
Results: A substantial proportion of patients in each study (65–100%) were able to perform DIBH. Intrafraction tumour position was not significantly changed ($P \geq 0.05$), demonstrating good intrafraction reproducibility. Results were contradictory for interfraction motion, meaning that margin reduction cannot currently be recommended unless daily image guidance is also in use. The establishment of interfraction reproducibility would allow reduction of healthy tissue exposure and potential for dose escalation. All studies reporting lung-dose volume parameters of V20 Gy and mean lung dose showed significant decreases with the introduction of DIBH (ranging from 6–6% and 13–32% decrease, respectively; $P < 0.05$), indicating reduced risk of pulmonary toxicities, especially radiation pneumonitis.
Conclusions: A reduction in healthy lung tissue doses may allow for dose escalation without compromising quality of life due to toxicity. This may improve local control and disease-free survival rates. DIBH should be implemented with current margins to reduce toxicity, and further research into reproducibility and margin reduction should be conducted.

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Comparison of MRE findings in adult and paediatric patients with Crohn's disease

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Objective: Crohn's disease (CD) is one of chronic inflammatory bowel diseases.[1] Magnetic resonance enterography (MRE) can demonstrate mural and extramural inflammatory signs and complications which makes it a valuable diagnostic modality.[2] The aim of the study was to demonstrate the value of MRE in the assessment of possible intestinal complications in both paediatric and adult patients with Crohn's disease.
Methods: The study included 76 adults and 36 children diagnosed with Crohn's disease. Each patient underwent MRE with intravenous administration of a contrast agent. All the studies were performed using Siemens Aera 1.5T scanner according to a local study protocol. Whenever applicable, MR findings were verified with endoscopy.
Results: 40 adults and 36 children had active phase of CD according to MRE criteria. In both groups a thickened edematous ileum wall was the most common manifestation of an active disease. 58% of adults (N = 23) and 89% (N = 32) of children presented with edematous swelling of Bauhin's valve, whereas inflammatory infiltration of the mesenteric adipose tissue was observed in 34% (N = 9) adult and 64% (N = 23) paediatric patients. Penetrating complications of Crohn's disease were particularly found in adult population (40%, N = 16); 18 fistulas (14 adults, four children) and six abscesses (two adults, four children) were detected.
Conclusions: MRE is a non-invasive and reliable method in the evaluation of Crohn's disease activity.[3] CD manifestations seem to be age-dependent – focal edematous lesions are more often encountered among children,[4] while there are more penetrating complications in adults.[5]

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Formalising initial commenting by Australian radiographers: a valuable future practice?

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Currently mandated under National Law, as articulated by the Medical Radiation Practice Board of Australia, is the minimum capability for all registered radiographers to assess acquired images for trauma or disease and convey findings to clinical staff. Despite endorsement of a written commenting system by professional bodies in several countries including Australia, radiographer input remains inconsistent and often informal.[1] The purpose of this review was an assessment of current literature to determine if commenting would be of value to the Australian health system, particularly when a radiologist report is not available within a clinically relevant timeframe. A structured search of four health research databases produced 58 articles used to support conclusions drawn within the review, with 11 core articles of highest relevance assessed for bias and quality forming the basis of discussion. Studies have suggested there is a contextual need for commenting due to increased imaging service pressures, radiologist shortages, and subsequent reporting delays.[2] Radiographers appear well placed and willing to provide accurate and confident initial input with evidence this would be valued and appreciated within the multidisciplinary team. Commenting has also been shown to reduce diagnostic and communicative errors, with the potential to improve patient management.[3] Finally, it was shown that role extension enhances recruitment, retention, and job satisfaction among radiographers.[2] Therefore, current literature supports implementation of radiographer commenting within the Australian health system. Future research into financial and legal aspects of initial commenting would also be of value.

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Daily adaptive planning on halcyon for head and neck patients: potential benefits to a patient's treatment?

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Objectives: Patients having radiotherapy for head and neck cancer experience weight loss or tumour shrinkage that can result in contour changes and positional errors during daily set up.[1,2] Adaptive radiation therapy (ART) can account for these variations and accurately deliver the radiation dose to the tumour. The aim of this study was to assess the impact ART might have on a patient's treatment.
Methods: 10 patients receiving radiotherapy for head and neck cancer were included in this study, with contour change data collected between fractions 11–20. For each patient, three plans were compared: the original plan, a dose evaluation plan (the original plan applied to patient's daily cone beam computed tomography [CBCT]), and an adaptive offline plan produced from daily CBCT.
Results: Across the patient cohort target volume doses increased, with slightly higher conformal dose across fractions 11–20 accounting for variation. Overall, coverage was improved using the adaptive offline plan, especially in the low dose target region. A comparison across all three plans indicated that following adjustment to compensate for dose coverage, little change in organs at risk dose was evident.
Discussion: A dose evaluation of target volume and organs at risk doses indicated that daily CBCT matching and offline replanning can impact on a patient's treatment. ART can account for variations such as weight loss or tumour shrinkage, delivering a more accurate radiation dose to tumour volumes, with little change in organs at risk dose.

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Incorporating probabilistic nanoparticle radiosensitisation factors into a head and neck cancer radiotherapy predictive model

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Objectives: Head and neck cancers are characterised by hypoxia and radioresistance, cumulating in negative radiotherapy (RT) outcomes.[1] Standard-of-care involves concurrent chemoradiation, a treatment method associated with high acute grade toxicities. Gold nanoparticle (AuNP) radiosensitisers permit RT dose reduction through the promotion of localised dose deposition and sensitisation of cells to damage, offering a new approach to treatment delivery.[2,3]
Methods: This project aimed to maximise the therapeutic benefits of AuNPs through the optimisation of RT doses, fractionation schedules and nanoparticle injection regimens. The HYP-RT model,[4] capable of growing in-silico tumours and simulating fractionated RT was utilised. This project involved the incorporation of probabilistic nanoparticle sensitisation factors into the model through the implementation of nanoparticle uptake distributions and dose enhancement ratio variables. HYP-RT was used to predict total doses required for 100% tumour control probability with/without AuNPs during fractionated RT.
Results: Minimal decreases in total doses for local tumour control were found with single AuNP injections. For hypoxic tumours with accelerated repopulation and reoxygenation applied, undergoing 2 Gy per fraction RT, weekly and bi-weekly AuNP injections decreased required doses from 89.76 Gy to 62.24 Gy and 53.38 Gy, respectively. All total dose outcomes significantly reduced with the addition of AuNPs, with the most decrease associated with bi-weekly AuNP injections.
Discussion: For most simulations in which no AuNPs resulted in above standard clinical prescriptions, the addition of reoccurring AuNP injections enabled reductions below these doses. AuNPs allowed for the reduction in total tumour control doses and facilitates a method for effectively treating hypoxic (radioresistant) tumours.

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Extinct radiology examinations: what has changed in the past 50 years?

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There are many examinations and procedures both past and present which are unfamiliar to students, emerging graduates and qualified radiographers alike.
A university film library of historical radiographs submitted by former students was catalogued and analysed, which has provided an invaluable portal to the past 50 years of radiology practice. These resources have provided a unique opportunity to reflect on learnings from examinations which are now extinct, provoking thought about where the next 50 years of innovation may take the field of radiology. The historic examinations within the collection were directly compared with the current gold-standard procedures, identifying similarities and differences, and highlighting the gaps in former practice that prompted subsequent changes and advancements. Some examples include procedures such as air encephalograms which have been replaced by computed tomography (CT) and magnetic resonance imaging (MRI) for neuroimaging, tomographic intravenous pyelograms which have been largely superseded by CT, and arthrography which has moved from being a fluoroscopic procedure to an MRI examination.
By understanding this history, identification and awareness of current gaps in radiology practice may be facilitated, leading to a continued appreciation and drive towards innovation in technology and patient care. It is through reflection upon historical accomplishments that we can truly appreciate the vision of future improvements in our field.

Through the looking glass: a new educational approach to enhancing students' radiographic commenting skills

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Introduction: Commenting on radiographic abnormalities is an expectation in radiography and is an obligation for qualified radiographers.[1] Despite this, radiographers' confidence articulating descriptions of radiographic pathology and anatomy varies.[2] The purpose of this research was to evaluate the influence of ePortfolios as a creative learning approach in enhancing students' confidence in commenting on normal and abnormal radiographic anatomy, both in the academic and clinical environment.

Methods: A mixed methods survey comprised of both quantitative and qualitative questions was formed via a Monash installed platformed Qualtrics and then distributed to second year Monash radiography students who had used ePortfolios for anatomy study in year one. The survey was distributed to students at the beginning of a lecture via Moodle and data was obtained anonymously through Qualtrics.

Results: Initial findings have been positive with 89% of respondents either agreeing or strongly agreeing that ePortfolio was useful in enhancing their confidence in commenting on radiographic pathology in the academic environment. The correlation was not as strong in the clinical environment where roughly 25% felt the ePortfolio was not as useful in helping them confidently identify and describe radiographic pathology respectively in their clinical placement. The clinical environment has unique challenges that affect the students' confidence which was evident from the qualitative findings.

Conclusion: Preliminary findings suggest that ePortfolios have assisted in improving confidence in the identification and description of abnormalities, particularly in an academic setting. A thematic analysis of the qualitative data will develop a deeper understanding of results.

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The benefits and challenges of implementing electronic medical records into practice

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Introduction: An electronic medical record (EMR) is a collection of data about a patient's healthcare that can be used by healthcare professionals to provide care. EMR is being implemented in healthcare practice across Australia and other developed countries. However, potential issues exist surrounding patient privacy, cost and technical problems.

Objectives: This study investigates the benefits and challenges of EMR, by examining relevant literature relating to the EMR and the effects on practice before, during and after implementation.

Results: The EMR has been shown to increase clinical efficiency and reduce the number of clinical appointments without compromising patient care. It has also allowed for an enhanced inter-disciplinary healthcare approach providing healthcare professionals with greater amounts of clinical information to improve patient outcomes. However, the implementation of the EMR challenges the attitudes of healthcare professionals with rejection and unwillingness to adapt being a hurdle in implementation. Further challenges identified included patient data security, cost of implementation and healthcare professional training.

Conclusion: The EMR has effectively demonstrated improved healthcare practice and assisted healthcare professionals in the delivery of care. The implementation of EMRs allows healthcare professionals to improve patient management and outcomes. However, the employment of EMR brings along issues that challenge the potential benefits. To further explore the benefits and challenges of the EMR within Australia, studies within the Australian clinical setting need to be undertaken.

Operator dose reduction through patient shielding in fluoroscopically guided interventional procedures

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Concerns regarding radiation-induced effects in operators of fluoroscopy equipment are currently on the rise. Radiobiological effects reported in the literature include cataracts and carcinogenesis of the brain in cardiologists and interventional radiologists. Operators are mainly exposed to scattered radiation emanating from the patient. It has been suggested that a significant portion of this exposure can be removed by patient shielding materials in interventional procedures.
The aim of this review is to evaluate the efficacy of patient shielding through the examination of current literature. Recent advances in protective products have enabled the use of non-lead heavy metals including bismuth, barium, antimony and tin. These products are shown to be effective in attenuating scattered photons, however, the reduction of occupational exposure may not be significant if standard radiation safety devices are used such as lead aprons, thyroid shields and ceiling or table-mounted shields. In instances where it is not feasible to use radioprotective equipment to reduce the dose to the lens of the eye or extremities, patient shielding could be an effective method to reduce exposure to areas not covered by operator shielding alone. The use of patient shielding for the purpose of operator dose reduction has been shown to potentially increase the dose to the patient, however, further investigations are required.

Highlighting areas of communication downfalls in radiotherapy for Indigenous Australians' health

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The aim of this presentation is to discuss and highlight how the barriers in communication that present in radiation therapy affect Indigenous Australian patients. Throughout this paper, differences in health ideals between Indigenous and non-Indigenous Australians will be discussed, how these values, beliefs, cultural needs and variations in health history create the need for modifications to care pathways and in communication approaches in order to achieve optimal health outcomes for Aboriginal and Torres Strait Islander peoples. The role of language, culture, shame, men and women's business, access to healthcare and the additional subcomponents that apply will be examined, and what is being currently done to improve the discrepancies that are present.
This presentation is aimed at improving the knowledge of students across the multidisciplinary board of the clear health gaps that are present and how these complex issues can be improved by the acknowledgement and cohesion of health services.

A vision on LGBTQ patient care in medical imaging and radiation therapy

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Background: Lesbian, gay, bisexual, transgender and queer people (LGBTQ) have always existed in society, yet acceptance of their identity, both socially and legally, has only recently been recognised. Therefore, there is a knowledge gap about appropriately tailored patient care for this community.
Aims: This study aims to understand the challenges that the LGBTQ community face in health care. In doing so, it creates a vision for providing better patient care for this community.
Methods: A literature search was completed using the Monash University library search engine. Keywords such as LGBTQ, patient care, radiology, and allied health were utilised. The seven most relevant peer-reviewed journal articles were chosen for inclusion in the review.
Results: No studies were found relating to the Australian healthcare system. Only two articles were specific to a radiology setting with the rest relating to healthcare practitioners in general. Hormone therapy associated with transgender patients can have negative effects, some of which are of particular importance to medical radiation practitioners. These include reduced renal function and bone density, as well as increased risk of thromboembolism. Gender assumptions, gender identification and preferred name sections on forms contribute to miscommunication between patients and healthcare workers.
Conclusion: Healthcare workers need to have a better understanding of the LGBTQ community to provide optimal holistic health care to this vulnerable group. There are also specific precautionary needs that medical radiation practitioners should be aware of. Education on LGBTQ groups should be implemented to better inform healthcare workers of specific needs of this community.

Optimisation of medical imaging departments for paediatric patients with autism spectrum disorder

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Autism spectrum disorder (ASD) in paediatric patients is a disorder with a prevalence of about 1% in Australia. ASD often results in difficulty interpreting verbal and non-verbal cues and can create anxiety and impede effective communication.[1] Children with ASD frequently react to sensory stimuli in an atypical manner and this is evident in radiology departments during examinations.[1] This could include over-reaction to sound stimuli and under-reaction to pain stimuli. Healthcare visits can be anxiety-inducing and overstimulating for the child, yet few radiology departments have guidelines in place for examining patients with ASD.[2]
Imaging of autistic children can be eased by following a set of guidelines and customising these to form an individualised approach. This involves communicating with the parents/guardians of the patient to obtain information regarding the child's needs.[2] Environmental features are another factor to consider.[2] Minimising external sensory stimuli, such as utilising dimmable light, closing doors and minimising sounds, can reduce the sensory overload and promote a calm environment.[3] The most crucial focus in interacting with a child with ASD is communication and this should be customised to the patient.[1] Slow, simple and low toned language should be used, while observing all signs of recognition of communication, not only verbal responses.[3] Repeated information or varied messages can be used to ensure patient understanding and, most importantly, the radiographer must maintain a calm and patient demeanour. A customised approach to examining a paediatric patient with ASD is vital in providing an optimal experience for the patient, guardian and radiographer.

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Ireland's radiographers now have 'prescriber and practitioner' status – how it happened

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The European Council Directive 2013/59/EURATOM – which relates to medical exposures to ionising radiation – was transposed into Irish law in 2018 by Statutory Instruments No. 256 of 2018 (with amendments S.I. No. 332 and S.I. No. 413 of 2019). It replaces S.I. No. 478 of 2002 and all its amendments including S.I. No. 303 of 2007. In S.I. No. 256 the term 'prescriber' changed to 'referrer'.

The Irish Institute of Radiographer and Radiation Therapy (IIRRT) began making representations in 2007 when nurses were given prescriber rights under S.I. No. 478 of 2002 and radiographers and radiation therapists were not. Once European Council Directive 2013/59/EURATOM was published, the IIRRT made written proposals and held face-to-face meetings with key stakeholders to look for referrer and practitioner status in new legislation. This was achieved in S.I. No. 256 of 2018.

The SIPTU (Services Industrial Professional and Technical Union) also made representation on behalf of radiographers and radiation therapists.

This was a long journey, but radiographers and radiation therapists – once registered with the Radiographers Registration Board of CORU – are now 'referrers' and 'practitioners' in the legislation.

The importance of utilising Indigenous liaison officers throughout a patient's radiotherapy journey

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An Indigenous liaison officer (ILO) is an employee who identifies as being Aboriginal or Torres Strait Islander and who provides support to staff, patients and their families. The employment of culturally appropriate services such as an ILO bridges barriers in Indigenous healthcare, however, ILOs are not widely known and their benefit within a radiation therapy (RT) department needs to be discussed.

Indigenous cancer patients experience a poorer prognosis than non-Indigenous patients for an equivalent stage of disease.[1] Reasons for this are multifactorial, however it is largely contributed to decreased screening participation, a mistrust in mainstream medicine, cultural beliefs about cancer and limited access to healthcare services. Literature states that culturally insensitive practice impacts whether Indigenous patients are willing to present for diagnosis and attend daily radiotherapy treatment sessions. Missed fractionations of treatment can be detrimental to the radiobiological effect of RT, whereby the number of double-strand breaks in malignant DNA is reduced. Through patient advocacy and education at commencement of RT, the work of an ILO can improve treatment attendance and compliance.[2] Specifically, an ILO can assist in travel, accommodation and welfare needs as well as address tailored cultural needs to patients and their families. Radiation oncology departments are not strongly represented by people who identify as Indigenous, hindering the benefits the integration of this multidisciplinary team member can have regarding curative and palliative RT outcomes.

The incorporation of an ILO needs to be recognised from the onset of RT treatment to maximise the benefits they can provide to Aboriginal and Torres Strait Islander patients. Moreover, a greater representation of Indigenous workers in radiation oncology departments is critically important to provide culturally appropriate services to maximise RT treatment attendance and compliance. Over time, the survival deficit experienced by Indigenous Australians compared to non-Indigenous Australians for same-staged cancers may be shortened by utilising an ILO.

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Dosimetric evaluation of four-dimensional computed tomography (4DCT) and three-dimensional computed tomography (3DCT) datasets for lung cancer patients in radiation therapy planning

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Background: Respiratory motion causes anatomical uncertainties in three-dimensional computed tomography (3DCT) datasets traditionally used in radiation therapy planning (RTP) for lung cancer.[1] The use of four-dimensional computed tomography (4DCT) in RTP improves planning target volume (PTV) delineation for increased treatment accuracy.[2] The Sunshine Coast University Hospital acquires both 3DCT and 4DCT datasets for RTP of radical lung cancer patients, which has limitations, including reducing department efficiency and increasing patient imaging dose.
Objectives: The purpose of this study was to compare dose distributions between plans generated on 3DCT and 4DCT datasets to determine a single CT dataset suitable for lung cancer RTP at Sunshine Coast University Hospital.
Methods: 20 lung cancer patients were retrospectively selected for this study. Plans generated on 4DCT datasets were copied to 3DCT datasets and recalculated. Clinically relevant dose parameters including global maximum dose, 95% isodose PTV coverage, minimum, mean and maximum doses and volume doses to PTVs and organs a risk were statistically compared using t-tests, Wilcoxon tests and Bland Altman plots.
Results: Clinically small but statistically significant differences were found for PTV maximum dose ($P = 0.04$), mean dose ($P = 0.028$), D98% ($P = 0.035$) and D50% ($P = 0.017$). Bland Altman plot shows good agreement among the two datasets for 95% PTV coverage. Combined lungs-PTV showed statistically significant differences for V5 ($P = 0.005$), V20 ($P = 0.006$) and V30 ($P = 0.011$) however again, these were clinically insignificant.
Conclusion: 3DCT and 4DCT (AIP) datasets resulted in similar dose distributions, suggesting that 4DCT datasets alone would be suitable for radical lung cancer RTP.

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Floating the PIE

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This presentation considers various aspects of the newly established ASMIRT Preliminary Image Evaluation (PIE) exam. PIE refers to the practice of radiographers flagging abnormal findings on X-ray images via a short descriptive comment which is seen by the referring doctor at the time of the examination.
Radiographer X-ray image interpretation shifted from an informal practice to a formalised practice in the mid 1980s at Northwick Park Hospital in London. Several Northwick Park Hospital radiologists conducted a trial in which radiographers marked X-ray images with a red dot to flag the existence of an acute abnormality. After publishing their trial findings in the *British Medical Journal*,[1] the practice of 'red dotting' became commonplace in the United Kingdom. It soon became apparent that this practice (referred to as 'the red dot system') had significant flaws. A revised method of flagging abnormal acute findings by radiographers was developed and became known as radiographer 'commenting'.
This presentation considers the development of commenting (PIE) and the ASMIRT commenting exam in Australia. The presentation includes practical information focussed on preparing for and sitting the ASMIRT PIE exam.

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Radiation dose to the orthopaedic surgeon when using an external fixation during surgical procedures

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Objectives: Orthopaedic surgeons are increasingly relying on the use of C-arm fluoroscopy in paediatric limb deformity correction.[1] There is little research regarding the radiation dose exposure to the surgeon in the paediatric setting.[2-4] The aim of our study was to compare the radiation dose rate to orthopaedic surgeons with and without an external fixation frame.

Methods: A simulated environment was created using a urethane and epoxy resin-based lower limb phantom (PBU-50, Kyoto Kagaku, Japan). Using a Philips Veradius C-arm the dose rate was measured with a solid-state survey sensor (X2 Survey Sensor, Unfors RaySafe, Sweden). Dose measurements were taken from where surgeons most commonly stand at 15 cm height increments.

Results: Preliminary statistics have been performed with a linear model. Compared to no frame there is a 0.02 mSv/hr increase in dose rate for a single ring ($P = 0.008$), 0.016 mSv/hr increase in dose rate for a Taylor Spatial frame ($P = 0.027$) and 0.023 mSv/hr increase in dose rate for a double ring ($P = 0.006$). At the level of the operating table, the dose rate to the primary surgeon on the tube side is 0.112 mSv/hr more than the flat panel detector side ($P < 0.001$).

Discussion/Conclusion: To our knowledge, this is the first study investigating the radiation dose rate to the orthopaedic surgeon when using external fixations. The surgeon receives a greater dose rate when using an external fixation frame compared to no frame. It is important to quantify doses orthopaedic surgeons receive to ensure optimal radiation practices.

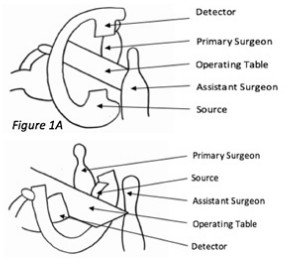

Figure 1A

Figure 1B

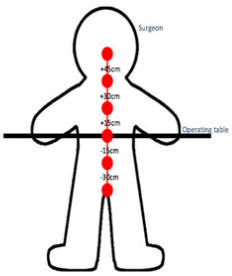

Figure 1C

***Figure 1A, 1B and 1C**: Diagrams of the set-up and measurement. **Figure 1A** configuration of the C-arm in the PA orientation and the surgeon positioning. **Figure 1B** configuration of the C-arm in a lateral orientation and the surgeon positioning. **Figure 1C** representation of the positions at which measurements were taken.*

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Using size-specific dose estimates to set diagnostic reference levels in paediatric CT

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In Australia, there are currently only diagnostic reference levels (DRLs) for the head, chest and abdomen-pelvis computed tomography examinations for two paediatric age groups: 0 to 4 years and 5 to 14 years. As per the International Commission on Radiological Protection recommendations, age should only be used for head examinations, while weight is recommended for trunk examinations.[1] Additionally, the American Association of Physicists in Medicine suggest the use of size-specific dose estimates (SSDE) for paediatric computed tomography, as this reflects a more accurate dose value.[2] This review synthesised the literature on DRLs for the paediatric head, chest and abdomen computed tomography in order to recommend national DRLs in Australia using SSDE.

A systematic search of the literature was performed using the following databases: Medline, Embase, Emcare, Scopus, CINAHL, Cochrane and Web of Science. Articles were included if they measured DRLs based on less than 1 year, 1 to 5 years, 5 to 10 years and 10 to 15 years age brackets as these were the most common comparable age brackets. Of the articles included for the review, the SSDE adjusted DRL values ranged from 29.4 mGy to 37.7 mGy for the head, 4.6 mGy to 8.9 mGy for chest, and 8.5 mGy to 11.5 mGy for abdomen-pelvis between age groups. The literature showed a considerable variation in the grouping of paediatric data, which resulted in a limited number of comparable articles. This highlights the need for international standardisation of dose reporting related to paediatric DRLs. Overall, the recommended DRLs from this review were lower than the current Australian Radiation Protection and Nuclear Safety Agency DRLs for the chest and abdomen-pelvis, therefore emphasising the need for reviewing and updating Australian DRLs.

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MRI simulation for radiation therapy

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Radiation therapy has seen a rapid increase in the use of targeted treatment techniques. The highly conformal dose distributions, steeper dose gradients and the potential for dose escalation with these planning techniques mean that the detail and information required from imaging modalities is increasing. Due to this, magnetic resonance imaging (MRI) has played a greater role in radiation therapy planning than ever before, as it affords an improvement in tumour and soft tissue visibility and functional imaging abilities. MRI has been shown to increase the reproducibility and accuracy of tumour delineation in radiotherapy when compared to computed tomography and has the potential for further expansion on its use in radiation therapy.

Commissioning an MRI scanner into a radiation oncology department brings with it a new set of safety risks, alongside training, education, staffing and equipment considerations. Having a dedicated MRI simulator allows for more tailored radiation therapy planning sequences. There are differing priorities between diagnostic imaging and radiation therapy planning, such as diagnosis, signal-to-noise ratio, spatial localisation and geometrical integrity; having a dedicated MRI simulator allows for a radiation therapy focussed approach to imaging. Given the added complexities and considerations around MRI, and to gain the greatest benefit from MRI in radiation therapy, a collaborative and multidisciplinary approach is required.

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ePosters

Systematic review of selective radiological procedures of injured patients compared to immediate full body computed tomography

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Objective: Trauma is a leading cause of mortality globally.[1] The high diagnostic accuracy of computed tomography (CT) compared to other modalities makes it an attractive imaging tool for initial trauma imaging, despite its high radiation dose.[2] This review assessed the value of immediate full-body CT as part of the primary survey, in comparison to selective conventional radiological procedures in terms of mortality rate, emergency department/hospital/intensive care unit length of stay, duration of mechanical ventilation, and incidence of multiple organ dysfunction syndrome/multiple organ failure.

Methods: A search strategy was developed using the keywords: computed tomography OR CT AND X-ray OR other imaging modalities AND trauma. Keywords were applied in the following electronic databases: Scopus, Cochrane and PUBMED. Reference list of included studies were searched for additional references. Studies were limited to diagnostic studies, English and from 1947 to present. Assessment of study quality was conducted using CASP for Diagnostic Studies. Data was analysed using statistical pooling. The review protocol was registered in PROSPERO.

Results: A total of 1570 titles and abstracts through literature search were obtained and after screening for abstracts, 1546 duplicates and non-relevant studies were excluded. The remaining 24 studies were fully read. Final results are pending but will be available at time of presentation.

Conclusion: Preliminary data suggests that full-body CT demonstrates a decrease in mortality and emergency department length of stay. Findings on other outcomes will be discussed at the presentation. Further randomised controlled studies are warranted to investigate the viability of full-body CT for trauma patients.

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Paediatric trauma C-spine: MRI as a one stop modality?

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Background: Spinal injuries are rarer in children than adults, accounting for 1–10% of all reported spinal injuries.[1] Spinal fractures are more commonly observed in older children, while ligamentous injury is more frequent in the under 10 years age group.[2] While computed tomography (CT) has been considered superior to conventional magnetic resonance imaging (MRI) in the detection of fracture, in younger children, CT has been found less reliable in the assessment of cervical spine injury.[1,3,4] The application of the 3T MRI Enhanced T1 High-Resolution Isotropic Volume Excitation (eTHRIVE) sequence has enabled the detection of pathologies such as rotatory subluxation and fractures can largely replace CT and reduce patient radiation exposure.

Method: Modified 3D T1 fat-suppressed weighted gradient echo sequence was acquired in sagittal plane using Philips 3T Ingenia MRI. The MPR and isovolumetric images were generated in axial and coronal planes with 0.5 mm thickness.

Result: This sequence provides isotropic resolution in three dimensions with a short acquisition time, ideal for the paediatric population. Inversion of image greyscale simulates CT style appearance,[5] demonstrating successful detection of paediatric rare cervical spine fractures or ligamentous injuries in the trauma setting of two patients studied.

Conclusion: 3T MRI with isotropic 3D T1 eTHRIVE was shown to be accurate with excellent detection of cervical spine fractures and characterisation of traumatic injuries. This technique has the potential to replace CT imaging resulting in a significant reduction in ionising radiation. Thus, MRI using eTHRIVE could provide a one-stop-shop for imaging of paediatric cervical spine trauma.

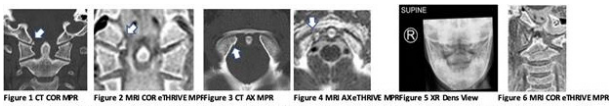

Figure 1 CT COR MPR Figure 2 MRI COR eTHRIVE MPRFigure 3 CT AX MPR Figure 4 MRI AXeTHRIVE MPRFigure 5 XR Dens View Figure 6 MRI COR eTHRIVE MPR

Figure 1-4. 14-year-old girl demonstrated an avulsion fracture (arrows) of the medial aspect of the right occipital condyle. Both CT and MRI could demonstrate the fracture, however MRI better demonstrated the fracture on axial MPR and a further right sided of alar ligament injury. **Figure 5-6.** 4-year-old girl fracture through the dens and body of C2 with anterior angulation and rotatory subluxation of the atlantoaxial articulation on the left, which was unable to be seen on plain x-ray but detected on the MRI scans.

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Escaping to fantasy land: using leading-edge technology to distract children during medical procedures

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Background: Paediatric magnetic resonance imaging (MRI) is becoming less stressful for children as more dedicated paediatric facilities are using a child-friendly environment, child life therapy (i.e. play therapy, role-playing) and new technologies to reduce anxiety.[1,2] However, intravenous (IV) cannulation post-contrast studies remains a significant challenge and often reduces cooperation where general anaesthesia is required. Virtual reality (VR) is now being utilised in some centres to manage patients with pain, disability, anxiety and depression.[2–4] This inspired the MRI department to trial VR, together with child life therapy and Phillips Healthcare's ambient (visual and auditory) experience to test the suitability and efficacy in paediatric imaging procedures.

Methods: Patients attended the MRI department prior to the scheduled scan to meet the play therapist and engage with the kitten MRI. If successful, patients then transitioned to the mock MRI with VR goggles. Following this, the recommendation was either VR or general anaesthesia for their imaging study. Parental consent was obtained.

Results: Over a 6-month period, 38 children (28 male, 10 female) aged 4–14 years had IV cannulation using VR. The success rate for cannulation was 100% and all 38 children (100%) in the trial reported they would be happy using VR again. In combination with topical analgesia, we also identified VR significantly reduced subjective pain children experienced during the insertion of an IV cannula, with an average pain score of two out of 10.[5,6]

Conclusion: The innovative combination of VR/child life therapy/ambient experience has proven to be successful in improving the child's healthcare experience.

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Research interest, confidence and experience in diagnostic imaging is similar to other allied health disciplines

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Objective: In 2019, a large metropolitan health service implemented an allied health research and translation fellow to enhance the research culture and opportunities for allied health professionals working in diagnostic imaging. We aimed to measure self-reported research participation, interest and experience of current allied health professionals working in diagnostic imaging and compare the findings to a similar survey conducted in 2015 with clinicians working in allied health therapies.

Methods: A cross sectional survey was conducted with ethics approval. The primary outcome measure, the Research Spider survey, measures 10 domains of research interest/experience on a 5-point Likert scale. The levels of research interest and experience were described using medians and inter-quartile ranges (IQR), and results compared to 2015 data.

Results: 85 responses were received by clinicians working in diagnostic imaging (39% response rate). Overall, clinicians in diagnostic imaging rated themselves as having 'some interest' and 'little experience' in research. There was no difference between interest and experience among different imaging professions (interest $P = 0.277$, experience $P = 0.0305$) or other allied health therapy professionals (interest $P = 0.137$, experience $P = 0.331$). Participants reported greatest interest in finding and reviewing literature and lowest interest in applying for funding. Participants expressed desire for practical opportunities such as participating in workshops.

Conclusion: Clinicians working in diagnostic imaging express interest but currently have a lack of opportunities to participate in research. Given the similarities between diagnostic imaging and other allied health therapies, strategies used to promote research culture in allied health therapy could be leveraged to provide opportunities for diagnostic imaging.

Eyes too big for your belly – reducing fasting times for CT

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Reducing the fasting time for computed tomography (CT) to 1 hour is easier for out-patients and reduces the delay for in-patients, leading to improved experience for all patients, as well as improved throughput in busy CT departments.

Patients are routinely requested to fast for 4–6 hours (no food or fluids) prior to their CT scan,[1] except for diabetics or patients from the emergency department who are usually not required to fast. There appears to be no rationale for these varying timeframes. Historically, it was related to the higher incidence of vomiting associated with the use of high-osmolar ionic intravenous (IV) contrast agents.[2]

Patients were historically requested to fast in CT so that if they vomit (known side effect of administering IV contrast), they are less likely to aspirate if their stomach is empty. It has been suggested that many patients, especially in-patients, fast for longer than is necessary.[3] Research has shown that oncology out-patients who did not fast prior to CT correlate with an improved patient experience, reducing discomfort and inconvenience.[1]

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Seeing the truth about dose: how to establish FRLs for X-rays

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Background: Since 1996, the International Commission on Radiological Protection (ICRP) has recommended the use of diagnostic reference levels (DRLs). The ICRP has described it as 'a form of investigation level used as a tool to aid optimisation of protection in the medical exposure of patients for diagnostic and interventional procedures'.[1] Used in conjunction with justification, DRLs can assist in keeping patient radiation exposure as low as reasonably achievable (ALARA).[2]
Methods: kV, mAs, clinical EXI, DI and dose area product (DAP) was recorded for 20 patients from each general X-ray room for postero-anterior (PA) chest X-ray (CXR), left lateral (L.Lat) CXR and antero-posterior (AP) CXR. The median DAP was calculated for each projection in each X-ray room across both hospitals.[3] The facility reference levels (FRL) were then compared to published international DRLs.
Results: The FRL for a PA CXR was calculated as 12 $\mu Gy.m^2$ with differences noted between vendors. The FRL for the L.Lat CXR was 38 $\mu Gy.m^2$ and 8 $\mu Gy.m^2$ for an AP CXR.
Conclusion: This project provided a baseline measurement of FRLs for CXR projections which facilitated the quality improvement team in optimising radiation doses between the X-ray rooms. It also provides data for the medical imaging department to know what the radiation dose for a CXR is locally when providing information to patients and referrers. This also prompted discussion with the radiation safety officer and further investigations were performed.

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Using optical coherence tomography for an innovative multimodal imaging approach to diagnose vision complaints

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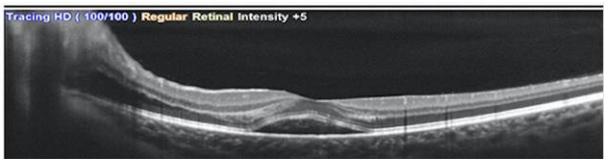
Introduction: Papilloedema is an ocular emergency. It is secondary to a number of sinister conditions that require timely interventions in order to prevent mortality. For healthcare practitioners, papilloedema is a complicated clinical diagnosis due to these sinister causes and need to exclude the benign, such as pseudopapilloedema.[1,2] Often magnetic resonance imaging (MRI) is a critical step in confirming a diagnosis and cause of papilloedema. Using this imaging technique alone is challenging due to the small size of the optic nerve head.[3]
Case Presentation: With informed consent, an innovative application of multimodal imaging to diagnose papilloedema and its cause is presented for a patient who attended with acute decreased vision and severe migraine. Optical coherence tomography (OCT) imaging of the optic nerve head and maculae provided confirmatory images of the severe oedema of the optic nerve head with subretinal oedema. MRI diffusion and susceptibility weighted imaging and post-contrast venogram identified a partial dural venous thrombosis.
Management and Outcome: A homogenous dural-based enhanced lesion suspicious of a dural metastasis was diagnosed. The patient was prescribed 20 Gy cranial radiotherapy to the whole brain in five fractions resulting in regression of the visual symptoms.
Discussion: OCT is a fast and non-invasive method to diagnose papilloedema.[4] This case demonstrates how to perform careful OCT image interpretation to quantify and visualise oedema that could indicate the potential deadly causes of papilloedema. OCT can be used as a part of a multimodal imaging approach to supplement the diagnose of papilloedema and justify the need for further investigative MRI.



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Radiation therapy student reflections on communication skills training following their first clinical placement

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Objectives: The University of Newcastle radiation therapy degree includes a clinical reasoning module that provides students the opportunity to learn about and engage with different communication skills prior to attending their first clinical placement. This study aimed to investigate students' post-clinical perceptions on how well the module prepared them for interacting with patients and radiation therapists (RTs).
Methods: Data was collected via an online survey comprising 48 closed and open-response questions assessing confidence, thoughts on how the module assisted in their preparation for clinical and on perceptions on their interpersonal skills with patients and fellow RTs. Survey data were analysed quantitatively (counts and weighted sum average (WSA) of Likert scales) and qualitatively using thematic analysis.
Results: Participants rated the module as helpful (WSA 2.25/4) which was evidenced through increasing confidence levels when measured over three timepoints (before module, after module and after clinical) in their ability to communicate with patients (WSA scores 1.13, 2.88 and 3.38) and RTs (WSA scores 1.0, 2.13 and 3.25). Participants were more confident in discussing general issues (WSA 3.63) than treatment related issues (WSA 2.5) with patients. Direct feedback from clinical RTs provided positive reinforcement and further development of their interpersonal communication skills.
Discussion/Conclusion: The clinical reasoning module successfully improved students' confidence and provided communication skill preparation strategies for clinical interactions both with patients and RTs. Student reflections of both module and clinical experiences provided a user perspective as well as a mechanism for improvement and vision for future university curriculum-based clinical preparation.

A comparison of physical and non-physical grids on radiation dose and diagnostic image quality

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Introduction: Non-physical grids are relatively new software advancement within the medical imaging field. This development, which utilises digital anti-scatter correction software, allows for the elimination of physical grids among diagnostic radiographers. This therefore enables the minimisation of exposure factors required for any given examination that traditionally requires a physical grid.[1,2]
Objective: This paper aims to compare the radiation dose and diagnostic image quality attained from both physical and non-physical grids.
Methods: Quantitative and qualitative studies were conducted in a restructured hospital in Singapore using two different X-ray systems from Fujifilm and Philips. Each system has its own image acquisition detector, a physical grid and a non-physical grid. The systems were tested on a phantom mimicking an average-sized human abdomen. First, the quantitative study was executed to demonstrate the changes to radiation dose acquired to the phantom. Second, a qualitative study was done to gather information from reporting radiologists regarding image quality.
Results: It was demonstrated that the diagnostic image qualities of abdomen X-rays attained using non-physical grid software are superior (or at least, similar) to those attained via physical grids, even when radiation dose accrued to the phantom is significantly reduced by approximately 49.2%.
Conclusion: Because radiographers abide by the ALARA principle to attain diagnostically acceptable images for reporting radiologists to review, this paper shows that non-physical grid software are promising substitutes for traditional physical grids – not only for the abdomen region for future patients, but also for other regions that would typically require a physical grid.

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Assessing pain response in participants receiving image guided analgaesia injection

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Background: This ethics approved research investigated if the routine one-week period from when patients receive image guided analgaesia injection and then return to their referrer, was appropriate.
Objectives: To identify the time-point that pain subsides, following routine image guided analgaesia injection in the subacromial bursa, cervical spine nerve root and lumbar spine nerve root.
Method: A single centre prospective cohort study allowed consenting participants to be surveyed, using the Wong-Baker FACES® Pain Rating Scale, to identify the time-point which pain was alleviated. Pain levels were recorded at four key time-points: time-point 1, immediately prior to analgaesia injection; time-point 2, immediately afterwards; time-point 3, three days post-procedure and time-point 4, seven days post-procedure.
Results: Subacromial bursa pain participants ($N = 67$) experienced immediate pain relief ($P < 0.0001$), with a further statistically significant ($P = 0.0091$) pain reduction at time-point 3 which lasted until time-point 4. Cervical spine nerve root participants ($N = 43$) experienced immediate pain relief ($P < 0.0001$) and this was maintained until time-point 4. Lumbar nerve root pain participants ($N = 93$) also experienced significant pain reduction ($P < 0.0001$) immediately, however, pain levels increased at time-point 3 and this was maintained to time-point 4.
Discussion/Conclusion: This study provides data to support recommending when participants can return to their referrer to re-evaluate their ongoing management. Participants receiving analgaesia for subacromial bursa or lumbar nerve root pain can return to their referrer after day three, whereas those receiving analgaesia for cervical nerve root pain can return immediately.

To determine an imaging regimen for VMAT SRS: are we going overboard with image guidance?

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Aim: The aim of this study is to determine the need for image guidance between arcs for linac based stereotactic radiosurgery (SRS) patients using the VMAT technique with flattening filter free beam (FFF).
Methods: A retrospective study was conducted on 15 SRS patients treated using the co-planar VMAT technique. The departmental guideline for SRS imaging consists of four-step CBCT: pre-CBCT, verification CBCT, mid-CBCT and post-CBCT with bony match. If the mid image requires a move based on predefined tolerance, then a verification CBCT is to be performed. Each patient had four CBCTs with varying fractionation and in total 50 CBCT images were analysed to determine the intrafraction movement. The data analysed was compared with the predefined tolerance to determine whether a mid-CBCT is required for treatment.
Results: The average translational error of 0.3 mm +/- 0.2 mm in craniocaudal direction, 0.1 mm +/- 0.2 mm in lateral and anteroposterior directions were recorded. A 0.3 +/- 0.1 degrees in rotation, pitch and roll were recorded. In some patients, these changes were only noted in the post-treatment CBCT.
Conclusion: The data analysed indicates that there is minimal intrafraction motion. Factors such as predefined image tolerance, time taken to obtain and analyse the mid treatment image, the quick treatment delivery using FFF, the margins used for planning and imaging dose were all taken into consideration in decision making. As a result, the imaging policy was changed to pre- and verification CBCT only for linac based VMAT SRS treatment.

Using online technology to raise awareness of values and ethics in radiography, student perspectives

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Introduction: Ethics and values are increasingly significant aspects of patient-centred healthcare. While it is widely agreed that ethics and values are essential for healthcare delivery, there is also an acknowledgement that these are areas that are challenging to teach.[1,2] The purpose of this study is to report a small-scale evaluative research project of a web-based technology with the educational potential to facilitate learning in relation to ethics, values, self-reflection and peer-based learning.

Methods: Five radiography students took part in a semi-structured focus group with the aim of exploring their experiences of using Values Exchange, an online ethical decision-making framework, to examine practice-based ethical issues. Transcripts were interrogated for key themes.

Results: From the thematic analysis three major themes emerged, understanding and appreciating others, addressing the theory-practice gap and delivering a safe and effective learning environment. Perceived limitations of the platform included students' fear of misinterpreted responses and possibility of poor group dynamics.

Conclusion: There are varied approaches to how ethics and values are taught and assessed within health-related environments. Values Exchange is one such teaching tool and has been investigated and described positively by radiography students in this study. Online teaching tools can have a positive effect in helping students identify their own values but require skilled implementation to reap positive rewards.

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Colouring outside the lines: a visionary digital teaching tool for students

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The expertise required to practice as a radiation therapist (RT) is evolving.[1] RTs are responsible for contouring organs at risk and soft-tissue image matching.[1,2] Reducing interobserver and intraobserver variability in soft tissue delineation between students and qualified RTs is a key concern for educators in the university setting.[2,4] Appropriate education is a necessity for reducing this variability. The implementation of a cloud-based software (Proknow™) as a teaching tool in March 2019 for university students has been a successful intervention from the informal and formal feedback received from students. Initial observations by the academic staff has seen an improvement in student planning submissions.

(Proknow™) is a novel cloud-based software application founded in 2016 that specialises in empowering professionals to improve contouring accuracy and analyse plan metrics for radiation therapy planning.[3] By providing visual and timely feedback to students this software aims to improve the quality of the professionals produced by the university.

This presentation will examine the pathway of implementation of new software in the teaching environment and look at the different directions this visionary tool may direct us towards in the future. This is the first time this software has been used by a university in Australia and a structured ethics approved evaluation is underway and the initial qualitative findings will be presented.

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Improving our vision of the radiation dose contributors during uterine artery embolisation: a review article

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Background: Uterine artery embolisation (UAE) is an interventional angiography procedure for the treatment of symptomatic fibroids and/or adenomyosis in women.[1,2] Although UAE is a less invasive procedure,[3] ionising radiation is used to visualise and access the uterine arteries for embolisation and treatment.

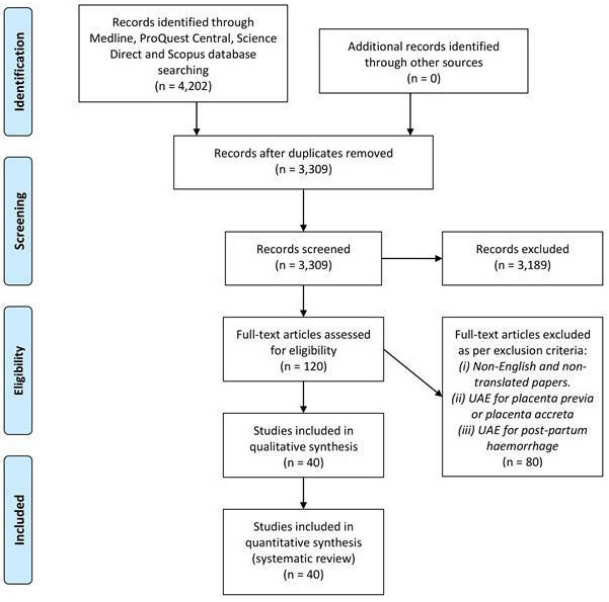
Aim: The purpose of this review was to examine the literature on radiation exposure measurements and identify the factors contributing to the total radiation exposure of female patients undergoing UAE to form a clear vision of radiation dose reduction techniques for patients undergoing UAE.

Methods: A Medline, ProQuest Central, ScienceDirect and Scopus database search from 2000 to 2018 was performed and 40 articles were deemed acceptable for review following the inclusion and exclusion criteria set. Ethics review was not required.

Results: The reviewed literature demonstrated that the reported radiation exposure doses appear to be below the threshold for any tissue (deterministic) radiation risks. The total radiation exposure of UAE patients is affected independently by multiple patient, operator expertise and technique, angiographic imaging and X-ray unit variables.

Discussion: A clear vision for dose reduction is required by both the radiographer and radiologist when performing interventional procedures. Uterus preservation can be attained post-UAE with dose reduction and optimisation, however, a longitudinal study on UAE patients and their risk of radiation-induced tissue and/or stochastic effects is recommended.

Conclusion: This review article serves as a foundation point for understanding the contributions to radiation dose reduction techniques for UAE and is applicable to all involved in this procedure or interventional radiology procedures.



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Who? What? Where? A snapshot of research presentations at recent ASMIRT conferences

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Introduction: Health and medical research underpins improvements in our quality of life. A Victorian government directive for developing research led by allied health professionals was published in 2018 to embed a stronger research culture across allied health.[1] Conferences are great opportunities to share scientific knowledge, providing evidence to challenge or improve current practices. This study is a review of research presented at recent ASMIRT conferences to gauge Australian research culture.

Objective: To review:

- Contributors (by city) of oral and poster presentations at recent ASMIRT conferences
- Institutions with the highest number of oral and poster conference abstracts
- Comparative analysis between radiography and radiotherapy streams
- Determine publication rates of conference abstracts to full research papers.

Methods: A retrospective analysis of 516 abstracts published between 2015 and 2017 in the Journal of Medical Radiation Sciences (excluding international) using PubMed, Google Scholar and Google was conducted.[2–4]

Results: At the time of abstract submission, data analysis was not complete. This study will present a final analysis with the conference presentation to full publication rate determined for radiography and radiotherapy streams. Preliminary results indicate the conference presentation to full publication rate for the radiotherapy stream is at least twice that of the radiography stream. The RANZCR rate reported in 2004 was 41% for radiation oncology and 29% for radiology.[5]

Conclusion: With government initiatives driving the need for increased medical research, this study will report a conference baseline for each stream. A comparative study in 3–5 years would be interesting to chart changes.

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Enhancing the versatility of the Halcyon™ treatment unit

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Background: The Varian Halcyon™ radiotherapy system is an innovative new treatment delivery unit, which is easily identified by its closed bore appearance. The Halcyon™ has many desirable features including accelerated treatment times, operational efficiency and a human-centred design. These advantages have meant many historic standard linac features such as a light field, optical distance indicator, jaws, single projection imaging and flattening filter have been omitted.

Aim: The purpose of this investigation was to maximise the usage and versatility of the Halcyon™ treatment unit, adapting C-arm treatment techniques to suit the characteristics of the Halcyon™.

Discussion: Since the introduction of Halcyon™, a multidisciplinary team was tasked with adapting current traditional C-arm linear accelerator-based protocols for the Halcyon™ through a retrospective investigation. The Halcyon™ utilises only modulated treatments (IMRT or RapidArc®) and as such an investigation was required to find alternative solutions for traditionally non-modulated techniques like breast, skin and extended distances. The initial investigation focussed on creating a solution for breast treatments, as the breast cohort contributes significantly to overall workload in our organisation. Our conventional Hybrid-IMRT breast technique was adapted to suit the Halcyon characteristics and produce comparable dosimetry to our gold standard linac technique. Subsequent investigations focussed on developing a modulated approach to skin treatments historically treated with electrons.

Conclusion: Volumetric techniques are easily streamlined using the Halcyon™, resulting in increased efficiency in both planning and treatment delivery. Planning and treating historically non-modulated treatment sites required retrospective investigation to develop innovative new treatment approaches of comparable quality.

Empathic clinical communication training for patients undergoing MRIs using virtual reality

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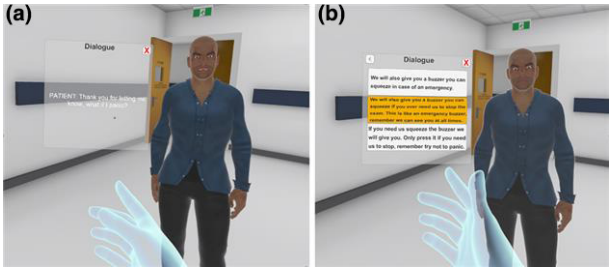
Background: Approximately 2 million (1.2%) MRI scans worldwide are prematurely terminated.[1] The termination rate could potentially be decreased if health professionals working in MRI are better prepared to encounter claustrophobic patients.[2] Immersive virtual reality simulated learning environments (VRSLE) offer a novel approach for recreating real-world scenarios with the advantages of repetition and determinism in a safe environment.

Aim: The aim of this study was to establish whether the mode of delivery, VRSLE versus clinical role-play, could have a measurable effect on clinical empathic communication skills for a specific medical imaging scenario.

Methods: A randomised split-cohort study was performed with trainee practitioners (N = 70) and qualified practitioners (N = 9).

Results: Participants in the trainee (TVR) and clinicians (CVR) group using the VR intervention reported an 11% and 12% improvement post-training ($P < 0.05$) than those assigned to the role-play intervention. Empirical assessment of communication training scores showed that participants in TVR performed 5% better on average than their role-play counterparts ($P < 0.05$).

Conclusion: The level of empathic language used by participants was shown to differ following a training intervention designed to improve interactions with patients that present for an MRI scan. The ability to have an individualised immersive VR experience without the judgement of peers, may be a contributing factor why group TVR and CVR participants reported and group TVR participants demonstrated a significant improvement in clinical communication skills over their role-play counterparts.



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A 15-year review of incident reporting in two integrated cancer centres

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Incident learning systems (ILS) have been implemented in many organisations globally to improve safety in radiation therapy.[1] Reported incidents over the period of 15 years between two integrated cancer centres were analysed to provide an insight into the effectiveness of an in-house ISL.

There were 1727 incidents submitted over the 15-year period. The average number of reported incidents were analysed and their severity assessment code (SAC) compared. SAC score grades the severity of incidents into four severity levels: SAC 1 being the highest and SAC 4 being the lowest (Table). Two 7-year periods were considered for analysis and the average for the first period (2005–2011) was six reported incidents per 1000 attendances compared to two incidents per 1000 treatment attendances for the later period (2012–2018). The data correlated well with literature in that the development of new technologies, especially IGRT, has impacted the severity of incidents reported with a reduction in SAC 1 and SAC 2 errors.[2] This can be attributed to the quality assurance aspect of IGRT where the incident is identified prior to treatment delivery rather than after, reducing the severity of any potential incidents.

This review was limited by the variations in incident classification in the ILS, with a large proportion of incidents classified as 'other'. Review of our ILS has shown that due to process changes the severity of errors has decreased, but it has also highlighted that taxonomy improvements are essential for better categorisation of incidents in the future.

	CONSEQUENCE				
LIKELIHOOD	Serious	Major	Moderate	Minor	Minimum
Frequent	1	1	2	3	3
Likely	1	1	2	3	4
Possible	1	2	2	3	4
Unlikely	1	2	3	4	4
Rare	2	3	3	4	4

Every incident assessed against the Severity Assessment Code Matrix should be scored separately for both their actual and potential consequence or outcome

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Educating for collaborative healthcare opportunities (ECHO): engaging medical radiation students in rural interprofessional education

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The University of Newcastle Department of Rural Health (UONDRH) is funded under the Australian Government Multidisciplinary Rural Health Training (RHMT) Program. The UONDRH supports students from medicine, nursing and allied health on rural placements in the Hunter New England and Mid-North Coast regions. The aim is to support students to have productive placements and encourage them to consider a rural career path after graduation.

It is a requirement of the RHMT Program to 'support opportunities for inter-disciplinary learning', hence, the UONDRH provides opportunities for rural-based students from different disciplines to learn together, and so better prepare them to work together in the future. The UONDRH has conducted interprofessional education (IPE) since 2001 and now conducts 40 or more IPE activities every year across multiple sites. Activities are of varying duration and cover a range of topics, such as stroke, palliative care, dementia, communication, and ageing gracefully. Collectively, they are called Education for Collaborative Healthcare Opportunities (ECHO).

The UONDRH employs four medical radiation science (MRS) clinical academics at different sites to support MRS students. The MRS staff work as part of a multidisciplinary team to develop and deliver ECHO. With some 700 MRS placement-weeks per year across the region, students often engage in IPE. Though MRS students are sometimes sceptical about engaging in IPE at first, post-participation evaluation shows they better value the role of other health professionals, appreciate the importance of collaborative teamwork, and understand the need for holistic patient care. More IPE is needed in MRS curricula at all universities.

Closing the Gap in cancer care: initiatives to foster cultural safety and improve access

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Objectives: Aboriginal and Torres Strait Islander peoples receive a poorer cancer prognosis compared to non-Indigenous Australians. Indigenous access to cancer care is limited by several factors, including differences in cultural understanding surrounding cancer and distrust of mainstream health institutions.[1]

It is believed that radiation therapy is being under-utilised by the Indigenous community. In response, several strategies were implemented to increase presentation and attendance by Indigenous Australians at a rural, private radiation therapy practice.

Methods: A local Indigenous health service, traditional owners and Elders and the clinic's Reconciliation Action Plan working group were consulted to implement initiatives to reduce barriers to engaging in healthcare. One of these initiatives involved community consultation to select a culturally safe, Indigenous word to name one of the clinic's linear accelerators.

Indigenous patient referrals into the clinic are tracked using an oncology information system. It is expected that by implementing a number of culturally safe strategies there will be an increase in utilisation of the radiation therapy service and a decrease in Indigenous cancer burden across the local region.

If strategies are yielding positive outcomes, there will be scope to implement them at other sites across a broader, monitored network.

Results: Presently, service utilisation is being monitored to determine whether the first round of initiatives has been successful. Data evaluation will be conducted to determine whether strategies must be re-evaluated.

Conclusion: Work has been undertaken to implement strategies and preliminary results show an increase in the number of presentations to the clinic for treatment.

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Feasibility of atlas-based auto-segmentation for head and neck organs at risk

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Objectives: Delineation of organs at risk (OARs) is required to optimise the benefit of modern radiation therapy. Manually contouring head and neck (H&N) OARs is time consuming. This work investigates the efficacy of atlas-based auto-segmentation (ABAS).

Methods: 40 H&N datasets were added to the Smart Segmentation (Varian Medical Systems, Palo Alto, USA) ABAS library. The Varian-provided and user-defined atlases were validated on 10 H&N datasets not included in the library. Dice similarity coefficient (DSC) was calculated for brain stem, parotids and spinal cord using Plastimatch (MGH, Boston, USA).

Results: Five Varian provided atlases with the highest similarity score were selected, the median DSC and 95% confidence interval on 10 H&N datasets for brain stem, left parotid, right parotid and spinal cord were 0.72 (0.69–0.76), 0.74 (0.70–0.77), 0.73 (0.70–0.76) and 0.59 (0.48–0.63).

To compare, five user-defined atlases with the highest similarity score were selected, the median DSC and 95% confidence interval for the same 10 H&N datasets and structures were 0.81 (0.75–0.83), 0.82 (0.74–0.83), 0.78 (0.75–0.80) and 0.7 (0.65–0.74).

Estimated time for ABAS and manual contouring was 2–3 and 15–20 minutes, respectively.

Discussion/Conclusion: This study has shown that utilising user-defined atlases is feasible and has the potential to improve the performance of ABAS for H&N OAR segmentation. ABAS may require some manual alteration. However, when there are many structures to contour and required changes are small to moderate, it is likely that it will be more efficient. This tool has the capacity to improve H&N planning workflow.

The role of the radiographer in educating speech pathologists undertaking videofluoroscopic swallowing studies

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Background: A videofluoroscopic swallowing study is a dynamic procedure conducted by radiographers and speech pathologists (SPs) to visualise swallowing to diagnose and treat dysphagia in children and adults. Given the requirement to feed patients during these assessments, SPs may be exposed to both primary and scatter radiation.

Aim: The main aims were to assess radiation protection practices utilised by SPs performing videofluoroscopic swallowing studies, and whether radiographers have a role in providing practical training.

Methods: An online questionnaire was distributed to SPs from six different countries (Australia, Canada, Ireland, New Zealand, United Kingdom and the United States). Responses were analysed quantitatively using frequencies and chi-square analysis ($P = 0.05$) and qualitatively using thematic analysis.

Findings: While SPs identified distance (83%) as a valid method of radiation protection, less than 40% stood the recommended 2 metres from the patient during screening. The use of thyroid shields (94%) were used more frequently than lead gowns (72%). Differences ($P < 0.0001$) existed between Australian and US participants regarding the use and position of radiation badges with 43% of Australian respondents stating they always used a badge, compared to 75% of US participants. Australian SPs wore badges under shielding (92%) at waist level (69%), while US participants wore them outside shielding (97%) at thyroid level (94%). Thematic analysis revealed the significance of the radiographer in providing education to the SP.

Conclusion: This research identified that SPs were knowledgeable about radiation protection principles, though did not always adopt these principles in practice. Radiographers have an important role in ongoing SPs education.

Evaluation of an information pamphlet for HPV-positive oropharyngeal cancer patients

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Objectives: Human papillomavirus (HPV), a sexually transmitted infection, has been found to be a causative factor for oropharyngeal cancer (OPC). This dual diagnosis can lead to unique psychosocial issues that clinicians are not well equipped to address. The primary objective of this study was to undertake a preliminary evaluation of the effectiveness of an information pamphlet about HPV+OPC in addressing common information gaps which exist for this patient population.

Methods: Eligible patients were randomly assigned (1:1) to either receive the information intervention or not. Patients in both groups completed questionnaires regarding quality of life, distress, anxiety and HPV knowledge at two time points: week one (W1) and week three (W3) of treatment. Patients assigned to the intervention group received the information pamphlet in week two.

Results: 22 HPV+OPC patients were recruited. Mean distress levels of participants within the intervention group reduced when compared to the control group (intervention group W1: 4.55 $\pm$ 2.46, W3: 4.09 $\pm$ 2.38; Control group W1: 1.64 $\pm$ 1.5, W3: 2.09 $\pm$ 1.51). A similar trend was demonstrated in mean depression scores with the intervention group score reducing from 12.2 $\pm$ 2.40 to 11.3 $\pm$ 3.30 and the control group score increasing from 13.2 $\pm$ 2.92 to 13.54 $\pm$ 2.87.

Conclusion: The results of this study suggest that the information pamphlet is a beneficial tool to assist in minimising some of the psychosocial impacts that a dual diagnosis of HPV and OPC has on patients.

Developing a RapidPlan model for hippocampal-avoidant WBRT

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Objectives: A multi-institutional phase II trial, RTOG 0933, demonstrated that hippocampal-avoidant whole brain radiotherapy (HA-WBRT) provided improved preservation of memory and quality of life compared to historical controls.[1] Similarly, NRG CC001, a phase III trial that randomised patients to standard WBRT with memantine or HA-WBRT with memantine, demonstrated better cognitive preservation and quality of life without difference in intracranial tumour control or overall survival.[2] The objective of this study is to create a HA WBRT RapidPlan VMAT model. In addition to this, comparison between an optimisation template and the model will be performed to assess the best treatment planning approach.

Methods:

1. Create an optimised VMAT beam arrangement and planning template to create a WA HBRT plan. Use this beam arrangement and planning template on 22 patients to create a RapidPlan model.
2. Compare the dosimetric difference between plans created with a template and RapidPlan model by applying them to 10 patients to assess which planning approach produces dosimetrically better plans.
3. A paired 2-tailed student t-test will be used to assess plan differences with clinical significance set at P = 0.05.

Results: The RapidPlan model can achieve clinically significant lower maximum dose and better organ sparing.

Discussion: The use of RapidPlan allows for streamlining the treatment planning improving efficiency and plan quality as it requires less manual iteration and relies less on planner experience to produce a clinically acceptable plan. This technique will improve the current departmental treatment standard for patients with non-SRS suitable brain metastases.

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WEB: closing the net on cerebral aneurysm treatments

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For 26 years, interventional neuroradiology has used coils for the endovascular treatment of cerebral aneurysms in our clinical centre. In recent years, a new technology known as the 'woven endo bridge' (WEB) is becoming a valuable option for neuro-interventionists, especially in the treatment of wide-necked aneurysms.

At our clinical centre, 17 cerebral aneurysms have been treated with WEBs over the past three and a half years. In cases of wide-necked aneurysms, when surgery is not desirable, coils have required intracranial stents as an adjunct therapy option for successful obliteration of the aneurysm. The WEB device can safely secure aneurysms which have been unsuitable for endovascular treatment, or high risk due to their morphology or position. The procedural time is significantly less than for endovascular coiling, which is advantageous for the patient, reducing anaesthetic time. WEB treatment rarely needs adjunct therapies such as balloon assistance or stenting. Dual anti-platelet therapy is no longer required, which is advantageous, particularly in the setting of acute subarachnoid haemorrhage. Imaging within the angiographic suite include 2D, 3D and coned beam CT techniques which characterise the device, pathology and surrounding structures in great detail. The radiographer's role is key in the work up to these implantations and during the procedure.

This presentation will show some case studies and imaging techniques used to demonstrate the use of the WEB, with improved outcomes for patients.

Effect of dietary counselling interventions on gastrointestinal toxicities in pelvic radiotherapy patients: a systematic review

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Objective: Gastrointestinal (GI) toxicities are common in patients receiving radiotherapy (RT) to the pelvis. This systematic review aims to evaluate the effectiveness of nutritional interventions (NI) involving dietary counselling (DC) on GI toxicities in patients receiving pelvic RT.

Methods: Papers published between 2013 and 2020 were extracted from five electronic databases, including MEDLINE, EMBASE, CINAHL, CENTRAL and Scopus. Studies included randomised controlled trials (RCTs) involving adults $\geq$ 18 years, undergoing curative pelvic RT, receiving a NI involving DC with or without supplements. DC was defined as written or face-to-face dietary advice provided before or during RT. Outcomes included GI toxicities reported by validated assessment tools. The Academy of Nutrition and Dietetics Quality Criteria Checklist was utilised to assess quality and risk of bias.

Results: A total of 1922 studies were retrieved, with 12 papers encompassing 11 individual RCTs included. Seven studies included a supplement in addition to DC, while four included DC only. Supplements included, in descending order, probiotics, prebiotics, probiotic + soluble fibre, high protein liquid supplement and fat emulsion. Of the 11 studies, only one involved individualised DC, while the remaining studies prescribed the consumption or avoidance of fats, fibre, lactose, protein and FODMAP.

The most common toxicities reported were diarrhoea (n = 11 studies), pain/cramping (n = 9), bloating/flatulence (n = 5) and constipation (n = 6). Three studies found an improvement in diarrhoea incidence, while nil papers reported any improvement in constipation.

Conclusion: Results varied between studies. Further quality studies are required to assess the effectiveness of DC on GI toxicities in patients receiving pelvic RT.

Fully adaptive MRgRT for prostate bed: initial Australian experience and potential benefits

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Background/Objective: In prostate bed treatments the anterior target border is defined by the posterior bladder wall and the posterior border by the anterior rectal wall. The known interfractional changes in both these organs result in a highly variable target volume.[1] The Adapt to Shape (ATS) workflow on the MR linac (MRL) aims to account for these changes through re-contouring and re-planning based on improved visualisation of the anatomy of the day. We report the initial Australian experience treating post-prostatectomy patients on the MRL.
Methods: All patients underwent a CT and MRI and contoured as per FROGG guidelines.[2] Plans were created using a template built from five previous prostate bed patient CT datasets. All fractions were delivered using an ATS workflow. A handover document was used for each patient to develop a library of comparable bladder sizes for matching to the MR of the day.
Results: Two patients completed treatment on the MRL using an ATS workflow. Treatment was well tolerated and treatment times averaged 30 minutes. Clinical target volume of the adapted plans varied significantly over the course of treatment, averaging between 85% and 155% of the reference volume.
Discussion: The ATS workflow allows cost functions to be manually adjusted, accounting for interfractional volume changes. This creates a new treatment plan with improved accuracy and dosimetric properties.
Conclusion: Given the internal anatomy variations throughout a prostate bed treatment course, it seems clinically beneficial to use an adaptive approach.

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Dealing with electron streaming effect on MR linac: clinical experience

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Background/Objective: Use of MR linacs (MRLs) is increasing and present challenges with respect to dose deposition in a magnetic field. As secondary electrons exit the patient surface they spiral in the direction of the magnetic field depositing dose on superior aspects of the patient in a phenomenon referred to as 'electron streaming effect' (ESE).[1] For treatment of a supraclavicular node on the MRL, it is necessary to mitigate the ESE to ensure skin dose to the patient's neck and chin area is avoided.
Methods: The patient was set up as per standard protocol but with the addition of a custom-made 8 mm thickness thermoplastic bolus moulded to the chin and neck. To explore the extent of the ESE, the clinical plan for delivery was recalculated using the same beam model but in the absence of the magnetic field. This guided placement of the in-vivo films used during treatment and ensured the bolus covered sufficiently.
Results: The In-Vivo film taped to the outer exterior of the bolus measured a total dose of 2.3 Gy. The film placed directly under the bolus, on the surface of the patient's skin measured 0 Gy.
Discussion: Adding thermoplastic bolus to the patient's skin effectively reduces the ESE seen in the presence of a magnetic field and is an essential clinical consideration for treatment sites in superior regions of the body, specifically thorax and head and neck.
Conclusion: The ESE was modelled and measured. Thermoplastic bolus of 8 mm was found to absorb the streamed electrons effectively.

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Victoria's first Halcyon™: turning a carpark into a state-of-the-art radiotherapy treatment facility

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In 2019, Icon Group partnered with John Fawkner Private Hospital to establish a new radiation therapy service for the north-western corridor of metropolitan Melbourne. But with space at an absolute premium, how do you accommodate a linear accelerator and all the essential services within a standalone facility, but having only 25% of the space normally required for a standard department?

The approach was to use an innovative modular construction technique, where six separate pods were prefabricated offsite, ready to be craned into place, along with our Varian Halcyon™ v2.0 Linac, the first of its kind in Victoria.

From concept design to implementation, and throughout the first 12 months of operations there have been many hurdles. Overcoming initial workflow challenges around adequate and functional workspace and in-patient transfers, we have also adapted to the Halcyon's single energy VMAT approach to treating patients. Including being able to offer radiotherapy to certain cohorts of stereotactic and skin patients that would have otherwise had to travel long distances to undergo treatment.

Our experience will highlight how these challenges were overcome using creative and innovative ideas and show how a service can be established in areas previously deemed unworkable by informing design and workflow solutions that could also assist current and future sites.

A comparative analysis of proton and carbon ions in the treatment of paediatrics

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Objectives: Paediatric cancers account for less than 1% of all cancer diagnoses[1] and most commonly present as leukaemia or central nervous system (CNS) tumours[2]. Radiation therapy (RT) as a treatment option poses significant risk to a child's developing tissues, bringing about an interest in the use of modern treatment techniques. Through thorough comparison of proton and carbon ions, we aim to identify how the use of particle therapy can be utilised to deliver highly targeted doses of radiation to the tumour while sparing a child's growing structures.[3]

Method: A review of current peer-reviewed scientific literature was undertaken, utilising numerous reputable databases. Topic-related keywords such as 'radiotherapy', 'paediatric', 'protons', 'carbon ions', 'treatment outcomes' produced pertinent results from which our research was concluded.

Results: Physical and radiobiological advantages of proton and carbon ions over traditional photon-based RT were successfully examined, concluding that the treatment technique allows precise targeted tumour volume irradiation and successful sparing of healthy tissues.[4] The theoretical advantages of carbon ion therapy have not yet been proven to the extent of proton therapy, where the benefits for paediatric cancers are intuitively clear. This can be attributed to the relative radiobiological effectiveness and long term outcome uncertainties associated with carbon ion therapy.[5]

Conclusion: Carbon ion and proton ion therapy allows for a greater conformal dose delivery of radiation that aims to reduce dose to the surrounding organs at risk and minimise patient side effects. This has been proven to be particularly beneficial for paediatrics with CNS malignancies.

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Ink tattoos, henna, UV tattoos or SGRT? A vision for improving breast patients' experiences

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Patients receiving external beam radiation therapy (EBRT) are traditionally given permanent Indian ink tattoos as a visual guide for their breast cancer treatment.

While the tattoos act as a tool for the radiation therapist, for some patients, these marks tell a permanent story of their struggle with illness.[1] This emerging awareness has spurred the need for new options. Progressing new techniques or reforming potentially problematic traditional methods will foster a more positive holistic experience for the patient, and thus a higher quality of patient care.

New approaches are being tested such as henna, UV tattoos and surface guided radiation therapy (SGRT).[2] These methods vary – but are often comparable – in set-up accuracy and consistency. For example, UV and henna tattoos are comparable to ink in their set-up accuracy, while SGRT promises improvement through advanced body scanning technology.[3,4] However, factors such as maintenance, funding and professional training may prevent alternatives from being employed.

Widening our tunnel-vision of ink tattoos by including viable alternatives, we aim to also bring into focus considerations such as the role of body-positivity and emotional wellbeing during and after treatment. Furthermore, allowing patients to make informed decisions about which option they would prefer may offer a sense of agency in the clinical setting.

Each practice within radiation therapy is evolving. It is time to bring the vision of improved patient care for breast patients to the forefront and progress to new techniques.

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Measuring quality of life in childhood cancer: what insights can be gained from the literature?

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Objectives: This scoping review examined the health-related quality of life (QOL) tools being used to capture patient-reported outcomes of children with cancer, either during or directly after radiation therapy. The aim was to use this work to guide future research in the field of patient-reported QOL outcomes for future patients undergoing proton radiation therapy in Australia.

Methods: Six databases were searched between July and September 2020, spanning all published and grey literature and following established scoping review methods.[1–3] Title, abstract and full-text screening was performed by three reviewers and was managed in Covidence software. Extracted data such as patient diagnosis, age, questionnaire format (paper or digital), availability of a parent-proxy version, timing and measured domains were tabulated for analysis.

Results: Of the 407 articles found, 27 met pre-defined eligibility criteria. These studies described 37 QOL tools being used in the paediatric oncology setting, with some being available in digital format. The most highly cited tool was the PedsQL Core Questionnaire version 4.0 which was cited 18 times. All tools captured baseline QOL plus at least one other data point for comparison. The most comprehensive tools continued data capture annually at follow-up appointments.

Discussion/Conclusion: Identification of 37 different tools provided valuable insights on which tools are most commonly used and in what contexts. It enabled a thorough evaluation regarding their format (digital versus paper) and the timing of QOL assessments in young patients. Future research is needed to evaluate these tools based on their validity, reliability and psychometric properties.

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Navigating imaging technology in paediatric oncology

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Capanna technique[1] is by no means a new procedure being used in orthopaedic theatres across Australia and around the world. However, in November 2020 at the Queensland Children's Hospital we were fortunate to be involved in the hospital's first navigation assisted Capanna surgery.

The Capanna technique[2] was first introduced in 1988 and is a method of reconstructing large osseous defects through a combination of block allograft resection and vascularised bone transfer. This procedure has been performed numerous times by the hospital's orthopaedic oncology team – however, it has never been performed onsite with navigation.

In November 2020, the orthopaedic team resected an osteosarcoma in an 11-year-old patient with the RB1 gene and a history of retinoblastoma. Pre-operative imaging (CT and MRI) was conducted and used for planning purposes. These images were also sent to the Queensland Bone Bank to find a suitable 'match' of femur, which would be used for the block allograft.

Combined with the use of the ground-breaking technology from the Siemens CIOS Spin in Theatre, the block allograft was resected with increased accuracy resulting in decreased blood loss and a shorter anaesthetic time. This case was a success as a result of teamwork and multi-disciplinary collaboration.

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The use of susceptibility-weighted imaging in MRI brain examinations

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Introduction: Susceptibility-weighted imaging (SWI) is a magnetic resonance imaging (MRI) technique that utilises differences in tissue magnetic susceptibility to generate magnitude, phase, susceptibility-weighted and minimum intensity projection images. SWI can pick up minute susceptibility differences, which may otherwise be missed on conventional MRI sequences. It complements MRI in the diagnosis of low-flow vascular malformations and aids in the timely evaluation of infarcts.

Aims:

- Demonstrate the complementary role that SWI plays in aiding the diagnosis of brain pathologies
- Demonstrate how SWI can determine the presence of haemorrhagic conversion in infarcts and if anti-thrombotic drugs should be administered in such patients.

Discussion: Treatment of brain infarcts caused by occlusion is commonly resolved through the administration of thrombolytic drugs. However, there is a possibility that infarcts develop haemorrhagic cores and result in brain bleeds. Detection of haemorrhagic conversion through an SWI scan before thrombolytic drugs are administered would greatly help decrease the rate of symptomatic haemorrhage in such patients and determine the necessity of administering anti-thrombolytic therapy.[1,2]

SWI is highly sensitive to differences in magnetic susceptibility and therefore plays a major role in detecting haemosiderin and in the timely treatment of infarcts.[2] However, this unique characteristic of SWI, also demonstrates calcifications, deoxyhaemoglobin and iron deposits. Thus, while SWI is good at detecting abnormalities, it is important to note that it is complementary to T1 and T2-weighted imaging and with clinical correlation, to distinguish between various conditions.

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Victoria's first Halcyon™: keeping it simple

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The K.I.S.S principle states that wherever possible, complexity should be avoided in a system – as simplicity guarantees the greatest levels of user acceptance and interaction. Unlike standard linear accelerators with various permutations of energies and imaging, the Halcyon™ has been paired back with 100% of treatments being image-guided and modulated using a single energy 6 MV FFF beam. So, it begs the question, can a standalone machine as simple and streamlined as the Halcyon™ offer a well-rounded radiation oncology service?

As one of the few sites in Australia to establish a radiation oncology service around a Halcyon™ treatment machine, Icon Cancer Centre at John Fawkner Hospital are pushing the envelope on what a single machine department can achieve.

We share our dosimetric comparisons around the use of the machines unique dual-layered MLC (as a departure from jaws) for small field applications and skin treatments in the absence of electrons. We will also discuss our in-house statistics around how the Halcyon™ set-up and treatment times stack up against standard linear accelerators. Risk analysis data around geographic misses and collisions compared to standard machines will also be explored, in order to answer the question on everyone's mind: Is the simplest answer most often the best?

Looking back to the future: literature review of appropriate use of gonad protection

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The standard practice in diagnostic imaging to use gonad shielding has repeatedly been questioned, stemming from a lack of evidence supporting radiation effects on human fertility at the doses typically used in imaging practice.[1] Consequently, the American Association of Physicists in Medicine has stated that the use of gonad shielding provides negligible protection to a patient, and the practice should be ceased.[2] Furthermore, in 2007, the International Commission on Radiological Protection reduced the gonad tissue weighting factor from 0.2 to 0.08,[3] supporting the fact that the radiation effects to the gonads is minimal. The difference between gonad shields and placing lead shielding across the patient's abdomen also needs to be considered. Current evidence from published literature strongly suggests that gonad shielding provides little radiation protection but offers only psychological assurance to radiographers and patients.

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AI-based detection of positioning error in skull X-ray images based on convolutional neural network

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Objectives: The purpose of this study was to develop an automated detection system of positioning error in skull X-ray image to assist inexperienced radiographers.
Methods: The convolutional neural network (CNN) model was developed for the classification of skull X-ray images. In this study, 104 skull X-ray images (AP image: 43, RL image: 43, LR image: 10, Towne image: 8) were used; and positioning error images were created by randomly translating original images. The CNN model was trained to predict each image class, i.e. AP, RL, LR, Towne and 'positioning error'. To increase prediction performance, the number of input images into the CNN model was increased by virtually generating images with a deep convolutional generative adversarial network. Prediction performance of the CNN model was evaluated with accuracy, sensitivity and specificity.
Results: Image classes of skull X-ray images were automatically predicted by the CNN model. The value of accuracy, sensitivity and specificity was 0.975, 0.937 and 0.984, respectively.
Conclusion: Our results showed the potential to automatically detect positioning error of skull X-ray images with an AI-based system. The proposed system could be useful to assist young radiographers.

Obesity in medical imaging: is patient-centred care being achieved?

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Background: Obesity is an epidemic that has become increasingly prevalent around the globe. Experiences of discrimination are common towards people who are obese. This review aims to highlight how attitudes of healthcare workers affect the health experiences of obese patients, with a focus on medical imaging.
Methods: PubMed and Scopus databases were used. Keywords such as 'obesity' and 'medical imaging' were entered; results were limited to peer-reviewed articles in English from 2010 to 2019. Extension outside of radiology was included due to limited availability of articles. Attitudes of other healthcare professionals also provide insight into the negative health experiences of obese patients. From the resultant yield (following removal of duplicates), the seven most relevant articles were included in the final review. Selection criteria included bias and difficulties experienced by obese patients within a healthcare setting.
Results: Initial analysis of the papers reveal that obesity has many challenges within medical imaging. Negative stereotyping may affect practitioner behaviour subconsciously, leading to intimidation and embarrassment, which can reduce patient adherence and ability to fully engage in medical encounters. From the review, it appears that there is insufficient literature specific to the opinions of patients themselves and how they perceive that discouraging attitudes may affect their clinical experience. This suggests a gap in our patient-centred healthcare model.
Conclusion: Obese patients face discrimination; therefore we must understand the challenges in order to provide optimal care. It appears that the perspectives of obese patients have not been captured and therefore further research is required.

The role of traditional Chinese medicine as complementary medicine to conventional cancer treatments

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Objective: The use of complementary therapies is becoming more common among cancer patients, with 65% of cancer respondents to an Australian study self-reporting the use of complementary medicine, of which traditional Chinese medicine (TCM) was one of the most common forms.[1–3] Some patients believe in the benefit of herbal therapy without proven evidence.[1] Doctors in Australia are also not equipped with adequate TCM knowledge to provide appropriate advice to patients.[1] Hence, safety issues are potentially present. This study evaluates current evidence regarding the role of TCM concurrently used with conventional cancer treatments and investigates the underlying safety issues.
Methods: A literature review was conducted with PubMed and Cochrane databases. Peer-reviewed papers were limited to those published in the past 10 years.
Results: Synergistic effects of some commonly administered herbs were evaluated for their cellular effects in mammals.[4] Some herbs can facilitate the recovery of healthy structures (e.g. gynostemma pentaphyllum assists in the recovery of leukocytes); additionally, some increase tumour sensitivity and promote cancer cell apoptosis (e.g. toona sinesis and lung cancer cells).[4] Randomised controlled trials studied the effect of TCM, showing its benefit in the safe and effective control of side effects.[5,6] However, some herbs can cause adverse effects. For example, dang gui can increase oestrogen levels and stimulate the growth of oestrogen receptor-positive breast cancer cells.[3]
Conclusion: TCM is a safe and effective complementary medicine when used appropriately. However, the reluctance of users to disclose its use and health practitioners' lack of knowledge may potentially cause harm.

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EOS micro-dose

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Background: Patients with adolescent idiopathic scoliosis (AIS) must undergo repeated X-ray exposure for diagnosis, monitoring, surgical planning and post-operative follow up. To reduce life-time risk of developing cancer, the bi-planar digital X-ray by the EOS system has been used recently; its newly adopted micro-dose protocol has been introduced with promising benefits.
Objective: This study will investigate the clinical effectiveness of EOS micro-dose protocol by comparing its induced radiation dose and image quality with EOS standard low-dose protocol and conventional digital radiography (DR) for AIS patients.
Method: A systematic review was undertaken using four electronic databases: Medline, Embase, Cochrane Library and CINAHL. Only studies with human subjects were included (i.e. anthropomorphic phantom based studies were excluded).
Results: Six studies were identified. Entrance skin dose, effective dose and organ dose were statistically lower in micro-dose protocol compared with DR, and 5–7 times lower than low-dose EOS protocol. Its intra-operator repeatability was better than inter-operator reproducibility for all parameters. There was good agreement for reliability of 3D spinal models and standard 2D radiographic measurement (such as Cobb angle) when comparing low-dose to micro-dose protocol. Image quality of micro-dose protocol was reported reduced with slightly less clarity.
Conclusion: Standard DR and low-dose EOS protocol were still recommended for initial representation of AIS patients for their most accurate assessment. Micro-dose can be used in radiological follow-up with less dose, adequate image quality and reliable measurement.

Radiation exposure (in mGy) of the most frequently used imaging techniques for spinal examination [16]

	Full spine frontal	Full spine lateral
EOS microdose	0.019	0.044
EOS low-dose	0.132	0.214
Conventional radiograph	1.662	1.862
Full spine CT scan	15.6	
Lumbar CT scan	5.6	
Low-dose full spine CT scan	5	
Low-dose lumbar CT scan	0.1	

A vision for paediatric radiotherapy: reducing radiation-induced skin cancer in childhood cancer survivors

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Introduction: An increased prevalence of secondary skin cancers among childhood cancer survivors treated with radiation therapy is documented.[1] The smaller stature, closer proximity of developing organs and longer expected survival of paediatrics increases their susceptibility to radiation-induced toxicities. This literature review investigates how advancements in radiation therapy influence entrance dose and consequentially, the future of paediatric patients.

Methods: 32 literature reviews and research reports published from 2012 to 2019 were investigated to explore radiotherapy techniques and modalities associated with increased radiation induced skin cancers (RISCs).

Results: The literature indicated the importance of further research and increased awareness about RISCs in paediatrics being vital for long term improvements in survival. Paediatric Normal Tissue Effects in the Clinic (PENTEC) guidelines are still being developed and practices are under consolidation.[2] It is evident that increased modulation reduces integral dose and the possibility of late toxicities developing in paediatric patients, although the future of paediatric therapy is focussed on tissue sparing rather than skin sparing.

Conclusion: The literature review found that skin dose is consequentially increased when using multidirectional proton beams with the aim of decreasing integral dose.[3] Proton and other heavy ion therapies are being investigated to determine their place in the future of paediatric radiotherapy treatments.[4] Evidently, the incorporation of multidirectional proton beams and the challenges, therapeutic compromises and process of proton therapy should be investigated further to promote long-term survival in paediatric patients.

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