Sunday 7 September, 0900–1030
Concurrent Session: Radiation in the Personalised Medicine Era

Imaging innovation in the era of the personalised medicine
B J Hillman
Departments of Radiology and Medical Imaging and Public Health Sciences, the University of Virginia, Charlottesville, Virginia, United States of America

The remarkable success of medical imaging over the last forty years is almost wholly due to continuous important innovation. Both imaging providers and the makers of imaging technologies have prospered. The future advancement of radiology requires the same level of innovation. However, this innovation cannot occur in isolation. Successful new imaging technologies must conform to the new paradigm of personalized medicine, also known as ‘P4 medicine.’ Radiologists’ participation in P4 medicine requires that future novel imaging technologies must provide care that addresses one or more of four qualities. They must be:

• Predictive of patient risks to improve and make more efficient disease surveillance;
• Preemptive, so disease is found earlier when it is treatable with less morbidity and mortality;
• Personalized, based on the individual’s genome and life experiences;
• Participatory, allowing patient preferences to help determine the most appropriate care.

A plethora of such technologies are in the pipeline but major adverse environmental influences are affecting their progress towards implementation in clinical care. These include: a bias on the part of non-radiologist providers, regulators, and payers that imaging is being performed wastefully, leading to enhanced efforts to suppress imaging; the persistent economic effects of the recent recession; greater concerns than in the past over diagnostic radiation; and the absence of a clear cut financial model that will make personalized imaging sufficiently profitable for companies to develop new personalized imaging technologies. The last is particularly germane. As personalized medical products become more sophisticated, they will increasingly segment the population of patients for whom they can suitably be applied. Companies will find it difficult to rationalize the very expensive product development, testing, and approval cycle for a diminishing number of patients for whom the product is intended. For these reasons, successful imaging innovations will need to be able to cross four hurdles. First, they must prove that they provide a benefit to patients over and above that of existing technologies. By ‘benefit,’ it is meant that the new product must be safer, more effective, less invasive or painful, or in some way be perceived by patients and their doctors as an improvement in care. Second, the innovation must fit with little effort into the context of existing care. Third, the product must be a good value – the cost/benefit ratio will have to be as good or better than what is in current use. And finally, society must be able to afford to pay for it. These are difficult requirements to meet. Nonetheless, the transition to personalized medicine is inevitable. Radiologists must partner with vendors to ensure imaging a continuing role in future health care.

How has radiation epidemiology helped to protect patients? The past, present and future of radiation epidemiology (abridged)
M Pearce
Institute of Health and Society, Newcastle University, United Kingdom

Epidemiology is crucial in determining risks related to radiation, and has provided the evidence base for radiation protection for many years. This talk will take a brief and selective historical review of radiation epidemiology, from the discovery of X-rays to the present day. Early evidence for adverse radiation effects came from medical settings with cancers noted in early radiologists and in thorotrast patients, but also in other occupational settings. The atomic bombings of Hiroshima and Nagasaki in August 1945 gave rise to the range of epidemiology studies that provide most of the evidence for our current evidence of radiation effects. However, this is not a field that stands still and the risk estimates continue to be updated with other studies and exposures in other settings and at lower doses. Such studies include those of radon, prenatal X-rays, employment in nuclear installations (and living nearby) and a range of studies related to the Chernobyl accident. This has resulted in a large increase in the understanding of radiation effects and reductions in exposures to the public and to workers, none of which is possible without the evidence provided from epidemiology. A greater understanding of risks at low doses is also crucial to protecting patients. This is the area in which much future research needs to concentrate, with many studies now focussing on patients exposed to relatively low levels of radiation through diagnostic and interventional radiology procedures.
Individualising the indication for radiotherapy in breast cancer – Balancing the benefits and risks
J Overgaard
Department of Experimental Clinical Oncology, Aarhus University Hospital, Aarhus, Denmark

The indication for adjuvant radiotherapy in breast cancer is based on a vast but old experience, mainly expressed in the large meta-analyses by the EBCTCG and transferred into international consensi and guidelines. Due to the national history of breast cancer do we need 10-20 years observation to get the full overview of the outcome and importance of a given treatment, but that also demand that the nature of the disease and treatment armamentarium is unchanged over time. However major changes have occurred recently which may jeopardize our understanding of the risk and benefit of adjuvant radiotherapy in breast cancer. The main factors includes different age-demographic parameters of the patients, different diagnostic procedures, incl. screening, a better understanding of the importance of the target (whole breast vs partial breast, involvement of the internal mammary lymph nodes), more exact knowledge of long term morbidity in form of cardiac damage and risk of second cancer, more intense systemic treatment, and a better subtyping of the disease with emerging predictive tests for both recurrences and morbidity.

The presentation will discuss this scenario in order to help us balancing the benefit and risk of using adjuvant radiotherapy in the current multidisciplinary handling of breast cancer.

Sunday 7 September, 0900–1030
Concurrent Session: MSK

Pitfalls in MSK MRI
J Linklater
Castlereagh Imaging, New South Wales, Australia

1) Attention to Clinical History: While many MSK MR examinations can be performed utilising standardised protocols, a significant number require tailored, customised examinations to assess the clinical problem. This frequently requires radiologist input at the protocol stage.

2) Use of Skin Markers: Placement of vitamin E capsule markers on the skin overlying an area of pain or swelling can be extremely helpful in identifying the symptomatic lesion in a patient, which otherwise may go undetected.

3) Coil Selection: An adequate array of surface coils for MSK imaging is required. In general, the main criterion in coil selection should be maximising spatial resolution. Sometimes spatial resolution may need to be sacrificed in order to gain adequate longitudinal coverage.

4) Use of Appropriate Imaging Planes: Double oblique sequence prescriptions are frequently required to optimally demonstrate anatomy and pathology in musculoskeletal imaging. Use of standard sagittal, axial and coronal imaging planes frequently results in suboptimal demonstration of anatomical structures.

5) Failure to Get to the Margins of the Pathology: Occasionally, despite appropriate protocol selection for the clinical history, an examination may not extend beyond the margins of a pathology. This most commonly occurs in the setting of an incidental mass lesion. A proactive approach by the MR radiographer in adding sequences and low threshold for getting the examination checked by a radiologist can help reduce the incidence of patient recalls.

6) Pitfalls in Interpretation: In each anatomic region, there are a number of pathologies whose appearance on MRI may be misinterpreted as reflecting an alternative pathology. A number of these pathologies will be presented.

7) Trauma vs Tumour: Occasionally a tumour may present with a misleading history of trauma, tempting a diagnosis of traumatic haematoma. The reverse may also occur where it is difficult to differentiate a haematoma from a tumour.
Unifying concepts in MSK imaging
J Linklater
Castlereagh Imaging, New South Wales, Australia

Abstract not available at time of publication.

Shoulder MRI – The Basics
F Malara

Abstract not available at time of publication.
Pathological fracture secondary to undiagnosed simple bone cyst
B Walton
Benson Radiology, Adelaide, Australia

**Aim:** To explain the clinical and pathological characteristics of simple bone cysts, including diagnostic and treatment pathways, complications, possible aetiologies and prognosis. Imaging appearances across multiple modalities are also explored.

**Method:** This case study describes a 32-year-old patient that presented at the emergency department with right humeral pain after throwing a ball. Initial imaging demonstrated an oblique comminuted pathological fracture of the mid-humeral diaphysis secondary to a previously undiagnosed simple bone cyst. Further fracture and lesion characterisation was performed with computed tomography and magnetic resonance imaging and the diagnosis confirmed through biopsy and histological analysis.

**Background:** Simple (unicameral) bone cysts are benign, single-chambered, intramedullary lesions that demonstrate a characteristic predilection for the proximal metaphysis of the humerus and femur (94% of cases). Typically associated with early childhood and adolescence (<20 years), lesions are normally asymptomatic; however, pathological fracture occurs in more than 50% of cases and is frequently the first sign of disease presence. In the absence of fracture, lesions often spontaneously resolve with skeletal maturity and are rarely found in adults.

On plain x-ray, simple bone cysts appear as well-defined medullary based lucencies with adjacent cortical thinning and a characteristically narrow transitional zone. Treatment options for non-fractured cysts are varied, with management directed by age, epiphyseal plate involvement and fracture risk. In this case, a conservative management strategy, focused on fracture healing was adopted as the associated fracture haematoma can promote cyst resolution.

**Conclusion:** Simple bone cysts are benign lytic lesions rarely found in skeletally mature adults. This case study presents an atypical 32-year-old patient with a complicating pathological fracture. Clinical and pathological manifestations of the patient’s underlying disease are explored along with imaging characteristics and treatment implications.

**References**

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**Rotator cuff tears: A comparison between MRI, plain radiography and ultrasound**
A Graham1 and R Ta2
1Princess Alexandra Hospital, Queensland, Australia,
2Townsville Hospital, Queensland, Australia

**Background:** Rotator cuff tears are a common injury to the shoulder joint. The soft tissue nature of these injuries can be difficult to detect but can be diagnosed through imaging modalities. Hence it is important that the benefits and limitations of each modality are evaluated to recommend the proper use and diagnostic accuracy of Plain radiography, MRI and Ultrasound.

**Aim:** The purpose of this literature review was to investigate the success of Plain Radiography, MRI and Ultrasound in diagnosing full and partial thickness rotator cuff tears, comparing the modalities in terms of accuracy and technique.

**Methods:** A review of the literature was performed to gain a primary insight into the equipment, techniques, imaging and success of each modality in diagnosing rotator cuff tears. Primary articles utilised arthroscopy or surgery as the reference standard.

**Results:** Plain radiography was able to identify acromial malformations and detect the probability of a rotator cuff tear’s presence with 78–88% sensitivity. Evidence demonstrates that both MRI and Ultrasound have similar specificities and sensitivities when diagnosing partial or full-thickness tears. Another finding was the 3.0T MRI had the highest accuracy of diagnosing either tear, when compared with the 1.0T and 1.5T MRI.

**Conclusion:** Plain Radiography provides a cheap, time efficient prospective that gives a great indication that a tear could potentially happen. Plain Radiography provides no soft tissue detail however, and would thus be only useful as a preventative measure. Ultrasound and 1.5T MRI are equally accurate in diagnosing rotator cuff tears but a 3.0T MRI has higher accuracy than both. Ultrasound is a cheaper, cost-effective and time-efficient examination that should be preferentially used for first-time entry. MRI is better left for complex cases where Ultrasound is not able to make a conclusive diagnosis.
John Thomas sign: What does it stand for?  
ML Chan  
Marina Radiology, Victoria, Australia

**Aim:** The John Thomas (JT) sign is a legendary myth in the world of radiography. It is defined as a prominent soft tissue radiological sign seen on an AP pelvis radiographic image, but its clinical application is restricted to male patients only. It was believed that JT sign predicts any pathology underlining in the pelvis or hips. Nonetheless, there were limited literatures and research studies discussed on the truthfulness of this sign.

**Method:** The point of JT sign raised interest among the colleagues in the radiology department. Thus a retrospective study was performed to examine the sensitivity of JT sign to indicate a hip fracture in an emergency setting based in a metropolitan public hospital.

**Results:** It was found that the sensitivity of JT sign is 19% and the positive predictive value is 12%.

**Conclusion:** JT sign is not a reliable radiological sign to identify a hip fracture. Furthermore, this research project provides a deeper understanding of the mechanism of the male organ in order to uncover the mystery of JT sign.

What can radiologists see? An eye-tracking and performance study in priming radiologists to finding breast cancers  
A Tan, S Lewis, C Mello-Thoms, W Reed, M Pietryzk, M McEntee and P Brennan  
The University of Sydney, New South Wales, Australia

**Aim:** To measure the effect of inserting lower difficulty malignant cases in a set of screening mammograms. It is hypothesised that the insertion of lower difficulty malignant cases will enhance radiologists’ likelihood of detecting cancers of higher difficulty.

**Method:** An observer performance and eye position study was performed. Four experienced breast radiologists were asked to interpret two sets of 40 screening mammograms, both containing 4 abnormal cases of higher difficulty. The distribution of abnormal cases of higher difficulty was such that each half of both sets contained two. One set contained two additional abnormal cases of lower difficulty as “primers” in the second half (Set B). Primers are defined as lower difficulty cases containing salient malignant features of breast cancers inserted shortly before cases of greater difficulty.

**Results:** The analysis of sensitivity and specificity demonstrated that no significant effect could be measured as a function of priming ($p > 0.05$). The number of visual fixations per case in the second half of Set B decreased significantly ($Z = -2.330, p = 0.020$) when priming was employed; however, this trend was also observed in cases of the first half where priming was absent ($Z = -3.366, p = 0.001$). The time taken to first fixate upon lesions in cases of Set B where priming was absent (first half) was statistically significantly shorter ($Z = -1.988, p = 0.047$).

**Conclusion:** Overall this study showed no evidence that the observer performance of radiologists, as measured by diagnostic accuracy, is affected by the strategic insertion of priming malignant breast cancer cases of lower difficulty. However, changes in their visual search behaviour derived from eye-tracking analysis suggest the effect of memory bias. Radiologists can see a lot of cancers but can remember a lot of cases too.
Research training for radiography students: Does it change students’ perception and attitude towards evidence-based practice?
M Schneider,1 and K Lasserre2
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Aim: Historically, radiography training has focused mainly on the acquisition of technical skills. The importance of evidence-based practice (EBP) has recently led to awareness in the profession that research skills and knowledge of research concepts are fundamental components of training. However, few courses incorporate EBP or research into the curriculum. At Monash University, final year (4th year) radiography students undertake a core programme of EBP and research methodology over one semester. The aim of this study was to evaluate if students’ perception and attitudes towards EBP and research improve after delivery of the programme.

Methods: All final year radiography students were invited to participate in a survey that was conducted at the beginning and again at the end of the semester after delivery of a core unit on EBP and research methodology. The questions aimed to evaluate skill acquisition, such as research project design, communication, scientific writing, presentation skills and students’ perception of research as a core tool for the radiography profession. Each question was scored on a scale from 1 to 7 (strongly agree – strongly disagree) and analysed using the Wilcoxon signed rank test.

Results: All survey questions had improved scores after delivery of the training module (12 were significantly improved, p < 0.05). Delivery of a unit on EBP significantly improved the knowledge and confidence of radiography students in their own research skills, as well as their perception of the role of EBP for career development and for radiography in general.

Conclusion: Radiography students benefit significantly from a training programme in EBP. Such training will hopefully lead to increased research activity among radiographers and a rising awareness that EBP is the foundation for ‘best practice’. The cultural shift from ‘technician’ to ‘professional’ will require that all professional courses in radiography equip their students with basic knowledge and skills in EBP.

MITIE CT – Innovative education in action
D Starkey, T Gunn, C Berry, V Braithwaite, P Bridge, G Mahoney, P Rowntree and K Wilson-Stewart
Queensland University of Technology, Queensland, Australia

Aim: The Medical Imaging Training Immersive Environment (MITIE) system is a recently developed virtual reality (VR) environment for medical imaging that was developed at QUT in 2013. The software platform has recently been expanded to include a virtual reality computed tomography (CT) scanning module. The aim of this project was to evaluate the use of this MITIE software environment in the student learning experience of CT imaging. This project was possible due to funding made available by Health Workforce Australia (HWA).

Method: MITIE CT is provided as part of the pedagogical approach for all undergraduate medical imaging (MI) students in their computed tomography imaging unit. As with the other VR MITIE modules, the software presents a realistic imaging environment. The MITIE CT module allows students to position and plan an acquisition for a range of standard CT protocols. The software is utilised in conjunction with a picture archival and communication system (PACS) environment to simulate the processes for CT image acquisition and processing.

Results: This presentation provides a demonstration of the MITIE CT module and the initial feedback from students in its use and contribution to the understanding of the processes for CT imaging.

Conclusion: MITIE CT has a role to play in the pre-clinical development of imaging process in CT imaging. Further research is underway to investigate student confidence and clinical skill levels when using MITIE CT as a learning tool. This project was possible due to funding made available by Health Workforce Australia.

Fig. 1. MITIE CT – Innovative education in action.
Quality and safety service management challenges: Connecting rural & remote sites
A Arnold
Illawarra Shoalhaven Local Health District, New South Wales, Australia

Radiotherapy is a complex step-wise process where many hand-offs or transfers of work exist, creating opportunity for error and near situations to occur. Many of these steps and processes can be measured, analyzed with a view to improving patient safety risk. These processes and work systems are relatively simple to control and monitor within an established facility where the various staff groups working together can collaborate closely with one another in person. Alerting that configuration; adding another facility in a rural / remote setting changes the nature of that ability for people to work closely together. Experience has shown this also makes it harder for all staff to be fully aware of changes and alterations to workflow, work practice and the subtle operations at the various site locations, be those the new site or the established site.

Radiation oncology practice relies on staff from many different professions working together towards the same outcome – best practice, safe and effective patient treatment. In a service split by geography, staff and patients need to be supported by a service management framework that measures and analyses operations and workflow system wide, exploring learning opportunities to improve practice and safety.

This presentation will provide an overview of systems established with the recent expansion of services at the South Coast Cancer and Hematology Network, following the opening of the new radiation oncology facility at the Shoalhaven Cancer Care Centre.

While ongoing this work is centered on a structure that will provide strategic department wide leadership and vision to facilitate ongoing service development and improvement in a network wide coordinated approach.

The revised structure and governance builds on core elements of effective incident monitoring systems, clinical practice audit, national practice standards and multidisciplinary team support.

Leading or managing
D Collier
Australian Institute of Radiography, Victoria, Australia

Aim: To explore the differences between leadership and management and the impact of understanding and recognising this can have in the healthcare environment.

Method: This paper explores the shift taking place in our understanding of the role of leadership, from traditional leadership structures based around power and recognition, to those which rely on personal responsibility, delivery and service. These changes mirror similar shifts in healthcare delivery towards the patient-centred focus and multidisciplinary team delivery.

There are seven critical components\(^1\) that identify the difference between a manager and a leader. These components applied effectively create a team and teamwork that subordinates all individualistic needs and ego to the purpose of the team or group of individuals. Lencioni (2002)\(^2\) identifies five possible dysfunctions that can possibly bring about failure in any teamwork effort. These are failures that originate from individual failures and weaknesses that manifest themselves in the process of trying to enhance teamwork. The five dysfunctions are a lack of trust, a fear of conflict, a lack of commitment, an avoidance or lack of accountability and lack of attention to results. The paper explores strategies that deal with these dysfunctions.

Results: The paper presents a programme that is structured in a supportive manner to empower individuals and their organisations to identify and support effective leadership development. It shows clearly that management and leadership are different, and that they require different skills. It shows that these skills and understanding can be acquired and developed.

Conclusion: Individuals have to lay aside their own personal egos and needs for the group that is recognised as one entity. The teams are brought together and they and their leaders have ownership of their work, their workplace and responsibility for themselves.

References
Future health leaders – shaping tomorrow, today
L Jukes
Radiation Oncology Queensland, Victoria, Australia

Aim: Future Health Leaders (FHL) is an initiative of Health Workforce Australia (HWA) established in 2011 to engage emerging health professionals in the health reform process. HWA considers Australia’s upcoming health professionals as an invaluable source of knowledge and ideas, believing their input into health reform in Australia is of the utmost importance. This presentation aims to provide an update on the progress of this initiative and how to get involved.

Methods: In 2011, an Interim Council of FHL was established to identify how students and early-career health professionals could better engage with Health Workforce Australia. The first full council was elected in September 2012 and meets face to face quarterly, participating in workshops and consultations to develop recommendations for the health reform process. FHL comprises a range of health professionals, making it the first multi-professional group of its kind in Australia. FHL engages members through online and physical forums, conferences, newsletters and social media.

Results: The FHL Council is working with HWA in discussing pertinent issues concerning young health professionals and students. There are five key areas of discussion under the umbrella of workforce innovation: rural, indigenous, global, mental health and aged care. After its official launch at the inaugural FHL conference in September 2012, FHL have participated in multiple conferences and held forums to help shape its recommendations in areas of rural health, palliative care, indigenous health and student innovation. With more meetings planned, the Council will also provide advice to HWA Board and act as a standing forum to discuss a range of HWA programmes and initiatives.

Conclusion: The FHL council facilitates discussion and ensures the next generation of the health workers contribute to the health reform process. Through inter-professional collaboration, FHL continue to strive for better health outcomes for all Australians.

Better access to radiation oncology – An update on the remote planning workforce project
M Enge and P Fenton
Epworth HealthCare, Victoria, Australia

Aim: Following success in obtaining a Better Access to Radiation Oncology Workforce Innovation grant to research and build a remote, offsite and responsive radiation therapy planning workforce utilising part-time or non-contracted radiation therapists across the country, this paper will cover the challenges and improvements to clinical workflow through remote planning utilisation.

Method: Since its inception in mid-2013, nine remote planners have been recruited. The years of experience these practitioners possess provide a readymade skills-base to rapidly respond to complex planning and spikes in referrals, increasing access and reducing turnaround times for radiation therapy. Initial on-site and remote off-site training was provided to all remote planners, with additional documentation and on-call support where required. Plans were rotated across the nine planners evenly to facilitate a fair distribution of techniques.

Results: Over an 8-month period, 27 cases were sent out for remote planning across a range of complexities and diagnoses. On average, one case per week has been planned remotely since activation. There was a correlation between familiarity of planning-based system and techniques with planning time spent. By the second or third plan for each planner, there was a significant decrease in turnaround time and on-call support required, which improved clinical workflow and efficiency.

The remote, work-from-home scenario promotes the flexibility in the workforce sought by many radiation therapists and retains the professionals in the workforce.

Conclusion: With no current evidence-based literature on remote planning workforce implementation, recruitment and management in the Australian healthcare sector, the data collected through this workforce initiative could be used to adapt a similar remote planning workforce model at a national level.

This project is supported by funding from the Australian Government Department of Health and Aging.
Knowledge and skill gaps of limited license x-ray operators and the educational imperative
T Smith and H Harries-Jones
University of Newcastle, New South Wales, Australia

Aim: The aim is to consider gaps in the knowledge and skills of rural and remote limited license x-ray operators in light of some recent project findings and reflect on how this might be addressed.

Method: In 2008–09, survey remote x-ray operators in NSW assessed their self-perceived radiographic knowledge and competency to inform the development of on-line continuing education materials. That project was funded under the Rural Health Support Education and Training programme. In 2012–13, further funding was obtained from the Rural Health Continuing Education programme to conduct a series of face-to-face refresher workshops for NSW limited licensees. Participants sat a test before and after the workshop. Since October 2013, with support from the AIR, a further project is underway to make the NSW Remote X-ray Operators Licensing Course available on-line, together with the existing continuing education materials.

Results: The 2008–09 survey raised concerns about maintenance of competency of the 83 respondents given the small number of examinations performed each week (Smith & Fisher 2011). In six common examinations, less than 80% reported feeling competent and in two examinations less than 50% felt competent. Areas of knowledge weakness included fundamental concepts and critiquing radiographs. Thirty-eight participants attended the 2012–13 workshop series. Pre-workshop quiz scores averaged only 11 out of 25 (range 3–17). Post-workshop scores were slightly better (p < 0.001, paired t-test), with a mean of 15 (range 5–20). The third project is due for completion in October 2014 and will result in educational materials being available through Medical Radiation Learning On-line (MRLO).

Conclusion: Educational support from radiographers is essential to ensure high quality radiography services by limited licensees. Recent projects have demonstrated gaps in their knowledge and skills that have been reported anecdotally for years. Ongoing, as well as future projects, must address this important need.

Reference

Setting a national standard for limited X-ray operator services by the Rural and Remote Practitioners Advisory Panel
R Foggarty
Western Australia County Health Service, Perth, Australia

The AIR had tasked the Rural and Remote Practitioners Advisory Panel (RRPAP) to produce a national standard for limited x-ray operators (LXOs). In some rural and remote hospital sites, it is not always possible to have a fully qualified radiographer on staff. In lieu of a radiographer, a LSO may provide limited x-ray services in order to meet the current needs and requirements of providing quality health services for all Australians. LXOs can be nurses, doctors and occasionally other non-medical hospital workers who are trained to take a restricted set of x-rays in some rural and remote zoned hospitals. Previously, the states and territories have created and set their own local standards for LXOs. The national standard is a uniform approach, which identifies the minimum professional requirements for LXOs, individual accountabilities and responsibilities of the LSO. The standard further determines LSO characteristics, examples of what work is permissible by the LSO and special circumstances for when paediatric imaging is allowed.

Aim: To provide the AIR with a national standard under which LXOs can be trained and establish a scope of practice to create a uniform approach to LXOs.

Method: The RRPAP set to discover what is currently done by each state and establish a national standard. This was achieved through inherent knowledge of the rural and remote panellists and discussion with interstate peers.

Results: The result is a national standard for LXOs, which addresses LSO characteristics, examples of what work is permissible by the LSO, and special circumstances for when paediatric imaging is allowed, identifies the minimum professional requirements for LXOs, individual accountabilities and responsibilities of the LSO. The creation of a uniform standard to which LXOs can be trained to and a uniform scope of practice in which to operate within.

Conclusion: The RRPAP has completed the national standards. The document is now open for ratification by the radiation state licensing bodies, comment and opinion for AIR members, relevant members of the nursing and medical community, private radiology practise and state governments.
An inter-institutional analysis of outcomes after single and multi-fraction stereotactic ablative body radiotherapy (SABR) for pulmonary oligometastases screened using FDG-PET

S Siva,1 K Kirby,1 H Caine,3 D Whalley,3 M Stephens,3 F Foroudi,1 M MacManus,1 T Kron,1 D Ball,1 M Sarmiento1 and T Eade2

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Aim: To retrospectively review the clinical outcomes of single fraction and multi-fraction SABR programmes from two independent Australian academic institutions.

Method: Patients with one to three pulmonary metastases were screened with FDG-PET scans to exclude occult disseminated disease. In the single fraction cohort, 26 Gy was prescribed for peripheral targets and 18 Gy for central targets. In the multi-fraction cohort, 48 Gy/4 or 50 Gy/5 was prescribed for peripheral targets, and 50 Gy/5 was prescribed for central targets. Overall survival, local and distant progression rates were analysed from the date of treatment completion. Toxicity was recorded using CTCAE v4.0.

Results: From February 2010 to June 2013, 65 patients were treated with 85 pulmonary metastases (Table 1). The median follow-up was 1.1 years (range 0.1–3.1 years). Metastases most commonly originated from colorectal cancer (27%), followed by non-small cell lung cancer (23%), and others (50%). There were more patients who presented with solitary pulmonary metastasis in the single fraction group (93%) than the multi-fraction group (71%). No patient suffered grade 3+ toxicities. There was no difference in grade 1–2 toxicities between single fraction (n = 15, 29% [95%CI [17–44%]]) and multi-fraction SABR (n = 6, 35% [95%CI [14–62%]), p = 0.74. There were no significant differences between overall survival (p = 0.32) nor progression outcomes (p = 0.14) in either cohorts. Overall survival [95% CIs] at 1 and 2 years in all patients was estimated to be 91% [82–100%] and 64% [48–85%], respectively. At 1 year and 2 years, 57% [95%CI (45–74%)] and 34% [95%CI [20–59%]] of patients were free from distant progression, respectively. Local progression occurred in 3/85 of all treatments, with a 1-year local control rate of 91% [82–100%].

Conclusion: We report excellent local control and toxicity with promising survival in both single fraction and multi-fraction SABR treatments for patients with pulmonary metastases screened using FDG-PET scans, with similar outcomes with either approach.

Table 1 An inter-institutional analysis of outcomes . . .

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<tr>
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<th>Single-fraction [Institution A]</th>
<th>Multi-fraction [Institution B]</th>
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<tbody>
<tr>
<td>Patients</td>
<td>41</td>
<td>24</td>
</tr>
<tr>
<td>Metastases</td>
<td>51</td>
<td>34</td>
</tr>
<tr>
<td>Central</td>
<td>4 (7.8%)</td>
<td>11 (32.4%)</td>
</tr>
<tr>
<td>Peripheral</td>
<td>47 (92.2%)</td>
<td>23 (67.6%)</td>
</tr>
<tr>
<td>Grade 1&amp;2 Toxicity</td>
<td>15 (29%)</td>
<td>6 (35%)</td>
</tr>
<tr>
<td>Death</td>
<td>5 (12.2%)</td>
<td>7 (29.2%)</td>
</tr>
<tr>
<td>Distant Recurrence</td>
<td>13 (32.7%)</td>
<td>14 (58.3%)</td>
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<tr>
<td>Present with isolated metastases</td>
<td>38 (92.7%)</td>
<td>17 (70.8%)</td>
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Variation in tumour breathing motion between planning four-dimensional CT scans (4DCT) and treatment, and between individual treatment fractions for stereotactic ablative body radiotherapy (SABR) of the lung
J Ruben and A Seeley
William Buckland Radiotherapy Centre, The Alfred, Melbourne, Victoria, Australia

Aim: To compare variation in tumour breathing motion (TBM) between the 4DCT used for contouring and planning and successive treatment fractions as well as the inter-fraction variation.

Method: Our first 14 consecutive patients receiving lung SABR were analysed. Peak inspiratory and expiratory range of motion in three dimensions was recorded from 4DCT at time of planning. The same range of movement was recorded at each treatment fraction using Exactrac KV imaging and an implanted fiducial marker.

Results: Measurements were available for 79 of 82 fractions. At treatment, TBM remained within the planning 4DCT range for just 56%, 48%, and 54% of fractions in the left-right, antero-posterior and superior-inferior dimensions respectively. Average inter-fraction TBM variation was 1.7 mm (0.6–3.2 mm), 2.3 mm (0.3–8.3 mm) and 4.7 mm (0.5–23.2 mm) in the left-right, antero-posterior and supero-inferior directions respectively. At treatment, the average magnitude of TBM when outside the 4DCT range was 1.1 mm (0.1–3.8 mm) left-right, 1.6 mm (0.3–4.3 mm) antero-posteriorly and 2.7 mm (0.1–21.2 mm) supero-inferiorly. Average tumour vector displacement beyond planned motion envelope was 2 mm (0–21.5 mm). For six tumours, there was less breathing motion throughout treatment than at planning in one or two dimensions, but no tumour exhibited less TBM in every direction throughout treatment than during 4DCT. The opposite was true for eight tumours however.

Conclusion: Every patient exhibited variation in the extent of TBM between planning and treatment and between treatment fractions. The greatest range of TBM variation was 23.2 mm in the supero-inferior dimension. Variation in TBM is unaccounted for by the current standard of 5 mm Gross- to Planning Tumour Volume expansion, which barely covers subclinical tumour extent (1) and thus insufficiently accounts for unplanned variations in target motion. TBM variation, which is inadequately accounted for in present practice, may explain some SABR failures. Accurate incorporation of TBM variation might improve cure rates or permit dose de-escalation with lower resultant toxicities.

Reference

Comparison of 3D-PET versus 4D-PET for planning of small peripheral lung metastasis treated using stereotactic ablative radiotherapy (SABR)
B Chesson, D Ball, M MacManus, L Crawford, J Callahan and S Siva
Peter MacCallum Cancer Centre, Victoria, Australia

Aim: To assess the differences between target volumes delineated using 3D-PET versus 4D-PET for small peripheral lung metastasis planned for SABR.

Method: Ten cases of peripheral lung metastasis treated with single fraction SABR were included in the study. Each patient had undergone both 3D-FDG PET/CT and 4D-FDG PET/CT. Contouring and planning were performed using CMS XiO. Three radiation oncologists independently contoured GTVs from 3D-PET/CT and 4D-PET/CT series, applying a 5 mm PTV expansion. Baseline plans were optimised to the 3D-PTV, prescribing to an isodose line between 75% and 85%, using a 3D-PTV coverage objective of D99=100%. DVHs were generated for both 3D and 4D volumes. The absolute volume of GTVs and PTVs was recorded. Target coverage was measured by recording the percentage of PTV covered by the prescription isodose, plus minimum GTV and PTV dose. Plan conformity was quantified by calculating the conformity of the prescription isodose (C.I.100%) and 50% isodose (C.I.50%) to the 3D-PTV.

Results: 3D-PTV volumes ranged from 3.98 cc to 52.04 cc. C.I.100% did not vary significantly between cases (mean1.45 ± SD 0.11); however, C.I.50% was inversely proportional to PTV volume. All cases failed to achieve the D99=100% PTV coverage objective when applying the 3D based plan to the 4D-PTV. The percentage of 4D-PTV covered by the prescription isodose proved variable, ranging from 80.03% to 98.58% (mean 89%). Minimum dose to the 4D-GTV and 4D-PTV was 101.8% and 72.4% respectively, suggesting that the GTV is more protected from motion than the PTV.

Conclusion: Our results demonstrate differences in GTV and PTV dimensions between 3D-FDG and 4D-FDG PET/CT studies. When applying the 3D based plan to the 4D-PTV, all cases failed to meet the PTV coverage objective. Results of this study suggest inadequacy of 3D-PET/CT target delineation when compared to 4D-PET/CT volumes.
Collaborative implementation of stereotactic ablative body radiotherapy. A model for the safe implementation of complex radiotherapy techniques in Australia

E Hau,1 F Hegi-Johnson,2 J Barber,3 S Best,3 L Browne,1 Y Chin,1 P Dwyer,4,5 T Eade,5 P Graham,1 D Lu,1 M Rains,6 K Small,3 K Uniconb,3 K West,3 S White,2 W Wong,7 K van Tilburg1 and R Yeghiaian-Alvandi3,8

1Cancer Care Centre, St George Hospital, Sydney, New South Wales, Australia, 2Gosford Cancer Care Centre, Gosford, New South Wales, Australia, 3Nepean Cancer Care Centre, Kingswood, New South Wales, Australia, 4North Coast Cancer Institute, Port Macquarie, New South Wales, Australia, 5Royal North Shore Hospital, St Leonards, New South Wales, Australia, 6Wollongong Hospital, Wollongong, New South Wales, Australia, 7Prince of Wales Hospital, Randwick, New South Wales, Australia, 8Westmead Cancer Care Centre, Sydney, New South Wales, Australia, 9Lismore Base Hospital University of Sydney, New South Wales, Australia

Introduction: Stereotactic ablative body radiotherapy (SABR) is emerging as the standard of care for patients with early lung cancer who would otherwise not be candidates for curative management. Access to appropriate treatment for lung cancer patients is a significant problem with impact on survival especially in patients in regional and remote areas of Australia.

Aim: To describe the collaborative implementation of a SABR program across several centres in Australia.

Method: A tripartite expert committee consisting of a number of radiation oncologists, radiation therapists and physicists formed a collaboration group with special expertise in implementing SABR. After a series of telephone conferences and setup of an email group, a consensus protocol was developed to enable the implementation and safe delivery of SABR in several centres including regional sites.

Results: These protocols had ethics approval and all collaborative sites are required to undergo accreditation of their physics quality assurance, radiotherapy planning and treatment delivery prior to being permitted to treat on collaborative protocols. A clinical trial database and archive were created, to collate all clinical, imaging and radiotherapy planning data. Data collection is supported by a full-time trial coordinator who also assists departments with administration. In total, 11 sites have ethics and 7 have site specific approval to run the study. The setup of an email group has been a useful forum to exchange ideas and share expertise in treatment of patients using SABR.

Conclusion: SABR requires expertise from several disciplines and the setup of a collaborative special interest group greatly aids in the successful and safe implementation of such techniques. It provides the necessary support for those centres which do not have SABR specialist staff, allowing them to implement a SABR program safely and to the highest quality.

References

The role of stereotactic body radiotherapy (SBRT) in the treatment of oligometastatic prostate cancer (PCa) – Initial experiences at Epworth Radiation Oncology (ERO)  

N Bailey and P Bowden

Epworth Radiation Oncology, Victoria, Australia

Aim: SBRT aims to deliver an ablative dose of radiotherapy to target tissues, minimising dose to adjacent healthy structures. Oligometastasis describes an intermediate disease state involving five or fewer metastases. Local control (LC) rates of 90% for PCa bony and lymph node metastases treated with SBRT are reported in literature. This study aims to evaluate the effectiveness of SBRT for PCa oligometastases, assessing improvements in LC, reduction of prostate-specific antigen (PSA) and disease progression.

Method: From May 2013 to March 2014, 37 men with 80 PCa lesions were treated with SBRT at ERO. Treatment sites included spine ($n=32$), other bony sites ($n=33$) and lymph nodes ($n=15$). Treatment regimes were 16 Gy in a single fraction, 35 Gy in 5 fractions, or 50 Gy in 10 fractions. All patients had a detectable PSA at the time of radiotherapy.

Treatment techniques were intensity modulated radiation therapy for spinal tumours or dynamic conformal arcs for lymph nodes and non-spine bony sites. All sites required strict patient immobilisation. Precise tumour localisation was achieved utilising ExacTrac kV imaging for bony sites, and a combination of ExacTrac kV and Cone Beam CT for nodal sites. All positioning utilised a robotic couch with 6 degrees of freedom.

Results: Early results indicate SBRT for PCa bone oligometastases is effective for long-term pain relief. No acute toxicity was reported in the majority of cases; <8% had nausea or diarrhoea that required pharmacological management. The first post-SBRT PSA was lower than pre-treatment levels in 88% of patients and continued to decline in greater than 70% of patients at subsequent follow-up.

Conclusion: Preliminary results show oligometastatic PCa patients may be safely and successfully treated with SBRT. Further follow-up is necessary to assess the long-term impact of SBRT on LC, toxicity, PSA response, and clinical outcomes.

References
Are 6MV X-rays all it takes for SABR?
T Kron, D Pham, A Lim, N Hardcastle, A Edgar, P Lonski, F Foroudi, D Ball and S Siva
Peter MacCallum Cancer Centre, Melbourne, Australia

Aim: To explore the role of radiation qualities other than 6MV X-rays in extracranial stereotactic ablative body radiotherapy (SABR)

Methods: Peter MacCallum Cancer Centre has an active programme of SABR ranging from lung to spine, bone, liver and kidney lesions. The variety of lesions sizes and locations makes treatment planning challenging and we employ 3D conformal and IMRT techniques for this purpose using mostly 6MV X-rays. 18MV X-rays were investigated as they have the advantage of better penetration and skin sparing but come at the expense of production of unwanted neutrons and a considerably larger uncertainty of dose calculation in the presence of inhomogeneities. We also studied the role of electrons in treating superficial bone lesions. Here typically an electron photon mix would be required to maintain acceptable skin dose and careful consideration must be given to prescription and normalisation of dose.

Results: High energy photons were used mostly for patients with abdominal lesions. In particular for renal lesions, which feature several posterior beams going through couch and immobilisation device (ELEKTA bodyfix), the additional skin sparing afforded by the increased build-up was found to be beneficial. A mix of 6 and 18MV X-rays was employed in more than half of the 20 kidney SABR patients. Skin sparing was verified in selected patients using in vivo dosimetry with radiochromic film. Electrons were used in two patients with bone lesions (sternum and skull). Doses per fraction were 14 and 20 Gy, respectively, with approximately 50% of the dose delivered using a 9 MeV energy electron beam.

Conclusion: As SABR applications extend to more and more locations, radiation qualities other than the standard 6MV X-rays were found to be useful. They need to be carefully considered on a case by case basis and additional quality assurance may be required.

Sunday 7 September, 0900–1030
Proffered Papers: Paediatrics

Under-ordering of ultrasound results in over-imaging and increased emergency department length of stay for children with non-traumatic hip pain
P O’Hare1 and A Lamont2
1The Townsville Hospital, Douglas, Queensland, Australia, 2The Department of Medical Imaging, The Townsville Hospital, Queensland, Australia

Aim: Hip pain in children poses a diagnostic challenge. Imaging is frequently required to identify the cause and direct treatment. Ultrasound is often under-utilised in emergency departments due to perceived difficulties with availability and time constraints. We reviewed a tertiary hospital emergency department’s compliance with the Western Australia Diagnostic Imaging Pathways for children with non-traumatic hip pain.

Method: The emergency department database was retrospectively interrogated. We included children between the ages of 0 and 17 years, over a 7-year period, from September 2006 to 2013. Children with a diagnosis of transient synovitis, Perthes disease, slipped capital femoral epiphysis (SCFE) or septic arthritis were sampled.

Results: One hundred and one patients were included (mean age 6 years, 63% male). The final diagnosis was transient synovitis 60%, septic arthritis 18%, SCFE 14% and Perthes disease in 8% of patients respectively. Ninety-three per cent received an x-ray as the initial investigation. Of the 61 patients with transient synovitis, 10% complied with the guidelines. Forty-five per cent of transient synovitis patients who had a hip x-ray received further imaging, predominately hip ultrasound. The mean emergency department length of stay was 6.75 hours if x-ray was the primary investigation. This was reduced to 3.75 hours if ultrasound was the initial imaging investigation (difference-of-means 3 hours). There was good compliance with the guidelines to use hip x-ray in patients with septic arthritis, SCFE and Perthes disease. Hip ultrasound supported the diagnosis of septic arthritis in 60% of patients. By comparison, x-ray was suggestive of septic arthritis in only one of 18 cases.

Conclusion: Hip x-ray, although good for excluding other pathology, is a poor investigation for the diagnosis of transient synovitis and septic arthritis. In children with suspected transient synovitis, early ultrasound reduces emergency department length of stay and unnecessary further imaging. Early ultrasound for the investigation of transient synovitis or septic arthritis is recommended.
Practical ways to reduce paediatric CT cancer risk
J De Campo and M De Campo
Melbourne University, Victoria, Australia

Aim: To outline practical steps to actually reduce the number and radiation dose of paediatric CT.

Method: CT is an important, extremely useful and generally very safe diagnostic imaging tool in patients over 30, where radiation risks are very low.

Studies by Pearce et al. (1) and Mathews et al. (2) support the initial finding by Brenner et al. (3) that there is a strong link between CT performed in children/young adults and the subsequent development of cancer.

The overall risk of developing cancer following a single body CT in children is estimated by ARPANSA to be 1 in 1000 (4).

The use of CT in children has increased by 21% in the 6 years to 2011/12 (5).

Results: Seven steps to reduce both the use and dose of CT in children are detailed below.

1. The profession adopt a policy on CT radiation risk reduction, which mandates that all radiologists provide written information on the risks of malignancy based on the ARPANSA patient information (4) to all parents of patients less than 16, except in emergencies.

2. All requests for CT in patients less than 16 must include a referrer’s statement that ‘alternative imaging techniques are not considered appropriate’.

3. A funded education programme be provided for all medical practitioners and technologists on the appropriate use of CT and CT dose minimisation.

4. The profession supports a change in approved criteria for MRI in children where MRI is an acceptable clinical substitute.

5. Where radiologists and technologists are licensed, they must have successfully completed a learning module on dose minimisation.

6. The RANZCR require completion of a learning package on the risks, appropriate use and CT dose minimisation as part of CPD.

Conclusion: “. . . if we choose to be careful, we will have appropriately discharged our professional responsibility,” says Golding (6).

References


Diagnostic reference levels for common paediatric fluoroscopic examinations performed at the Women’s and Children’s Hospital, Adelaide
D Balman1 and G Bibbo2
1Women’s and Children’s Hospital, Adelaide, South Australia, Australia, 2Women’s and Children’s Hospital, Adelaide, South Australia, Australia

Aim: To establish diagnostic reference levels (DRL) for the common paediatric fluoroscopic examinations performed at the Women’s and Children’s Hospital (WCH), Adelaide.

Method: Patients’ demographic data, exposure factors and dose area product (DAP) values have been entered in an Access database since the current Philips MultiDiagnost Eleva fluoroscopic system was installed at the hospital in 2006. These data have been analysed to provide DRL (75 percentile) for airways, airway/swallow, barium swallow/meal, barium follow-through, barium enema and micturating cystouretrography (MCU) and feedback to the radiologists, registrars and radiographers on the dose delivered to paediatric patients for these examinations. Literature searches show that only MCU data published by the UK Health Protection Agency (HPA)1,2 are available for comparison with WCH MCU data.

Results: The data analysed were DAP, screening time, number of images taken and those printed for the age groups: 0–1 y, 1–3 y, 3–6 y, 6–12 y and 12–18 y. For comparison with those recommended by HPA1,2 (Table 1), the DAP data for MCU were also analysed for the age groups that closely match the ages used by HPA. Apart for the age group 12–18 y, the WCH DRL compare well with those of the HPA 2005 review2 but not with the stricter DRL in the 2010 review1.

Table 1. WCH and HPA DRL data for MCU

<table>
<thead>
<tr>
<th>Age group (y)</th>
<th>WCH DRL</th>
<th>HPA DRL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2005 review</td>
<td>2010 review</td>
</tr>
<tr>
<td>0–0.5</td>
<td>29 (μGy m²)</td>
<td>30 (μGy m²)</td>
</tr>
<tr>
<td>0.5–1.5</td>
<td>40 (μGy m²)</td>
<td>70 (μGy m²)</td>
</tr>
<tr>
<td>1–3</td>
<td>60 (μGy m²)</td>
<td>80 (μGy m²)</td>
</tr>
<tr>
<td>3–6</td>
<td>170 (μGy m²)</td>
<td>150 (μGy m²)</td>
</tr>
<tr>
<td>6–12</td>
<td>425 (μGy m²)</td>
<td>250 (μGy m²)</td>
</tr>
</tbody>
</table>

Conclusion: The current database will be analysed on a regular basis to provide ongoing awareness to staff of the doses delivered and review the protocols and procedural techniques.

References

The ins and outs of intussusception: Intussusception management at Wellington Hospital 2001–2013
R Walklin and J Murdoch
Capital and Coast District Health Board, Wellington, New Zealand

Aim: Ileocaecal intussusception is a common paediatric surgical emergency and one in which prompt radiologic diagnosis and management are critical to patient outcomes. Draft guidelines published by the British Society for Paediatric Radiology set out best practice guidelines and targets for reduction performance. We aimed to validate the use of these guidelines, assess performance against them, and identify any areas requiring improvement in practice.

Method: A retrospective chart review of all ileocaecal intussusceptions managed radiologically in Wellington Hospital between 2001 and 2013 was performed.

Results: Eighty intussusceptions in 70 patients were identified in the audit period. Seventy-two per cent were male, with an average age of 15 months. Pneumatic reduction was attempted in 77, of which 57 (74.0%) were successful. There was no significant difference in reduction rates between paediatric and general radiologists ($X^2=0.68$, $p=0.41$). A pathologic lead point or ischaemic bowel requiring resection was found in 9 of 24 patients who underwent surgery following or instead of reduction. Other than failed reduction, only one significant complication (pneumoperitoneum) occurred during reduction.

Conclusion: Methods for pneumatic reduction of ileocaecal intussusception described in the BSPR guidelines were consistently applied and resulted in a high rate of success with minimal complication.

Diagnostic reference levels for paediatric CT examinations performed at the Women’s and Children’s Hospital, Adelaide
G Bibbo and S Brown
Women’s and Children’s Hospital, South Australia, Australia

Aim: To establish diagnostic reference levels (DRL) for paediatric CT examinations performed at the Women’s and Children’s Hospital (WCH), Adelaide.

Method: Patients’ demographic data, exposure factors, CTDI$_{vol}$ and DLP values have been entered in an Access database since the current GE CT750HD was installed at the hospital in 2009. GE colour-coded paediatric protocols based on patients’ size (age for brain, weight for all other examinations) are being used. The images have been reconstructed with 20 to 60% adaptive statistical iterative reconstruction (ASIR).

Results: The database has been analysed to provide DRL (75 percentile) values and a comparison with the Australian National Radiation Dose Register (NDRLD). The comparison data are shown in Tables 1 and 2 with data restricted to using “Head” phantom for brain and “Body” phantom for all other examinations. The WCH DRL compare well with those of the NDRLD. Separate analysis of axial and helical data shows that DLP values are higher for helical scans due to helical-over-beaming.

Table 1. CTDI$_{vol}$ (mGy)

<table>
<thead>
<tr>
<th>Age</th>
<th>Brain</th>
<th>Chest*</th>
<th>AbdoPelvis</th>
<th>ChestAbdoPelvis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>NDRLD</td>
<td>WCH</td>
<td>NDRLD</td>
<td>WCH</td>
</tr>
<tr>
<td>0–4 y</td>
<td>30</td>
<td>21</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>5–14 y</td>
<td>35</td>
<td>32</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>15–18 y#</td>
<td>60</td>
<td>39</td>
<td>15</td>
<td>7</td>
</tr>
</tbody>
</table>

#NDRLD includes adult data.

*Excluding axial high resolution chests. Also, scan range may include portion of upper abdomen.

Conclusion: The current database will be analysed on a regular basis to provide ongoing awareness to staff of the doses delivered and review the protocols and procedural techniques.

Reference
Interventional sclerotherapy in paediatric patients from effectiveness of treatments, sclerosing agents, complications and lymphangioma types: A 5-year evaluation
F Shay¹ and M Walsh²
¹Princess Alexandra Hospital/Mater Children’s Hospital, ²Mater Children’s Hospital, Queensland, Australia

**Aim:** Lymphatic malformations are congenital abnormalities of the lymphatics of the head and neck, trunk and axial regions. Although they are benign, the lymphangiomas can internally bleed, become infected, cause localised mass effect on important structures, increase in size, or limit self-confidence or function. As a result, patients may consider the minimally invasive treatment of sclerotherapy to the surgical intervention.

The aim of the study is to review the sclerotherapy paediatric patients from 2009 to 2014 at the Mater Children’s Hospital and determine effectiveness of the treatments, sclerosing agent (PBS bleomycin or off pharmacy OK 432), which type of lymphangioma is more amenable to treatment, and potential complications.

**Methods:** Retrospective audit of 82 patients with lymphangioma treated by interventional radiology sclerotherapy at Mater Children’s Hospital from 2009 to 2014. The data are collated by reviewing preliminary and follow-up imaging findings, operative/procedural notes, outpatient clinic reviews, and readmissions.

**Results:** The following review areas will be evaluated:
- Types of lymphangioma based on type: microcystic, macrocystic, single cyst, cavernous
- Location: head and neck, trunk, or axial regions
- Treatment agent: bleomycin or OK 432
- Indications for treatment: functional, infection, cosmetic regions
- Complications post-sclerotherapy
- Number of treatments till effective management
- Referring team

**Conclusion:** Interventional sclerotherapy is a mainstay treatment for lymphangiomas in the paediatric population. By evaluating an Australian experience of sclerotherapy treatments, there would be better understanding of which lymphangioma types have more effective outcomes, sclerosing agents, and likelihood of complications impacting patients’ treatment options and care.

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Sunday 7 September, 1100–1300
Combined Plenary: Future Directions in Radiology and Radiation Therapy

Delivering radiology in 2030 - who, what, where, how?
P Cavanagh
Musgrove Park Hospital, Taunton, Somerset, United Kingdom

**Aim:** This presentation will look at the major drivers for change in healthcare and more specifically in diagnostic radiology, and, by reflecting on the recent past, look at how radiology may develop in the next 20 years.

The recent past has seen a step change in the role of radiology in healthcare. Much of this has been due to the major developments within the specialty itself. However, there are other powerful drivers for change that will have a major influence on the future of radiology. These drivers are outwith health science itself and include the changing population demography, economic challenges and changes in culture. Added to this there are the technological advances that are making the world a smaller place and changing the way we communicate.

Although it is not possible to predict the future with accuracy, there is no doubt that radiology will need to adapt to these drivers. The role of the radiologist is under threat, but with all threats come opportunities for developing the specialty into the future.

This presentation will explore how these various drivers may influence how we provide diagnostic imaging services in the future.
Radiotherapy services England: Progress and vision for 2024  
C Beardmore  
The Society and College of Radiographers, London, United Kingdom

Overview: In 2004 the government in England set up an ambitious plan to identify the requirements for world class radiotherapy service delivery for patients1. This presentation will reflect on the progress made, and focus on the vision for radiotherapy services over the next 10 years2,3.

Background: The population of the United Kingdom is over 63 million. Radiotherapy services are delivered across 61 National Health Service (NHS) Trusts in the UK (51 NHS Trusts in England) and there are a growing number of private providers in England. The four countries of the UK have devolved health policy and thus the strategy for radiotherapy service development is different by country. However there has and continues to be a strong emphasis on sharing developments between the countries. There have been many challenges and opportunities with a re-organisation of the NHS, in England in 2012 leading to changing for the commissioning of radiotherapy services4. Progress is being made due to the commitment of the radiotherapy professionals working with the key stakeholder organisations. Collaboration and engagement has been critical and this co-ordinated approach is helping support the drive to ensure that the radiotherapy strategy continues to support the delivery of world class service to patients5,6,7,8.

A new vision for radiotherapy service has been published, and this will be shared during the presentation together with the latest national work to support this vision7.

Summary: An overview will be provided of work in progress within England in relation to radiotherapy service delivery: both equipment and workforce8,9.

References
Personalised radiotherapy using risk adaptive optimisation
W A Tomé
Montefiore Medical Center and Albert Einstein College of Medicine, Bronx, New York, United States of America

Aim: To review the rationale and physical aspects of biologically guided radiation therapy.

Methods: A series of biologically guided radiation therapy techniques are compared to their corresponding plans in which the entire PTV receives a homogenous boost dose resulting in the same equivalent uniform dose (EUD) to it as in the case of dose painting. Iso-TCP maps are introduced as a tool to aid the planner in the evaluation of the resulting non-uniform dose distributions. Iso-TCP maps are akin to isodose maps in 3D conformal radiotherapy. The impact of the currently limited diagnostic accuracy of functional imaging on biologically guided radiation therapy is also explored.

Results: Utilizing biological parameters in the generation of biologically guided radiation therapy plans results in an increase in the therapeutic ratio as compared to conventional plans in which optimization techniques based on physical dose for dose painting are used.

Conclusion: For the assessment of the fidelity of biologically guided radiation therapy plans, voxel-based iso-TCP maps present a promising tool. However, due to the detection threshold for identifying high-risk tumor voxels inherent in all functional-imaging techniques, one should choose for the low-risk PTV the biological parameters or physical dose level such that current minimal prescription peripheral doses are achieved for the entire PTV in the resulting biologically guided radiation therapy plan. With the above caveat biologically guided radiation therapy appears to be a promising approach for individualized patient- and disease-specific radiotherapy.