Proffered papers: AI

H6.1 Automated quantification of fat infiltration in paraspinal muscles on MRI scans with U-Nets

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Background: Fatty infiltration in the paraspinal muscles is frequently observed on MRI scans; it is considered to be a marker of deconditioning. Without quick and reproducible methods for quantification, the diagnostic importance cannot be explored. Artificial Intelligence (AI) technologies provide a tool for easy quantification of fatty infiltration.

Method: An MRI dataset of 39 images was used to train and test an automated spinal muscle segmentation method. Manually created binary masks indicating the location of the left erector spinae were used to train (36 images) and test (3 images) using U-Net. Blurring and thresholding was used to determine which pixels in the muscles were likely to be fat; four fatty infiltration indicators were calculated. 1: calculated percentage fat, 2-4 modified fat percentage using weighting factors to measure fat-dispersion within the muscle. The methods were compared using the ranked values calculated for each image.

Results: On average, the trained U-Net correctly classified 99% of the muscle pixels in the test images. The muscle fat percentage ranged from 13% to 24% (mean 17%). The fatty infiltration indicator calculated using Method 2 was most different to Method 1, indicating it provided the greatest differentiation of fat dispersion between the images.

Conclusion: A trained U-Net can automatically extract the erector spinae from MR images with good accuracy and measures of fatty infiltration can assess differences in fat content and distribution within the muscles. With larger training sets, these methods could be applied to assess deconditioning of the paraspinal muscles.

H6.2 Curating large datasets for artificial intelligence tool development: our experience of participating in the ProCAncer-I project

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Prostate cancer is the most prevalent cancer in men in the UK (1). It is critical to distinguish between clinically relevant disease and low-risk disease at diagnosis to guide management. Multiparametric MRI (mpMRI) is now widely used to evaluate and stage prostate cancer due to its high sensitivity and NICE guidelines (2019) recommending mpMRI prior to prostate biopsy (2). Artificial intelligence (AI) techniques show early promise in automatic assessment of diagnostic imaging, including assessment of mpMRI. Large, annotated datasets of scans and clinical information are necessary to test and validate AI algorithms. ProCAncer-I is a Europe-wide consortium who are collating an anonymous dataset of 17,000 mpMRI prostate scans that can be used for research, including AI algorithm development. Curating datasets for imaging repositories from routine clinical infrastructure requires careful patient cohorting, image preparation, review, and annotations to be useful in AI tool training. We share our approach to preparing and managing large datasets, including the associated processes and governance needed to support projects of this nature. Our multidisciplinary approach -- involving research radiographers, radiologists, informatics scientists and data analysts; working together in an AI research hub environment, has proven key to the success of projects of this nature. The poster will include a description of the primary aims and objectives of the consortium project and an assessment of the benefits and challenges of being a part of projects of this nature, including the complexities of case selection, data and image collection, and the importance of good data management and GDPR compliance.

1. Cancer Research UK (2021) Prostate cancer statistics | Cancer Research UK, Cancer Research UK. Available at: https://www.cancerresearchuk.org/health-professional/cancer-statistics/statistics-by-cancer-type/prostate-cancer (Accessed: 2 December 2021) 2. National Institute for Health and Care Excellence (NICE) (2019) Prostate cancer: diagnosis and management. NG131. Available at: https://www.nice.org.uk/guidance/ng131 (Accessed: 2 December 2021)

H6.3 Deep learning approach for lung segmentation in computed tomography pulmonary angiography (CTPA)

Krit Dwivedi[1]; Michael Sharkey[2]; Michail Mamalakis[1]; Peter Metherall[2]; Louis Rees[1]; Caitlyn Hawkesford-Johnson[1]; Samer Alabed[1]; Robin Condliffe[2]; David Kiely[2]; Andrew Swift[1]

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Background: Lung segmentation in Computed Tomography (CT) involves detection of the anatomical lung boundary on every slice of the study and is an important step in artificial intelligence (AI) approaches. Most current applications are limited to non-contrast CT, however CTPA is commonly performed in clinical practice. We developed a lung segmentation model in CTPA using the state-of-the-art nnU-net deep learning (DL) method.

Methods: 226 patients with thin-slice (≤ 0.625 mm) CTPA imaging were identified from a tertiary center. 50 cases were manually segmented using MIM software. 29, 8 and 13 cases were used for training, testing and validation respectively. A single fold training approach with data augmentation, consisting of 1000 epochs with 250 mini-batches per epoch was used. Further clinical validation was performed on 173 unseen cases by a radiologist. Cases were evaluated and classified as 'optimal' if radiologically there were no significant segmentation errors, 'borderline' if ≤10 slices had errors, and suboptimal if >10 slices had errors.

Results: Mean DICE score and accuracy across the segmented validation cases was 0.998 and 0.989 respectively. On radiological review, 144 (83.2%), 20 (11.6%) and 9 (5.2%) scans were classified as optimal, borderline, and suboptimal respectively. There were no failures. Common reasons for suboptimal performance were peripheral consolidation, atelectasis and pleural effusions.

Conclusion: An DL segmentation algorithm can successfully segment the lung on CTPA. This is an important prerequisite step in the development of clinical AI models such as pulmonary embolism detection, vessel analysis or imaging-based biomarkers. Further studies involving larger external cohorts are warranted.

1. Isensee, F., Jaeger, P.F., Kohl, S.A.A. et al. nnU-Net: a self-configuring method for deep learning-based biomedical image segmentation. Nat Methods 18, 203-211 (2021). https://doi.org/10.1038/s41592-020-01008-z 2. Ronneberger O., Fischer P., Brox T. (2015) U-Net: Convolutional Networks for Biomedical Image Segmentation. In: Navab N., Hornegger J., Wells W., Frangi A. (eds) Medical Image Computing and Computer-Assisted Intervention - MICCAI 2015. MICCAI 2015. Lecture Notes in Computer Science, vol 9351. Springer, Cham. https://doi.org/10.1007/978-3-319-24574-4_28

H6.4 Early experiences of research radiographers working in an artificial intelligence imaging hub

Sharon Vit; Robby Emsley; Dow-Mu Koh; Christina Messiou; Ana Ribeiro; Janet Macdonald; Georgina Hopkinson

The Royal Marsden NHS Foundation Trust

Background: Radiographer role extension and advanced practice in areas such as reporting and intervention are well established but few radiographers have support to undertake research [1]. Furthermore, while approximately 65% of radiographers say they understand the term artificial intelligence (AI) only 31% said they felt confident using AI technologies [2], suggesting limited involvement in AI research. Therefore, the opportunity to work as radiographers in an AI research hub within a multi-disciplinary team, undertake tasks traditionally completed by a radiologist, develop a research portfolio and contribute to and influence developments in AI in imaging is novel and exciting.

Summary: This poster is a SWOT analysis of radiographers in an AI research team and will illustrate the particular skills and benefits radiographers can bring and outline suggestions to mitigate weaknesses that may currently prevent radiographer participation. It will also survey the many opportunities being a research radiographer in AI development brings to the individual, the profession and our patients; as well as the threats that can prevent effective engagement and research in the AI field.

Learning outcomes: Awareness of AI, its role in medical imaging and how AI applications can inform commissioning of scanners and information systems. Appreciate the valuable skills that a radiographer can bring to this new and exciting field; as well as new skills that radiographers may need to develop. Reporting of first-hand experience of working within an AI research hub as a Radiographer.

1. College of Radiographers (2020) 'Research Strategy 2021-2026' Available: https://www.collegeofradiographers.ac.uk/getattachment/Research-grants-and-funding/cor-research-strategy/cor-research-strategy-2021-26.pdf?lang=en-GB [Accessed: 30/11/2021] 2. Rainey C, O'Regan T, Matthew J, Skelton E, Woznitza N, Chu K-Y, Goodman S, McConnell J, Hughes C, Bond R, McFadden S and Malamateniou C (2021) 'Beauty Is in the AI of the Beholder: Are We Ready for the Clinical Integration of Artificial Intelligence in Radiography? An Exploratory Analysis of Perceived AI Knowledge, Skills, Confidence, and Education Perspectives of UK Radiographers.' Frontiers in Digital Health 3 739327. doi: 10.3389/fdgth.2021.739327

H6.5 Retrospective analysis of screen detected cancers not recalled by artificial intelligence

Samantha Smith[1]; Sally Bradley[2]; Katie Walker-Stabeler[2]; Cashmere Olipas[2]; Sarah Gascoigne[2]

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Background: Analysis of artificial intelligence demonstrates its great potential to perform as an independent reader in a screening double reading process and non-inferiority to human reader on screening key performance indicators. There is little literature available which describes the subsets of negative and positive discordant cases identified with artificial intelligence versus human reader. We review the screen detected cancers at this institution which were not recalled by artificial intelligence.

Method: A retrospective analysis of 37,764 screening mammograms was performed (April 2015 and March 2018). The subset of images with a positive cancer diagnosis at screening assessment which were not recalled by artificial intelligence were highlighted as discrepant cases and reviewed by a panel of film readers.

Results: Out of the 37,764 cases, there were 27 discrepant cases which artificial intelligence did not recall to assessment and resulted in a positive cancer diagnosis at assessment. The results show 27 women with an age range of 48-72; 3 prevalent and 25 incident round. There were 11 non-invasive and 16 invasive cancers. The mammographic features varied; 9 calcifications, 8 asymmetric densities, 8 masses, 2 distortions, 1 asymmetric density with calcification. 3 of these cases were subsequently excluded (2 invasive and 1 non-invasive), 2 were incidental findings within the contra-lateral breast. One was downgraded from non-invasive.

Conclusion: Artificial intelligence missed cancers with a variety of mammographic features. 58% of the cancers were invasive and 42% in situ.

H6.6 The impact of AI on radiographic image reporting - perspectives of the UK reporting radiographer population

Clare Rainey[1]; Tracy O'Regan[2]; Jacqueline Matthew[3]; Emily Skelton[4]; Nick Woznitza[5]; Kwun-Ye Chu[6]; Spencer Goodman[7]; Jonathan McConnell[8]; Ciara Hughes[1]; Raymond Bond[1]; Christina Malamateniou[9]; Sonyia McFadden[1]

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Background: It is predicted that medical imaging services will be greatly impacted by AI in the future. Developments in computer vision have allowed AI to be used for assisted reporting. Studies have investigated radiologists' opinions of AI for image interpretation (Huisman et al., 2019 a/b) but there remains a paucity of information in reporting radiographers' opinions on this topic.

Method: A survey was developed by AI expert radiographers and promoted via LinkedIn/Twitter and professional networks for radiographers from all specialities in the UK. A sub analysis was performed for reporting radiographers only.

Results: 411 responses were gathered to the full survey (Rainey et al., 2021) with 86 responses from reporting radiographers included in the data analysis. 10.5% of respondents were using AI tools? as part of their reporting role. 59.3% and 57% would not be confident in explaining an AI decision to other healthcare practitioners and 'patients and carers' respectively. 57% felt that an affirmation from AI would increase confidence in their diagnosis. Only 3.5% would not seek second opinion following disagreement from AI. A moderate level of trust in AI was reported: mean score = 5.28 (0 = no trust; 10 = absolute trust). 'Overall performance/accuracy of the system', 'visual explanation (heatmap/ROI)', 'Indication of the confidence of the system in its diagnosis' were suggested as measures to increase trust.

Conclusion: AI may impact reporting professionals' confidence in their diagnoses. Respondents are not confident in explaining an AI decision to key stakeholders. UK radiographers do not yet fully trust AI. Improvements are suggested.

1. Huisman M, Ranschaert E, Parker W, Mastrodicasa D, Koci M, Pinto de Santos D, Coppola F, Morozov S, Zins M, Bohyn C, Koç U, Wu J, Veean S, Fleischmann D, Leiner T, Willemink MJ. (2021a) An international survey on AI in radiology in 1,041 radiologists and radiology residents part 2: expectations, hurdles to implementation and education. European Radiology. . https://doi.org/10.1007/s00330-021-07782-4 2. Huisman M, Ranschaert E, Parker W, Mastrodicasa D, Koci M, Pinto de Santos D, Coppola F, Morozov S, Zins M, Bohyn C, Koç U, Wu J, Veean S, Fleischmann D,

Leiner T, Willemink MJ. (2021b) An international survey on AI in radiology in 1,041 radiologists and radiology residents part 1: fear of replacement, knowledge, and attitude. European Radiology. doi: 10.1007/s00330-021-07781-5 3. Rainey, C., O'Regan, T., Matthew, J., Skelton, E., Woznitza, N., Chu, K-Y, Goodman, S., McConnell, J., Hughes, C., Bond, R., McFadden, S., Malamateniou, C. (2021) Beauty is in the AI of the beholder: are we ready for the clinical integration of artificial intelligence in Radiography? An exploratory analysis of perceived AI knowledge, skills, confidence and education perspectives of UK radiographers. Frontiers in Digital Health (3) https://doi.org/10.3389/fdgth.2021.739327

Proffered papers: Wellbeing and workforce

I7.1 Picturing the wellbeing of radiotherapy students on placement using emoji

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Background: Many Health professional students starting higher education in 2020 embarked on clinical placement with no prior face-to-face contact with peers. COVID-19 social restrictions undoubtedly impacted the mental wellbeing of young people. Attempts to evaluate wellbeing via conventional survey methods often result in poor engagement and do not capture regular fluctuations in emotional state. Increased use of smartphones for social interaction suggests that short message service (SMS) functionality can provide rapid data. This pilot project tested the feasibility and validity of gathering anonymous data from students concerning mental wellbeing on clinical placement via free text emoji and SMS.

Method: Year 1 radiotherapy students were asked to provide anonymous daily emoji representing their mental wellbeing via WhatsApp. Weekly prompts sought textual responses relating to factors impacting wellbeing. Post data analysis, participants were asked to complete a short anonymous online survey to validate researchers interpretation of responses and provide feedback on the method.

Results: Fifteen participants provided 254 emoji responses, using 108 different emoji; these were supported with weekly texts. 'Happy' emoji were used most frequently, with social interaction and levels of fatigue identified as important factors regarding wellbeing. Anonymity and opportunity to feedback via SMS were viewed positively, and the ease and rapidity of response engendered engagement throughout the 3-week study.

Conclusion: Use of emoji for rapid assessment of cohort mental wellbeing is valid and potentially useful alongside more formal evaluation mechanisms and individual support strategies. Capturing simple wellbeing responses enabled a wider cohort perspective to be established, and implementation of generic support.

I7.2 Meeting their needs? A qualitative exploration into the clinical support needs of mature therapeutic radiography students

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Background: Attrition in radiotherapy education is traditionally high [1]. A compounding factor is the changing demographic of learners joining Higher Education Institutions (HEI) with an increasing number of 'mature' students aged 21+ returning to academia [2]. Previous research across healthcare programmes identified mature students often struggle to balance their studies with 'other' commitments thus requiring additional or different models of clinical support than school leavers [3]. To assess the support needs of mature students within radiotherapy and help review existing models, the research aimed to explore mature student experiences of support on clinical placement.

Method: A qualitative method underpinned by a constructivist epistemology was adopted to explore through semi-structured interviews, the lived experiences of mature student therapeutic radiographers. Host HEI ethical approval was obtained and eligible students undertaking their training at a single radiotherapy department were invited to take part.

Results: 11 interviews were completed (two male and nine female, age-range 21-45, mean-age 32). Four key themes emerged from the data; i) established models of support, ii) placement challenges, iii) positive training environment and iv) programme changes. Overarching, the themes illustrate that timely communication and a flexible approach would help students balance their other commitments. The findings also provide recommendations to support mature students including a "buddy system".