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Supporting Imaging and Radiotherapy Practice
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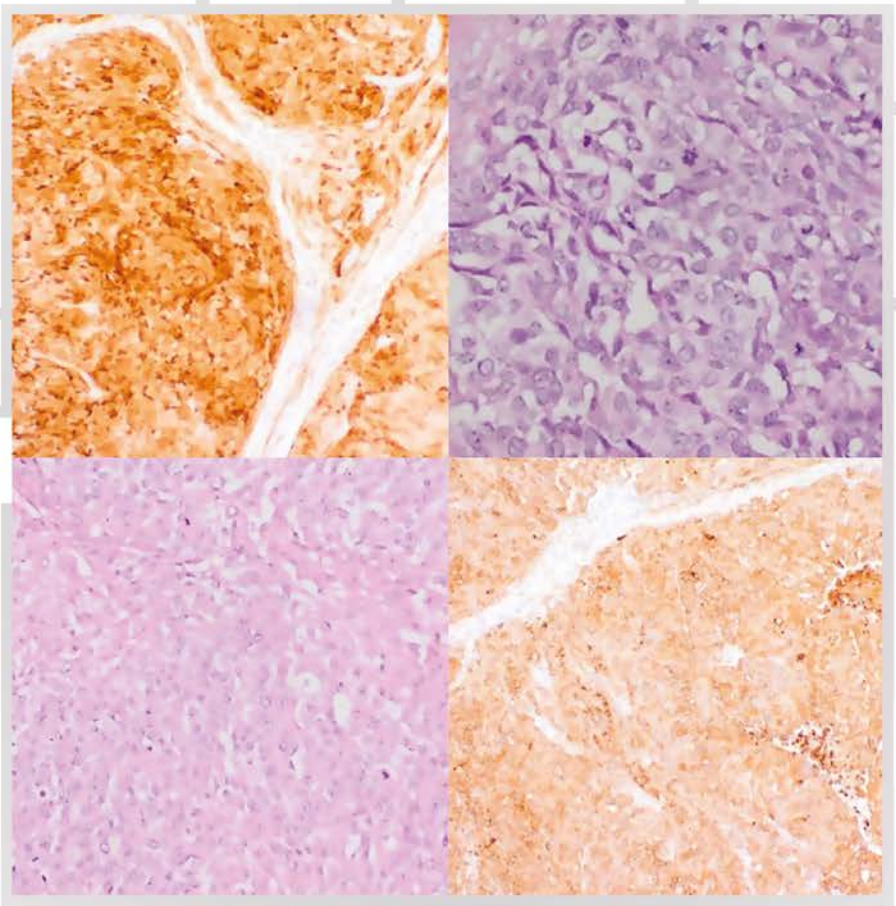

Rare multinodular epithelioid malignant mesothelioma

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Supporting Imaging and Radiotherapy Practice

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Physical exercise and radiotherapy

How might interaction with physical exercise support the quality of life of women receiving radiotherapy for breast cancer?

Lily-May Jeavons

Although research has explored the impact of physical exercise on aspects of the quality of life of breast cancer patients receiving radiotherapy – such as fatigue, physical function, body composition, strength and metabolic function – there is a scarcity of research on how physical exercise impacts all aspects of quality of life. This paper aims to gather insights on various quality-of-life dimensions to identify the most effective and beneficial forms of physical exercise for breast cancer patients to enhance their holistic wellbeing whilst encompassing their survival and oncological outcome.

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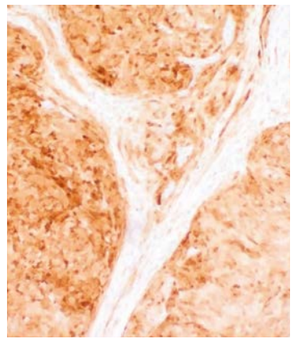
Abdominal radiographs

Seeing beyond obstruction: the hidden value of the abdominal radiograph

David Skinner, Hameed Rafiee, Doug Appleby

Plain abdominal radiography has historically played a central role in the assessment of acute abdominal complaints. Although its utility has diminished in the era of widespread cross-sectional imaging, this case demonstrates that abdominal radiographs can still yield critical diagnostic information, such as the presence of intramural gas, a critical finding that can demonstrate bowel ischaemia. Pneumatosis intestinalis, while rare, is an important radiological sign and must not be overlooked. It may also be associated with benign conditions but, in the correct clinical context, it should raise serious concern.



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Rare multinodular epithelioid malignant mesothelioma

Ultrasound presentation of a rare multinodular epithelioid malignant mesothelioma of the tunica vaginalis without asbestos exposure: a case report

Chidi Uchenna Ollawa, Eyo Akpan, Yannick Yangue, Ruchi Nasa, Emmanuel Abiola Babington, Ernest Ruto Upeh

Tumours of the tunica vaginalis include fibrous pseudotumours and malignant mesotheliomas. They both primarily affect middle-aged men and are characterised by painless nodules and scrotal enlargement. The common sonographic appearance suggestive of malignant mesothelioma of the tunica vaginalis includes the presence of singular painless nodules in the tunica vaginalis with hydrocele. This case report aims to present a multinodular variant of malignant mesothelioma of the tunica vaginalis associated with a complex hydrocele.

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Advanced practice accreditation

Two routes to NHS England advanced practice accreditation: the sonographer's perspective

Cat Lee, Nicki Davidson

Radiographers and sonographers are well placed to develop into advanced practice (AP) roles to provide flexibility and strengthen the imaging workforce. Following an accredited route of AP gives employers and patients confidence that an individual has achieved all of the necessary training and educational components to hold the title of advanced practitioner. For those involved in workforce development, the opportunity to recognise those currently in AP roles should be encouraged. This personal reflection from two sonographers explores two different routes to gaining an NHS England-accredited digital badge.

Also in this issue

New learning

Regulars

Issue 17
Autumn
September 2025

Save your learning with *Insight* magazine

Plan, record and evaluate your learning with CPD Now

Insight is the official CPD publication of the Society and College of Radiographers. Our vision is to share research, knowledge and timely evidence of best clinical practice, while providing readers with opportunities for CPD that are relevant to the world of diagnostic and therapeutic radiography.

The emphasis is on practical applications of new ideas to inspire clinical practice as well as encourage role development and highlight advanced practice.

Submissions are welcome from authors with any level of writing experience – part of our role is to be a "gateway" publication for new and developing authors, continuing to build the capabilities of radiographers and the wider evidence base for professional practices. Typical contributions include primary research articles, systematic and narrative literature reviews, case studies, posters and communication pieces to report new developments, as well as correspondence. To find out more, see the guidelines for authors on page 49 or visit *www.sor.org/insightauthor*.

An important part of the *Insight* mission is to provide learning in practical ways and to make it as easy as possible for you to start and record your CPD journeys. Many of the articles will end with a short section offering a list of key points or questions for your own personal reflection (see box).

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Displaying the breadth and richness of our profession

Guest editorial

Editorial Board member Ann Heathcote introduces the autumn edition of *Insight*

It is a pleasure to welcome you to the latest edition of ***Insight***, which, as always, presents a wide range of subjects that reflect the diversity of our profession. From projectional radiography to radiotherapy, this issue offers something for everyone.

This edition features seven articles. In the first, Lily-May Jeavons considers radiotherapy and examines the benefits of physical exercise for patients undergoing treatment for breast cancer, with a particular focus on quality of life and wellbeing.

Our second article, from David Skinner and colleagues, presents a case study demonstrating the vital role projectional radiographs play in managing acutely unwell patients, while also addressing the challenges posed by limited resources within radiology services.

"The wide range of subjects reflects the diversity of our profession – there is something for everyone"

The third submission, by Karolina Czescik, reflects on the importance of robust mentoring and leadership support for radiographers in reporting roles. Drawing on the author's personal experience as a CT head reporter, the article focuses on the importance of mentoring support and highlights the benefits of engagement with the special interest groups (SIGs) as part of this.

Our fourth article, by Chidi Uchenna Ollawa and colleagues, presents a fascinating ultrasound-based case study of a rare mesothelial tumour of the tunica vaginalis.

Our fifth article, by Cat Lee and Nicki Davidson, turns to the topic of advanced practice accreditation, discussing the available routes and the challenges that can accompany them.

The penultimate contribution, from Michael Williams and his team, explores the field of interventional radiography and its relationship with advanced practice. The authors highlight the importance of continued workforce development in this area, both to support patient pathways and to enhance professional growth.

Finally, Yaseen Obaid returns to one of the first examinations many diagnostic radiographers encounter: the chest X-ray. The paper considers how important this examination is in supporting clinical decision-making and investigates how confident radiographers feel when interpreting these images for nasogastric tube position.

I hope you enjoy this thought-provoking edition of ***Insight***. It highlights the breadth and richness of our profession – qualities that were among the key attractions that first drew me to the field of radiography. ■

About the author

Ann Heathcote is the Diagnostic Imaging Specialist Advisor for Alliance Medical. Following her early career in general radiography, Ann specialised in CT and MRI. She has particular interests in radiation protection and forensic imaging, and is motivated by a commitment to ensuring imaging is delivered safely, effectively and to the highest standards.

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Physical exercise and radiotherapy

How might interaction with physical exercise support the quality of life of women receiving radiotherapy for breast cancer?

Lily-May Jeavons

Breast cancer (BC) is the most prevalent cancer type in the UK, with one in seven women being diagnosed in their lifetime[1]. The World Health Organization (WHO) reported that 2.3 million women were diagnosed with BC in 2020[2]. While there has been a significant rise in the occurrence of BC over the past 20 years, the mortality rate has been reduced, in part, by the implementation of screening[3].

Yet, although preventative measures provide clinical management before diagnosis, the quality of life (QoL) of BC patients during treatment is deteriorating[4]. QoL is defined by the WHO as "individuals' perceptions of their position in life in the context of the culture and value systems in which they live and about their goals, expectations, standards and concerns"[5]. This encompasses aspects of an individual's wellbeing, including physical health, psychological status, autonomy, beliefs, and how they interact with their surrounding environment. Physical exercise (PE) benefits and enhances QoL, contributing to positive health – physically, socially and emotionally[6].

Furthermore, PE is defined as engaging in movement and activities to maintain one's physical wellbeing and health[7]. Incorporation of PE for BC patients could therefore enhance QoL, ensuring better survival and oncological outcomes and focusing on a more holistic patient pathway[8-10].

Although research has explored the impact of PE on aspects of QoL – such as fatigue, physical function, body composition, strength and metabolic function – for BC patients receiving radiotherapy (RT), there is a scarcity of research on how PE impacts all aspects of QoL. This paper aims to gather insights on various QoL dimensions and identify the most effective and beneficial forms of PE for BC patients to enhance their holistic wellbeing whilst encompassing their survival and oncological outcome.

Furthermore, the systematic review (SR) aims to answer the research question exploring the potential impact of PE on QoL for women receiving RT for BC.

Method

An SR was conducted following PRISMA to investigate the effect of PE on the QoL of women receiving RT for BC[11]. The aim was to recognise unexplored aspects of existing literature and further implement the intervention into practice.

Pilot search

A pilot search was conducted in March 2023 to ascertain how feasible a study would be. This was beneficial as it allowed for a sample search in advance to test how feasible or acceptable the study might be on a larger scale[12]. Search terms were extracted from the research question: 'physical exercise', 'breast cancer', 'radiotherapy' and 'quality of life'. These were filtered to articles published at any time and later refined to 10, five and two years as well as since 2023. Other key terms 'menopausal', 'pre-menopausal', 'resistance training' and 'aerobic training' were additionally filtered. The number of articles and refinements are demonstrated in Table 1.

Search terms

In March 2024, the search terms: 'physical exercise', 'breast cancer', 'radiotherapy' and 'quality of life' were entered into PubMed, Cochrane Library, Ovid and AMED.

The Boolean operator 'AND' was used to shape results, providing a relationship between the search terms and identifying articles most pertinent to the SR[13].

Search criteria and screening process

Articles were selected using the inclusion and exclusion criteria outlined in Table 2, and phase-one screening was carried out, demonstrated in Flowchart 1. Duplicates and outstanding SRs were eliminated from the results to avoid the introduction of bias »

Table 1. Pilot search

Search terms	Time of article publication	Total number of articles
Physical exercise, breast cancer, radiotherapy and quality of life	Any time	86,400
Physical exercise, breast cancer, radiotherapy and quality of life	2013-2023	17,600
Physical exercise, breast cancer, radiotherapy and quality of life	2018-2023	17,400
Physical exercise, breast cancer, radiotherapy and quality of life	2022-2023	17,300
Physical exercise, breast cancer, radiotherapy and quality of life	Since 2023	3,670
Physical exercise, breast cancer, radiotherapy, quality of life and menopause or menopausal	Any time	85,100
Physical exercise, breast cancer, radiotherapy, quality of life and pre-menopausal	Any time	5,960
Physical exercise, breast cancer, radiotherapy, quality of life and resistance training	Any time	29,600
Physical exercise, breast cancer, radiotherapy, quality of life and aerobic exercise	Any time	23,500

Table 2. Inclusion and exclusion criteria

	Inclusion criteria	Exclusion criteria
Date	Only articles published between 2019 and 2024 will be used because they are more time bound.	Any articles not published within this period will be excluded, given that they will not be as closely related to or relevant to the present population. As well as this, practice evolves and changes so current data is needed.
Full text	Articles that contain the full text and so the full data. This is to avoid misinterpretation due to loss of data that may have been excluded. This reduces the chance of bias.	Articles that do not contain full text cannot be analysed given they lack the in-depth information that is necessary for the study to be valid and so reliable.
Language	Only English-language articles will be used so reliability can therefore be accurately assessed.	Any non-English-language articles will be excluded given that this opens the systematic review up to transcription errors which could lead to raw data being invalid.
Patient diagnosis	Only breast cancer patients will be used as exercise may affect other diagnosis differently.	Non-breast cancer diagnosis will be excluded as results may differ to the initial research question.
Peer reviewed	All articles included must be peer reviewed, this reduces the chance of bias.	Articles that have not been peer reviewed as they could be deemed unreliable.
Treatment type	Patients undergoing RT and other cancer treatments will be included as this ensures the same variable is being tested.	Those not undergoing any RT at all will be excluded as this will be invalid.

Flowchart 1. Inclusion and exclusion criteria

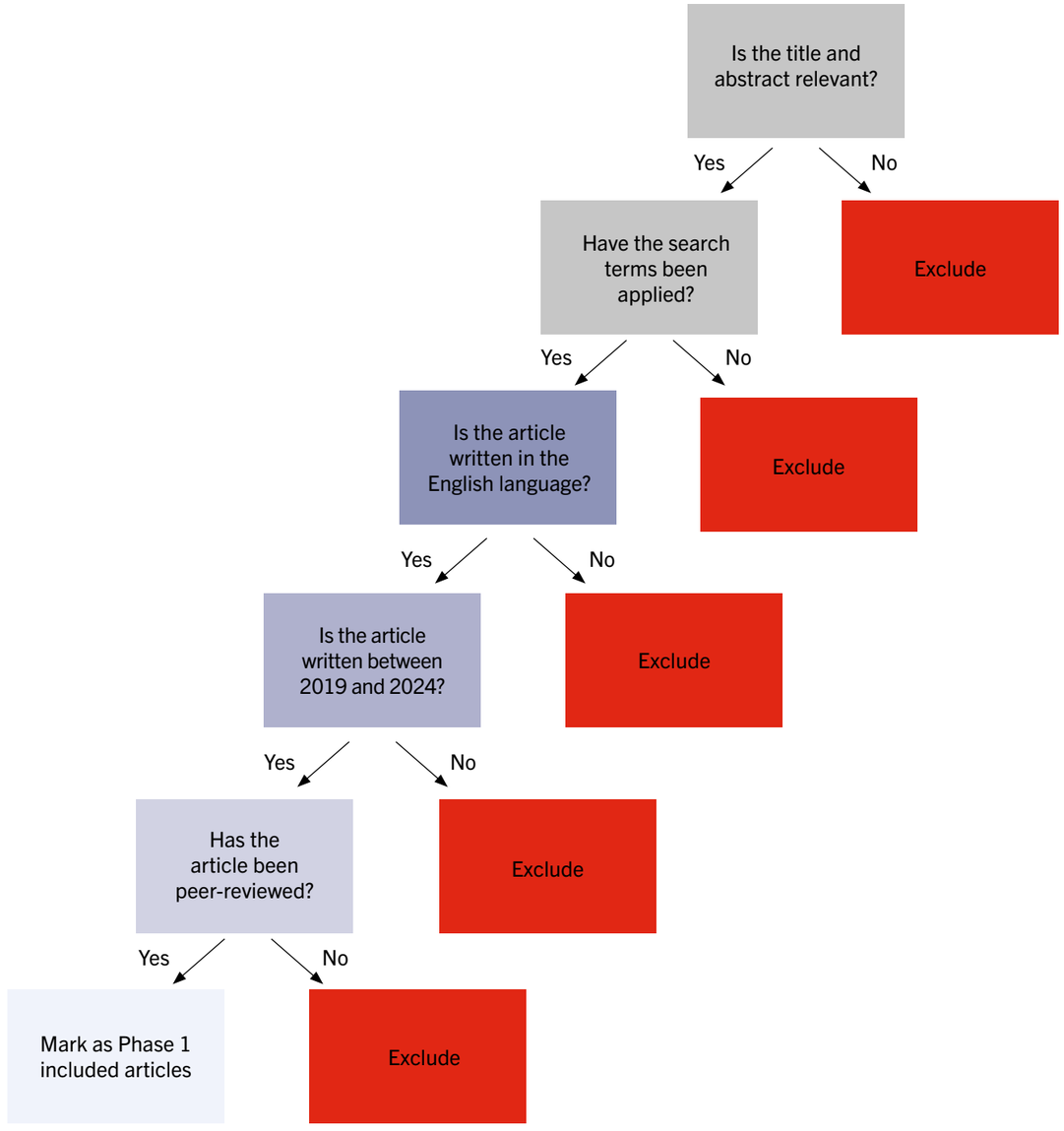
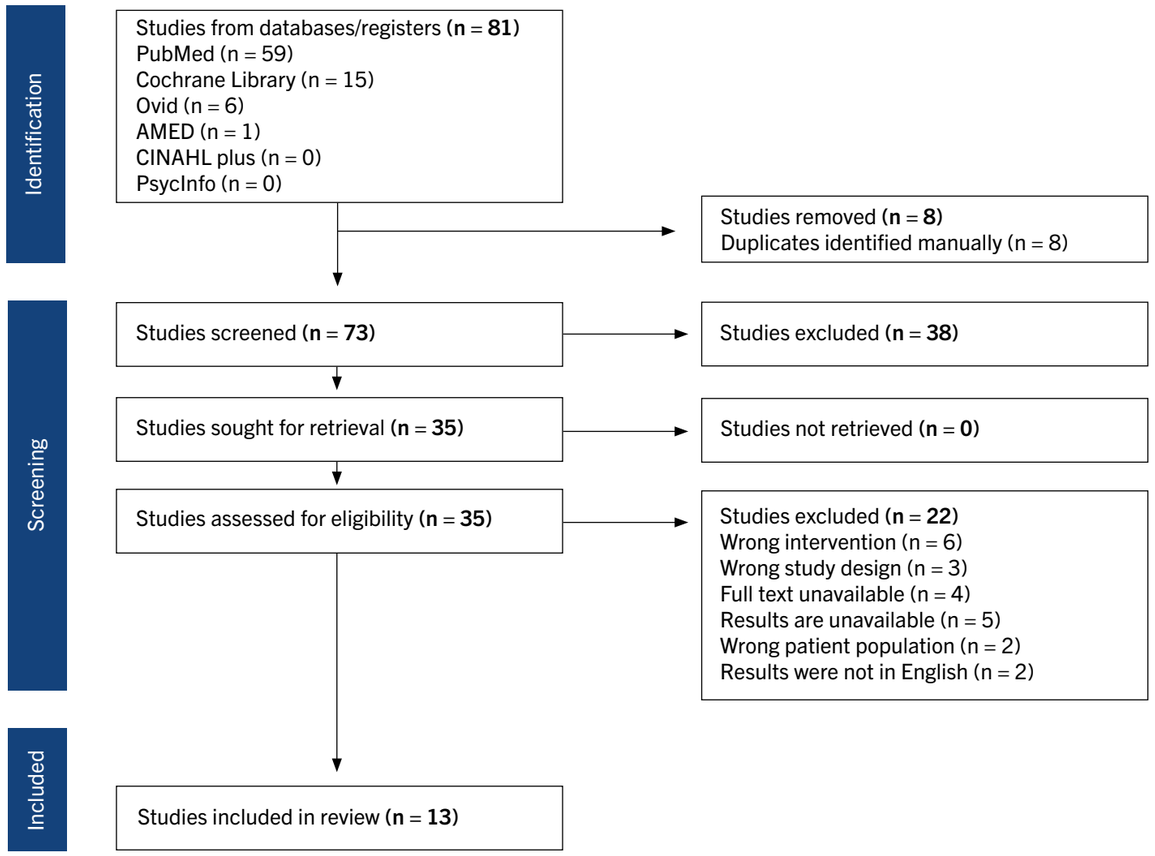


Figure 1. Search strategy decision-making model



into primary research[14]. The selected articles were then further screened in concordance with their relevance to the search terms, displayed in Figure 1. Phase-two screening was carried out, implicating the Critical Appraisal Skills (CASP) checklist[15]. This was to further infer the inclusion and exclusion criteria and assess the quality appraisal of articles[16].

All retrieved articles were assessed and classified by theme, which is demonstrated in Table 5. In terms of ethics, all reviewed articles were examined for ethical approval and consideration, adhering to good research practice.

Results

Seventy three articles were found within the search, whereby 35 full-text articles were reviewed (Table 3 and Table 4) and 13 were analysed (Table 5).

Discussion

The following subheadings were extracted from themes identified in the reviewed articles summarised in Table 6, allowing for analysis to obtain an understanding of behaviours across a data set[17].

Level of intensity

The intensity of PE is extensively explored in the reviewed literature. Discussions encompass moderate and high-intensity training, including cardiorespiratory fitness, high-intensity interval training (HIIT), moderate-intensity continuous training (MICT), resistance training and aerobics, all in relation to QoL aspects[18-21].

Engaging in moderate-intensity exercise with a focus on aerobics has shown yield in significant benefit across QoL but also contributes to positive adaptations in body weight and composition as well as muscular strength[20,21]. Furthermore, physical wellbeing is improved significantly by 95% when BC patients undergoing RT take part in continuous training[18]. This underscores the potential of long-term enhancement of QoL through BC patients' participation in PE. Additional data indicates that elements of QoL, such as improved sleep quality, alleviated anxiety and depression, can be gained through engagement in moderate intensity PE, mirroring the reviewed article findings[22]. As these studies were conducted within a clinical setting, the implications for practice suggest that such rehabilitative support could additionally be provided for BC patients, improving effectiveness and efficiency of healthcare[23].

Participating in high-intensity football training at 80-90% of maximum heart rate shows no significant changes in overall resting heart rate, which is an aspect of QoL[19]. However, it is important to note that BC patients undergoing HIIT had improved cardiovascular fitness[18]. This indicates that the success of differentiating modalities of high-intensity training may have varying impacts on cardiovascular QoL elements of BC patients. In terms of high-intensity training, HIIT consists of short bursts of intense exercise followed by a rest or lower-intensity exercise. This may be more beneficial for BC patients as it is time efficient, improves oxygen uptake, enhances muscle strength and reduces fatigue and psychological symptoms of

Table 3. Included articles

Article information	Scope	Key points	Strengths	Weaknesses
1) Carpenter et al. (2024). EXERT BC: A pilot study of an exercise regimen designed to improve functional mobility, body composition, and strength after the treatment for breast cancer. https://www.ncbi. nlm.nih. gov/pmc/ articles/PMC10943368/	**Include** – high-intensity compound exercises impact on QoL of BC patients who have undergone treatment. Whilst consideration paid to ethical concerns such as safety and adherence of patients.	Significant enhancements in body composition, including reduced body fat and increased muscle mass, along with elevated metabolic rate, enhanced muscular strength, improved balance, functional mobility and increased QoL were observed in BC patients, resultant of engaging in high-intensity compound exercise. This underscores the potential of an MDT approach in bolstering oncological survivorship. Tailored exercise recommendations for patients should consider factors such as comorbidities, functional status, cancer-specific risk mitigation and ongoing treatments to optimise outcomes and enhance overall QoL of BC patients. Specific aspects of QoL such as functional mobility and balance are particularly pertinent for BC patients as they may reduce the risk of falls and fractures associated with anti-oestrogen therapy. Improvements in QoL questionnaire scores may mirror corresponding enhancements in self-perceived functional mobility improving QoL.	Provides insight into a fair range of QoL elements. Shows an overall holistic approach that high-intensity compound exercises can have on the QoL of BC patients undergoing treatment. Results show attendance at 72.2% to the programme, highlighting the reliability of the study and its potential to be implicated into practice.	It is difficult to determine the extent of selection bias that could arise from the substantial time and logistical demands associated with 3x weekly sessions lasting up to one hour. Furthermore, randomisation of sample may attract a more motivated, resourceful population, potentially limiting the generalisability and reliability of the study's findings. In addition, there is an inherent risk of type-one error due to the numerous outcomes assessed through the t-test, which could compromise the validity of the study. The study also focuses specifically on high-intensity training; this questions whether similar results would be drawn for all types of PE.
2) Kirkham et al. (2019). Maintenance of fitness and quality-of life benefits from supervised exercise offered as supportive care for breast cancer. https://jnccn.org/v iew/ journals/jnccn /17/6/article p695.xml	**Include** – study delivered in real-world conditions of an exercise intervention (aerobic and resistance of moderate intensity) for BC patients undergoing treatment with a one-year follow up.	Implementation of supervised aerobic and resistance training of a moderate vigorous intensity baseline three times per week until the end of treatment shows improvements in the following elements: maintained QoL and body weight whilst strength improved. By the end of the programme, heart-rate recovery, waist circumference and QoL were improved. In follow-up (one year post treatment), QoL and waist circumference were all maintained, demonstrating PE in a study reflective of the real world has a long-term impact on the QoL of BC patients.	The single-arm design was specifically chosen due to its imitating the procedures of a real-world clinic so would attract a sample reflective of this. Ensures the generalisability, hence, validity and reliability of results.	There was no control group so intervention could not be compared with those who did not take part. This questions the study's credibility.
3) Dong et al. (2019). The effects of the combined exercise intervention based on internet and social media software (CEIBISMS) on quality of life, muscle strength and cardiorespiratory capacity in Chinese postoperative breast cancer patients: a randomized controlled trial. https://www.ncbi. nlm.nih. gov/pmc/	**Include** – investigates how internet and social media delivery of combined exercise can improve the QoL of BC patients.	Introducing internet and social-media-based PE programmes for BC patients has a rehabilitative effect in QoL and muscle strength of postoperative BC patients undergoing treatment. Results reveal that implication of PE improves the following elements of QoL: mental health, vitality, physical functioning, muscle strength and reported health transition.	Clear ethical consideration of patients is recognised, and an MDT approach used physiotherapists, therefore reflective of clinical practice. A smaller-scale preliminary study was taken prior to the study, supporting its credibility.	There was no follow-up study therefore the study time may have been too short to see the potential further benefits of social media and internet-led exercise programmes for BC patients.
4) Zhang et al. (2023). Effect of multimodal exercise on cancer-related fatigue in patients undergoing simultaneous radiotherapy and chemotherapy: a randomised trial in patients with breast cancer. http://alternative therapies. com/oa/ index.html?fid=8194	**Include** – effects of multimodal exercise on cancer-related fatigue in BC patients.	Multimodal exercise therapy administered to BC patients undergoing both RT and chemotherapy improves overall QoL. This type of PE mobilises physical function, providing mental distraction. Although no significant effect on anxiety was noted, there was, in fact, alleviation of depression and reduction in insomnia. The results showed physical, emotional and overall QoL of BC patients can be improved by the application of multimodal exercises.	The study consisted of a control group as well as an experimental group, allowing for validity of results in terms of PE impact on QoL-related elements. Ethical consideration is paid due to the study stating informed consent was given. An MDT approach was implemented in the experimental group intervention, reflective of clinical practice.	As patients volunteered to take part in the study, this could attract a certain patient population with various characteristics making results less generalisable. A small sample size was obtained as well as a lack in follow-up. Therefore, the long-term effects of the intervention were not assessed.
5) Dong et al. (2020). A longitudinal study of a multicomponent exercise intervention with remote guidance among breast cancer patients. https://www.ncbi. nlm.nih. gov/pmc/ articles/PMC7277866/	**Include** – longitudinal multicomponent exercise using remote guidance, looking at the effect on QoL, muscle strength, cardiorespiratory endurance and physical activity barriers after one year.	This study focuses on the long-term effects of Dong et al. (2019). It reveals that, after one year, participants in the remote multi-component exercise intervention reported higher vitality-related QoL, mental-health related QoL, leg strength and endurance, and strength and endurance of the upper extremities as well as lower physical activity hindrance. These significant differences suggest that multicomponent exercise intervention carried out remotely has long-term health benefits for those who have undergone BC treatment.	This is one of the only longitudinal studies evaluating the long-term beneficial effects of remote multicomponent exercises. This is significant as it provides a reference for the implementation of postoperative rehabilitation for BC patients, hence supporting future practice.	Follow-up was only one year post intervention so, in terms of the scale of time, is this long-term enough to be drawing such conclusions.
6) Ahn et al. (2020). Physical activity status in relation to quality of life and dietary habits in breast cancer survivors: subset analyses of KROG 14-09 nationwide questionnaire study. https://link.springer.com/ article/10. 1007/s11136-020-02585-4	**Include** – assesses a range of intensity of PE with dietary habits and QoL in BC patients.	PE of 150-450min/week (regular exercise) and dietary habits have a positive impact on QoL of BC patients. However, moderate and marked exercise beyond 450min/week did not significantly improve QoL. In addition, a relationship between PE and other socio-demographic and dietary habits were noted, revealing that intake of fruits and vegetables and reluctance to consume fatty foods were related to the physical activity groups. Moreover, those who had undergone a mastectomy exhibited moderate physical activity. It is suggested those who have undergone intensive therapies might tend to worry about health and look for alternatives to enhance health status.	The study was approved by the Institutional Review Board at each centre and informed consent was obtained, meaning ethical consideration was made.	QoL and physical activity were measured without baseline information. Moreover, due to a strict analysis, exaggerated data (those doing 4x the PE expected) were excluded. Therefore, exclusion of hyperactivity data may skew results, reducing reliability.

7) Isanejad et al. (2023). Comparison of the effects of high-intensity interval and moderate intensity continuous training on inflammatory markers, cardiorespiratory fitness and quality of life in breast cancer patients https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10658315/	**Include** – HIIT versus MICT for BC patients undergoing treatment and examining how PE impacts various aspects of QoL.	Both HIIT and moderate-intensity continuous training (MICT) significantly increased high-density lipoprotein cholesterol levels and emotional wellbeing. Moreover, physical wellbeing increased significantly in the MICT group compared with the control group and function wellbeing score increased in the HIIT group compared with the control. In both groups (HIIT and MICT), there was a significant increase observed in the functional assessment of cancer therapy general scores compared with the control. This concludes HIIT improves cardiovascular fitness in BC patients whilst both MICT and HIIT enhance QoL.	A clear decision-making model is presented as a diagram showing the sample and how they were split up within the intervention.	AI (artificial intelligence) was used in the design of the study, data collection, data analysis and manuscript writing. Use of AI lacks creativity and so various ideas may have been missed or not expanded on in depth.
8) Kokkonen et al. (2022). Factors predicting long-term physical activity of breast cancer survivors. 5-year follow-up of the BREX exercise intervention study. https://www.tandfonline.com/doi/full/10.1080/028418 6X.2022.2103388	**Include** – investigates factors associated with PE after adjuvant treatment and during a 5-year follow up.	PE after BC treatment is highly associated with the amount of leisure physical activity the individual took part in prior to diagnosis. Factors affecting how much PE was carried out post treatment were: QoL, baseline fitness and age. Moreover, 5-years later PE remains stable for these individuals. This is explained by motivators such as: weight management, body image and health improvements which all play a role in improving QoL.	Informed consent was gained by all participants, hence providing ethical consideration . All medical histories were recorded at baseline therefore ruling out any confounding factors that may influence PE.	All participants are mainly physically active contributing to a ceiling effect to improve PE during the intervention and also after.
9) Mavropalias et al. (2023). The effects of home based exercise therapy for breast cancer related fatigue induced by radical radiotherapy.	**Include** – assesses the feasibility and effectiveness of remote (home-based) resistance and aerobic training in reducing fatigue and improving QoL in BC patients undergoing RT.	All RT-related adverse effects occurred with participants in the PE group. Cancer-related fatigue was present at baseline for both groups, during RT there was no improvement in control group but PE group had less fatigue in comparison to baseline. Post-RT and at six weeks being more fatigued was associated with greater RPE (rating of perceived exertion) during resistance training while having less fatigue was related to longer aerobics exercise (duration). In terms of QoL, only the PE group improved as early as six weeks post-RT in comparison with baseline. Moreover, poor QoL was associated with greater RPE during resistance training. The score for sleep duration and quality for each of the groups did not change throughout the intervention. PE increased for the PE group at six weeks, six months and 12 months post-RT. Yet there were no significant differences between the groups in terms of PE. This reveals small duration of exercise can result in an improvement of QoL and fatigue levels.	Randomisation of participants was carried out by a researcher who had no contact with the participants, reducing researcher bias that could potentially skew results, making them less valid.	There was already fatigue experienced by patients at baseline, which may have been caused by other treatments. This reduces the credibility of the study just measuring fatigue and QoL for RT.
10) Adams-Campbell et al. (2023). An 8-week exercise study to improve cancer treatment, related fatigue and QoL among African American breast cancer patients undergoing radiation treatment: a pilot randomized clinical trial. https://www.sciencedirect.com/science/article/pii/S0027968423000184?via%3Dihub	**Include** – assesses the feasibility of implementing moderate-intensity PE alongside RT and its impact on QoL and fatigue, whilst gaining insight to adherence and acceptability of a PE intervention for BC patients.	A 75% acceptability of and adherence to PE was achieved by African American women undergoing RT for BC. Emotional wellbeing showed improvement in those undergoing PE compared with the control group from baseline to eight weeks. Similarly, the PE group had higher QoL after eight weeks. Among the non-PE group, fatigue worsened although this was not significant.	All participants received informed consent following ethical considerations. In addition, there was a control group, allowing PE to be measured accurately. Follow-up assessments coincided with treatment appointments, avoiding loss of appointments and reducing time spent for the participants.	The participant population is primarily obese, for both the control and intervention group. This group is not reflective of all BC patients and therefore reduces generalisability of results.
11) Jacot et al. (2020). Brief hospital supervision of exercise and diet during adjuvant breast cancer therapy is not enough to relieve fatigue: a multicenter randomized controlled trial. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7600233/	**Include** – providing aerobic and muscle training exercises along with dietary advice to early BC patients to assess and address levels of fatigue.	Fatigue is related to level of precariousness yet no significant difference was found between each of the groups in terms of fatigue. The group that underwent exercise and diet training at the end of the intervention reported a lower proportion of individuals with confirmed depression. This suggests a proactive diet-exercise care regime should be introduced to BC patients who have the tendency of being a precarious patient.	Patients were given the option of modality of aerobic exercise, this allowed for sustainability and adherence to the programme. This benefits the results received, making conclusions more valid.	There was a large dropout rate in one of the arms of the study and 17% discontinued the study early.
12) Uth et al. (2020). Exercise intensity and cardiovascular health outcomes after 12 months of football fitness training in women treated for stage I-III breast cancer: results from the football fitness after breast cancer (ABC) randomized controlled trial. https://www.sciencedirect.com/science/article/abs/pii /S0033062020301547?via%3Dihub	**Include** – exercise intensity and the impact of recreational football training on the QoL of BC patients being treated.	Football training, a high-intensity PE, led to improvements in self-perceived health limitations on daily activities after six months. Yet taking part in one year of weekly training did not result in improvements of CRF, blood pressure, blood lipids, fat mass or resting heart rate.	There was eligibility screening to see if patients were fit for the trial as well as baseline assessment. Six months later and 12 months later, a follow-up took place assessing each element at different time periods, measuring the long-term effect of the study.	Attendance of the football sessions was low because training sessions were only at certain times of the week. Therefore, the study was not very flexible and fewer results were received for the participants, reducing the validity of the study.
13) Gjerset et al. (2023). Health related quality of life, fatigue, level of physical activity and physical capacity before and after outpatient rehabilitation program for women within working age treated breast cancer. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10234893/	**Include** – women of working age completed primary curative therapy for BC and completed questionnaires on QoL after a weekly educational, fitness and group intervention.	BC patients of working age who participated in a rehabilitation programme demonstrated statistically significant enhancements in QoL, level of fatigue, physical activity and capacity. In terms of significance, improvements were observed in patient-reported outcomes (PROMs) for over 40% of the patients. A lower level of education was correlated with clinically relevant enhancements in emotional functioning, whilst living alone was linked to clinically significant improvements in mental fatigue.	Baseline variables were collected from a medical database, ensuring no confounding variables would influence data retrieval, enhancing the validity of the results and conclusions drawn.	A control group was not present so no causal conclusions can be drawn from the results.

Table 4. Excluded articles

Article information	Include/exclude
1) Feighan et al. (2023). Practitioner perception on the use of exercise and nutritional interventions for patients with breast cancer receiving radiation therapy. https://onlinelibrary.wiley.com/doi/10.1002/jmrs.713	**Exclude** – study aimed at healthcare professionals and whether they advocate PE to their patients, therefore wrong participant group.
2) Tam et al. (2023). Feasibility of a health coach intervention to reduce sitting time and improve physical functioning among breast cancer survivors: pilot intervention study. https://cancer.jmir.org/2023/1/e49934	**Exclude** – focuses on reducing the sitting time of patients so, therefore, too specific for a general overview on PE impact on BC patients.
3) Cuvelier et al. (2023). Preliminary feasibility and efficacy study of a programme of adapted, supervised water polo to reduce fatigue and improve women's psychological and social recovery after breast cancer treatment: a mixed-methods design. https://www.sciencedirect.com/science/article/pii/S2451865423000662?via%3Dihub	**Exclude** – focuses on adaptation of a water polo programme, therefore the wrong intervention.
4) VanderWalder et al. (2021). Randomized phase II study of a home-based walking intervention for radiation-related fatigue among older patients with breast cancer. https://www.geriatriconcology.net/article/S1879-4068(20)30440-9/abstract	**Exclude** – focuses on a home-based walking intervention impact on fatigue so is, therefore, too specific to draw conclusions about PE impact for BC patients.
5) Natalucci et al. (2023). Movement and health beyond care, MoviS: study protocol for a randomized clinical trial on nutrition and exercise educational programs for breast cancer survivors. https://trialsjournal.biomedcentral.com/articles/10.1186/s13063-023-07153-y	**Exclude** – focuses on nutrition in-depth and PE impact on BC not PE alone so, therefore, misleading conclusions about PE could be drawn as the study focuses on nutritional benefit.
6) Deveautour-Roy et al. (2022). Predictors of women's attendance in a home-based adapted physical activity program during localized breast cancer treatment. https://link.springer.com/article/10.1007/s00520-022-07417-4	**Exclude** – the objective of the study was to evaluate potential predictors for attendance of physical activity at home, therefore wrong intervention.
7) Nguyen and Patel (2019). The effect of exercise training on breast cancer patients: a review. https://www.dl.begellhouse.com/journals/757fcb0219d89390,594d39ec5eb9413f,6a09e31417b50c3c.html	**Exclude** – a systematic review cannot be included as a primary study in another systematic review. Also, a full text was unavailable.
8) Postigo-Martin et al. (2021). Attenuating treatment-related cardiotoxicity in women recently diagnosed with breast cancer via a tailored therapeutic exercise program: protocol of the ATOPE trial. https://academic.oup.com/ptj/article/101/3/pzab014/6124131	**Exclude** – focuses on cardiotoxicity after PE, too specific for conclusions to be drawn about overall QoL of BC patients.
9) DeVrieze et al. (2020). Physical activity level and age contribute to functioning problems in patients with breast cancer-related lymphedema: a multicentre cross-sectional study. https://link.springer.com/article/10.1007/s00520-020-05375-3	**Exclude** – focuses specifically on BC-related lymphedema, which is too specific for an overview of QoL.
10) Touillaud et al. (2021). Connected device and therapeutic patient education to promote physical activity among women with localised breast cancer (DISCO trial): protocol for a multicentre 2×2 factorial randomised controlled trial. https://bmjopen.bmj.com/content/11/9/e045448	**Exclude** – focuses on four interventions and involves use of a web-based connected device with an activity tracker, which was reported as not validated for monitoring physical activity.
11) Bruce et al. (2022). Exercise to prevent shoulder problems after breast cancer surgery: the PROSPER RCT. https://www.journalslibrary.nihr.ac.uk/hta/JKNZ2003#/abstract	**Exclude** – study carried out 2016–2017 and focuses only on upper limb problems, not whole QoL, while paying particular attention to cost and workflow, not necessarily the outcome for BC patients. As well as this, in-depth full text was unavailable.
12) Joaquim et al. (2022). Impact of physical exercise programs in breast cancer survivors on health-related quality of life, physical fitness, and body composition: Evidence from systematic reviews and meta-analyses. https://www.frontiersin.org/journals/oncology/articles/10.3389/fonc.2022.955505/full	**Exclude** – a systematic review, so therefore cannot be included within the systematic review.
13) Shen and Yang (2020). Impact of post-radiotherapy exercise on women with breast cancer: a systematic review and meta-analysis of randomized controlled trials. https://medicaljournalssweden.se/jrm/article/view/3734	**Exclude** – a systematic review, so therefore cannot be included within the systematic review.
14) Chazarra and Vila (2023). Influence of physical activity on radiotherapy-treated breast cancer patients: a systematic review. https://www.sciencedirect.com/science/article/abs/pii/S2603647922000525?via%3Dihub	**Exclude** – a systematic review, so therefore cannot be included within the systematic review.
15) Lavín-Pérez et al. (2023). High-intensity exercise prescription guided by heart rate variability in breast cancer patients: a study protocol for a randomized controlled trial. https://bmcsportsscimedrehabil.biomedcentral.com/articles/10.1186/s13102-023-00634-2	**Exclude** – focuses specifically on cardiotoxicity and heart rate variability, which is too specific for an overview of QoL.
16) Torres, Koifman and Santos (2022). Impact on fatigue of different types of physical exercise during adjuvant chemotherapy and radiotherapy in breast cancer: systematic review and meta-analysis. https://link.springer.com/article/10.1007/s00520-022-06809-w	**Exclude** – a systematic review, so therefore cannot be included within the systematic review.
17) Costa et al. (2021). The influence of a supervised group exercise intervention combined with active lifestyle recommendations on breast cancer survivors' health, physical functioning, and quality of life indices: study protocol for a randomized and controlled trial. https://trialsjournal.biomedcentral.com/articles/10.1186/s13063-021-05843-z	**Exclude** – focuses on canoeing as a type of PE, which is too specific for a general overview of PE impact on BC patients QoL.
18) Hiensch et al. (2022). Design of a multinational randomized controlled trial to assess the effects of structured and individualized exercise in patients with metastatic breast cancer on fatigue and quality of life: the EFFECT study. https://trialsjournal.biomedcentral.com/articles/10.1186/s13063-022-06556-7	**Exclude** – focuses on palliative treatment. As well as this, conclusions have not yet been reported and published.
19) Torres et al. (2023). Effectiveness of mat Pilates on fatigue in women with breast cancer submitted to adjuvant radiotherapy: randomized controlled clinical trial. https://link.springer.com/article/10.1007/s00520-023-07824-1	**Exclude** – focuses on mat Pilates and, specifically, on fatigue, not on all aspects of QoL.
20) Abed et al. (2019). Impact of self-reported exercise on recounted levels of fatigue and anxiety in early-stage breast cancer radiation therapy patients. https://www.jmirs.org/article/S1939-8654(18)30323-0/abstract	**Exclude** – study has a small sample size hence is lacking in validity as well as the study not being randomised. Moreover, full-text is unavailable so rounded conclusions cannot be drawn.
21) Ren et al. (2022). Effects of physical exercise on cognitive function of breast cancer survivors receiving chemotherapy: a systematic review of randomized controlled trials. https://www.thebreastonline.com/article/S0960-9776(22)00068-6/fulltext	**Exclude** – a systematic review, so therefore cannot be included within the systematic review.
22) Piraux et al. (2020). Effects of exercise therapy in cancer patients undergoing radiotherapy treatment: a narrative review. https://journals.sagepub.com/doi/10.1177/2050312120922657	**Exclude** – focuses on all cancer patients not BC patients alone, too broad.

Table 5. Summary of included articles

Author	Year	Title	Theme	Summary	Strengths	Limitations
Carpenter et al.	2024	EXERT BC: a pilot study of an exercise regimen designed to improve functional mobility, body composition, and strength after the treatment for breast cancer.	QoL of BC patients engaging in high-intensity compound exercises.	This study explores how 3x weekly high-intensity compound exercises affect BC patients in terms of QoL aspects such as: mobility, metabolic function, muscle mass and body composition. Primary outcomes included ethical elements such as safety and adherence. Assessments and comparisons were carried out using a t-test. Results revealed reduction in body fat, increase in muscle mass, resting metabolic rate, bilateral grip strength and functional movement. In conclusion, high-intensity compound movements provide a safe and high-adhering form of PE that improves QoL for BC patients.	Explores a good range of QoL aspects whereby results are laid out for each element clearly.	Only focuses on high-intensity compound training so conclusions cannot be drawn for all kinds of PE.
Kirkham et al.	2019	Maintenance of fitness and quality-of-life benefits from supervised exercise offered as supportive care for breast cancer.	Maintenance of QoL in BC patients participating in moderate-intensity aerobic and resistance exercises.	Supervised aerobic and resistance training of moderate intensity carried out during treatment (three times a week) and 10 weeks later (once a week) has a positive effect on QoL of BC patients and continues to do so at one-year post-treatment assessment.	Accessible bar graphs with significant difference showing impact of PE on the various elements of QoL at baseline, treatment, end of programme and follow-up. In addition, a clear purpose of the study is set out enabling for exploration of the area.	An example of the RAND 36 QoL questionnaire was absent – this would further support the understanding of questions asked to the patient population and how the various QoL elements were being measured.
Dong et al.	2019	The effect of the combined exercise intervention based on internet and social media software (CEIBISMS) on quality of life, muscle strength and cardiorespiratory capacity in Chinese postoperative breast cancer patients: a randomized controlled trial.	Exploring the impact of internet and social-media-based interventions on enhancing the QoL of BC patients through PE.	A randomised controlled trial (of 12 weeks) used an app that recorded steps, online face-to-face muscle and cardiorespiratory training; frequent social-media apps delivered knowledge on PE BC rehabilitation. QoL was measured via a Short Form Health Survey. Results revealed improvement in QoL and muscle strength	Clear table demonstrated patient population demographics.	Lack of information about the step-recording app and who was delivering the face-to-face online exercises.
Zhang et al.	2023	Effect of multimodal exercise on cancer related fatigue in patients undergoing simultaneous radiotherapy and chemotherapy: a randomised trial in patients with breast cancer.	PE impact on QoL and cancer-related fatigue of BC patients undergoing RT and chemotherapy.	A study of BC patients undergoing chemotherapy and RT and how using multimodal exercises (aerobic, stretching, warm-up training and anti-group training) improved cancer-related fatigue and aspects of QoL. A general information questionnaire, cancer-related fatigue scale, hospital anxiety and depression scale and QoL scale were used as evaluation tools. Conclusions highlighted multimodal exercise relieves fatigue, reduces depression and improves QoL.	In-depth display of the multimodal motion activities is noted chronologically, showing what the experimental group participated in, in terms of PE.	The sample size is relatively small so may lack generalisability.
Dong et al.	2020	A longitudinal study of a multicomponent exercise intervention with remote guidance among breast cancer patients.	Longitudinal measure of remote PE on BC patients' QoL.	A longitudinal study (long-term benefits of Dong et al. 2019) with the aim of examining how effective 12 weeks of multicomponent exercise, carried out remotely, affects BC patients. QoL, muscle strength, cardiorespiratory endurance and physical activity barriers after one year were all measured. Results demonstrated that multicomponent exercise results in an increase of QoL, muscle strength, cardiopulmonary endurance and physical activity participation. Overall, it provided long-term health benefits for BC patients.	Clearly set out objectives prior to expanding on the study's methodology, allowing for introduction of key aspects prior to further analysis. Clear explanation of inclusion and exclusion criteria set out.	Results from Dong et al. (2019) are not included in the text. Reference of this study would have helped support findings of the long-term benefits of the current study, providing a more chronological timeline of events.
Ahn et al.	2020	Physical activity status in relation to quality of life and dietary habits in breast cancer survivors: subset analyses of KROG 14-09 nationwide questionnaire study.	Examining the influence of PE intensity levels and dietary habits on the QoL of BC patients.	QoL in early phase BC patients after adjuvant RT was measured according to their physical activity. They were divided into four groups: inactivity (0–140min/week), regular activity (150–450min/week), moderate activity (451–900min/week) and marked activity (901–1800min/week). Results revealed that frequent intake of fruit and vegetables was observed in the physically active groups. Mobility and anxiety were best in physically active groups also. Overall, only regular activity improved QoL.	Clear sample of population demographic is displayed in a table with comprehensive subheadings providing descriptive in-depth information.	Baseline information was not collected prior to the study on QoL and physical activity so there is a lack of thorough analysis in these areas.
Isanejad et al.	2023	Comparison of the effects of high-intensity interval and moderate-intensity continuous training on inflammatory markers, cardiorespiratory fitness and quality of life in breast cancer patients.	Comparing HIIT and MICT on the QoL of BC patients undergoing treatment.	A randomised controlled trial with three arms: HIIT, MICT and a control group all undergoing BC treatment. The intervention took place over 12 weeks, whereby the following were measured: peak oxygen uptake, body composition, functional capacity, cardiorespiratory fitness (CRF), metabolic indices, sex hormones, adipokines, inflammatory markers and QoL. Results revealed HIIT improved peak oxygen uptake significantly compared with the control and MICT group. Both MICT and HIIT groups improved in terms of density lipoprotein cholesterol and emotional wellbeing. The HIIT group improved significantly in social wellbeing compared with the control and the MICT group improved in physical wellbeing compared with the control. This reveals HIIT is an efficient intervention to improve cardiovascular fitness in BC patients, while both MICT and HIIT could be used as an intervention to improve QoL of BC patients.	A clear decision-making model is presented as a figure showing the sample and how they were split up within the intervention.	AI was used in the design of the study, data collection, data analysis and manuscript writing. Use of AI lacks creativity and so various ideas may have been missed or not expanded on in depth.
Kokkonen et al.	2022	Factors predicting long-term physical activity of breast cancer survivors. 5-year follow-up of the BREX exercise intervention study.	Predictive factors of BC patients who partake in PE and how QoL impacts participation.	A randomised controlled trial aiming to determine physical and psychosocial factors explaining long-term physical activity after treatment for BC patients. Physical activity after treatment and changes in PE in the long term were analysed. Baseline independent factors consisted of: pre-treatment leisure time physical activity, demographic, treatment factors, physical fitness and QoL. Results demonstrated previous exercise habits and QoL were strong determinants of long-term physical activity.	Results are set out with clear subheadings indicating what was being assessed and where in the timeline of the intervention this took place. This allows for clear conclusions to be drawn about each time chronologically.	PE was self reported using an exercise diary. This questions the reliability of results as participants were also volunteers so may follow certain demand characteristics, following the study's aim.
Mavropalias et al.	2023	The effects of home based exercise therapy for breast cancer related fatigue induced by radical radiotherapy.	Remote aerobic and resistance training effects on aspects of QoL and fatigue of BC patients undergoing RT.	A two-arm randomised controlled trial consisting of a PE group undergoing 12 weeks of home-based resistance and aerobic training in comparison with a control group receiving standardised care. The following were measured at baseline, completion of RT (six weeks), completion of intervention (12 weeks) and six months and 12 months after RT: QoL, sleep duration and quality and physical activity. Fatigue was also measured weekly (during RT). Results revealed a significant difference in QoL at the RT treatment (higher in the PE group). In conclusion, the results suggest that resistance and aerobic training are safe, feasible and effective at improving fatigue recovery as well as improving QoL. Furthermore, suggestions are made to implement small exercise durations for BC patients.	Clear visible diagram breakdown of all results of the study, showing at which point in the intervention they were recorded. Self management strategies are explained in depth, reflecting an MDT approach that is furthermore reflective of clinical practice.	Discussion is long and confusing and should be collection of results found whilst integrating further literature. As a new topic, this needs to be easily accessible for people to read and understand.
Adams-Campbell et al.	2023	An 8-week exercise study to improve cancer treatment related fatigue and QoL among African American breast cancer patients undergoing radiation treatment: a pilot randomized clinical trial.	Feasibility of PE for BC patients undergoing RT and examining QoL, cancer-related fatigue and adherence.	The randomised controlled trial involved two groups: an experimental group (taking part in moderate-intensity aerobic training) and a control group (encouraged to continue with their daily exercise habits). The study's population demographic consisted of primarily obese participants and those who had completed high school. Results revealed high acceptability and adherence to the intervention and that taking part in PE of moderate intensity lowers fatigue and improves QoL at eight-week follow-up compared with baseline.	Easily accessible language on the topic with a clear representation of how the study was carried out.	Texts on results remain rather brief whereas further elements could have been explored and explained.
Jacot et al.	2020	Brief hospital supervision of exercise and diet during adjuvant breast cancer therapy is not enough to relieve fatigue: a multicenter randomized controlled trial.	Diet and exercise-based education and training provided to BC patients with the aim of reducing fatigue.	The randomised controlled study was proposed with the aim of assessing the effect of a combination of exercise (muscle strength and aerobic) delivered during chemotherapy followed by RT on fatigued early BC patients. Data was collected at baseline, end of chemotherapy, end of RT and six months post treatment. Results demonstrated fatigue tended to increase over time with the fatigue being greater in the group that underwent exercise and diet training (APAD group). Yet this was not significant. However, the study did reveal a larger baseline fatigue level in those with precarious tendencies. In terms of QoL, there was significantly better physical function in the APAD group after both treatments. Lower psychological distress was also reported among the APAD group after treatment. Conclusions suggest cancer care centres should provide diet-exercise supportive care to BC patients undergoing chemotherapy and RT, focusing on fatigued or precarious patients. Yet gaps were found where implementation of an intervention providing improved long-term QoL of BC patients.	Intervention was clearly split up into subsections of each element being tested, such as: exercise, diet, nutritional care and nutritional education. This allowed for break down and transparency of each tested element, making understanding of the layout of the study easier to comprehend.	Discussion is rather hard to interpret and read, given that there are no subheadings or a breakdown of each element analysed in the study.
Uth et al.	2020	Exercise intensity and cardiovascular health outcomes after 12 months of football fitness training in women treated for stage I-III breast cancer: results from the football fitness after breast cancer (ABC) randomized controlled trial	High-intensity football training's impact on BC patients who have received treatment.	A randomised trial comparing football training with standardised care. Examining the exercise and health impact of 12 months of weekly football training in women treated for early stage BC. Results revealed no difference in resting heart rate and body fat mass yet self-perceived health limitations improved after six months.	Clear layout of each of the elements of the results.	Rather small sample size and attendance due to the study remaining inflexible when it came to training sessions. As a result there is lack of data so conclusions are reduced in validity.
Gjerset et al.	2023	Health related quality of life, fatigue, level of physical activity and physical capacity before and after outpatient rehabilitation program for women within working age treated breast cancer.	Analysis of patient- reported measures, PE and physical capacity before and after PE rehabilitation for BC patients.	The pre-post intervention study aim was to examine change in patient reported outcomes (PROMS), level of physical activity and capacity from before and after an outpatient rehabilitation programme (ORP). This consisted of seven weekly group sessions providing patient education, group conversation and physical activity. A questionnaire was completed by these patients before treatment, immediately after treatment and six months later. Results revealed physical, role, fatigue and cognitive function improved significantly immediately after and six months after RT. Moreover, levels of physical activity and capacity improved from baseline to immediately after RT.	The summary of the ORP is clearly represented within a timeline diagram with a further descriptive element of what took part at each section of the programme. Baseline information on demographics and status are clearly represented in a table as a percentage so it is easy to determine how many in the sample had each element.	The study was funded by the 'Rapid return-to work project in Southern and Eastern Norway Regional Health Authority so may withhold bias that could influence the conclusions drawn.

Table 6. Integration of themes and associated articles

Theme	Article
Level of intensity	Carpenter et al. (2024), Kirkham et al. (2019), Isanejad et al. (2023) and Uth et al. (2020)
Remote training	Dong et al. (2019), Dong et al. (2020) and Mavropalias et al. (2023)
Fatigue	Zhang et al. (2023), Mavropalias et al. (2023), Adams-Campbell et al.(2023), Jacot et al. (2020) and Gjerset et al. (2023)
Long-term QoL	Dong et al. (2020), Gjerset et al. (2023), Kokkonen et al. (2022) and Uth et al. (2020)
PE and diet interaction	Ahn et al. (2020) and Jacot et al. (2020)

treatment[24]. Furthermore, an increase in oxygen uptake improves QoL as it reduces physical deterioration, resulting in a reduction of cancer mortality and improved oncological outcome[25].

Both high- and moderate-intensity training are reported to improve differing QoL elements[18]. Yet a novel idea would suggest that a tailored approach to exercise rehabilitation intervention, that is patient specific, would optimise overall wellbeing and QoL[26].

Remote training

Internet-based rehabilitation applications with guidance and exercise programmes are now available to BC patients to improve their QoL[27,28]. Research has shown that by incorporating remote training, via online applications, QoL factors such as muscle strength, cancer-related fatigue (CRF), cardiopulmonary endurance and engagement in physical activity improved[29,30,31].

Home-based resistance training and aerobics are safe, feasible and effective when carried out during RT treatment – and not only are they effective at increasing CRF recovery but they also improve QoL[31]. This concept suggests that smaller amounts of exercise are preferable to those stated in the generic recommendations for BC. Moreover, remote training supports long-term QoL by improving vitality and mental health[30]. By implicating remote training into the pathway for BC patients, there is an enhancement in psychological status, leading to a positive correlation in terms of oncological outcome and morbidity rates[32,33].

While remote PE may offer advantages to BC patients' QoL, self-directed exercise carries inherent risks. The overall value of such interventions will vary among individual patients[34]. The novel concept of integrating remote and home-based PE into the BC patient pathway is currently under investigation and trial, as exemplified by the ongoing TeleCaRe trial[35].

Fatigue

Fatigue is defined as an extreme sense of exhaustion and lack of energy that causes an interference with one's usual daily activities[36]. More specifically, CRF is a distressing and persistent form of fatigue that is related to cancer or cancer treatment[37]. Within the review, these symptoms were commonly referred to and can determine and adjust cancer prognosis and treatment outcomes, hence holding importance when supporting QoL[38,39].

Fatigue was measured throughout the review using the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire (EORTC-QLQ-C30) and the Functional Assessment of Chronic Illness Therapy – Fatigue (FACIT-F) scale[31,40,41,42]. Both provide reliable and valid measures for evaluating fatigue[43,44].

Less fatigue was observed during RT treatment in those who partake in PE[31]. However, post-RT treatment (up to six weeks) an increase in fatigue was observed among those who participated in PE[31,42]. Conclusions were drawn that general fatigue among BC patients increases over time after treatment[42].

In contrast, multimodal exercise in particular was noted for reducing fatigue[45]. It is theorised that continuous muscle contraction and relaxation promote vasodilation, increasing blood circulation, respiration and, therefore, energy expenditure whilst releasing endorphins that contribute to an improved psychological state[46]. This provides insight as to why PE showed clinical improvement in reducing mental fatigue[41,42]. Therefore, multimodal exercise mobilises PE, focusing on the motion of movement, preventing rest through mental distraction[47]. Consequently, multimodality exercises may be a preferred form of PE in terms of enhancing QoL and reducing fatigue of BC patients undergoing RT.

Specific characteristics were identified as contributing to fatigue levels within the review. For example, participants with an unhealthy body mass index (BMI) who underwent PE intervention improved in physical fatigue, whilst those who lived alone improved in mental fatigue[41]. In addition, BC patients presenting with signs of fragility should be closely monitored for fatigue levels during RT treatment and provided with PE-related supportive care[42]. By focusing on these particular demographics, PE interventions can play a role in supporting the overall patient pathway.

Following RT treatment, both immediately and six weeks post-treatment, higher levels of fatigue were correlated with increased perceived exertion rating during resistance training and lower levels of fatigue were associated with longer durations of weekly aerobic exercise[31]. This suggests longer sessions of PE with a greater resting period are beneficial, providing improvement in fatigue, energy and vitality, all of which are factors of QoL[48].

Long-term QoL

The review encompasses studies that employ varying durations of follow-up and long-term QoL assessments. For instance, some took place six months to a year later[19,30,41] while others took place up to five years[49] later. There is a small amount of data determining the long-term effects of PE on the QoL of BC patients undergoing RT. Despite this, subscales of function – physical, role and cognitive – as well as fatigue were reported to improve after intervention of PE[41,30,50]. This reveals that neurological changes take place due to the takeup of PE by BC patients[51].

Moreover, deterioration of psychological and physiological aspects of QoL in BC patients are likely to take place after treatment[52,53,54]. Through PE intervention, long-term improvement in mental health is achieved[30]. While PE may improve long-term psychological wellbeing, questions remain about maintaining these behaviours over time. This emphasises the importance of focusing on the emotional wellbeing of BC patients with lower emotional functioning[49].

In addition, physical activity decreased significantly six months after RT[41]. This, moreover, highlights the need for follow-up appointments on BC patients' QoL to gain insight into how PE affects long-term QoL[41]. A factor that plays a role in reducing the carrying out of QoL assessments is unwillingness due to logistical problems, such as limited resources and time[55]. However, it is imperative to incorporate long-term QoL evaluations of BC patients and engage with participants after interventions to ensure their perspectives are integrated into future programmes and that the long-term effect can be measured. By actively involving patients in the assessment process, unique experiences and insights can be considered. This highlights a more holistic approach and the collaborative effect not only acknowledges person-centred needs but fosters inclusivity within the programme, enhancing the QoL support provided[56].

PE, diet and interaction

Throughout the review, the significance of diet and nutritional intake in relation to PE was noted consistently in the context of the QoL of BC patients undergoing RT. The combination of PE and dietary support has led to weight loss in BC patients post-RT, improving their QoL[57]. This conveys the need for diet counselling and education on balanced dietary intake for BC patients undergoing RT[42].

A population study indicated that improved lifestyle and dietary habits were associated with reduced overall mortality rates following the diagnosis of BC[58]. For instance, the intake of fruit and vegetables and a reluctance to eat high-fat food was observed in PE groups[59]. This suggests food intake and PE could be positively correlated, resulting in favourable outcomes of QoL.

Nutrition is a crucial factor throughout the BC patient's pathway. Incorporating dietary guidance in conjunction with PE, involving physiotherapists and sports therapists, demonstrates an MDT approach focusing on the holistic wellbeing of the patient[60]. This helps prevent treatment side effects. Evidence-based guidelines on cancer prevention through nutrition and PE should be included in treatment protocols. A person-centred approach with personalised guidance from nutritionists and physiotherapists can tailor recommendations to specific side effects or QoL factors[61].

Barriers hindering the implementation of nutritional therapy in BC patients include a lack of valid and reliable evidence[62]. The formation of multidisciplinary medical teams, effective collaboration between oncologists and nutritionists, and the integration of education within the speciality can address these challenges[63].

Conclusion

In conclusion, the reviewed literature explores the relationship between PE and QoL for BC patients undergoing RT. Moderate-intensity exercise, such as aerobic exercise, has shown significant benefits across various QoL factors, including body weight, body composition and muscular strength, whilst continuous training during RT treatment has been shown to improve physical wellbeing. HIIT may be particularly advantageous for BC patients because it efficiently improves cardiovascular fitness whilst also allowing for rest periods. Remote training through internet applications also improves QoL factors and may provide future implementation in practice due to its effectiveness.

Furthermore, multimodal exercises effectively reduce fatigue and improve QoL. Tailored exercise programmes optimise overall QoL, with long-term benefits in physical, role, cognitive functions and fatigue. Combining nutritional and PE support for BC patients undergoing RT shows promising results in enhancing QoL.

Future studies could explore the optimal form of delivery methods of PE for BC patients during RT as well as determine the most suitable modality for individualised, person-centred care. ■

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Abdominal radiographs

Seeing beyond obstruction: the hidden value of the abdominal radiograph

David Skinner, Hameed Rafiee, Doug Appleby

A 55-year-old woman presented to the emergency department with abdominal bloating, nausea and vomiting. She was five days post-elective external iliac artery angioplasty and stenting, after which she had developed these symptoms. On examination, her abdomen was soft but mildly tender. Her National Early Warning Score (NEWS) was 3[1], with a heart rate of 118 bpm and a blood pressure of 106/76 mmHg[2].

An abdominal radiograph was requested to assess for possible constipation or bowel obstruction[3]. Routine blood tests the following day revealed a raised white blood cell (WBCs) count of 15.4 ×10/L (reference: 4.0–10.0), neutrophils of 12.72 ×10/L (2.00–7.00), and monocytes of 1.14 ×10/L (0.20–1.00)[4]. Other parameters were unremarkable. Post-operative elevated WBCs and neutrophils are likely reflective of an inflammatory/infective process or, in rare cases, an ischemic process also.

The abdominal radiograph was performed on a Saturday and the patient was admitted. The radiology report was completed the following Tuesday evening and stated: "Comparison made with previous CT scan dated 11/09/2024. Mildly dilated large bowel with the appearance of intramural gas within the sigmoid colon. The appearances are concerning for bowel ischaemia. I would recommend an urgent arterial and portal phase CT scan for further assessment. Left common/external iliac artery stent in situ. IUD and sterilisation clips noted. Clinical team informed via email."

A contrast-enhanced CT abdomen and pelvis was performed approximately 10 hours later. The on-call report described: "The sigmoid colon is dilated, measuring up to 6cm. There is focal hypoenhancement of the sigmoid bowel wall and extensive associated pneumatosis intestinalis as seen on the abdominal radiograph. Marked associated pericolonic inflammatory stranding. No portal venous gas. No pneumoperitoneum or free fluid. The remaining bowel is of normal calibre. Conclusion: Appearances are in keeping with bowel ischaemia involving the sigmoid colon. Clinical team informed at 05:58."

The patient underwent emergency laparotomy[5] with resection of the ischemic segment and formation of a stoma. Histological analysis confirmed full-thickness ischaemic necrosis of the sigmoid colon[6,7]. She was admitted to the Intensive Care Unit (ICU) and received multiple blood transfusions. Her condition stabilised and she was stepped down from ICU, ultimately being discharged approximately one month later. Ongoing care continues for stoma management and her pre-existing medical conditions.

Clinical decision-making and escalation

Imaging technique and initial review

An abdominal radiograph[8] was requested to investigate ongoing abdominal bloating and vomiting, with a clinical suspicion of constipation or bowel obstruction. The examination was performed in the supine position in line with local protocols. Exposure settings were selected to optimise abdominal soft tissue contrast, and image quality was assessed as diagnostic.

Despite the radiograph demonstrating an abnormal lucency suggestive of intramural gas in the sigmoid colon, this finding was not identified or escalated by the performing radiographer. The image was not flagged for urgent radiological review. As the examination occurred on a weekend, the image remained unreported until the following Tuesday. It should be noted that this is a very subtle finding and would have been considered a 'good spot' for any radiographer of any level of qualification.

Delay and missed opportunities

The subtle nature of the radiographic findings, combined with weekend limitations in formal reporting, contributed to a delay in diagnosing bowel ischaemia. This case highlights an ongoing issue in clinical practice: the abdominal radiograph is often underutilised and overlooked by operators, referrers and even some reporters. In this instance, a subtle but critical finding–intramural gas – went unrecognised initially, despite being visible on plain radiography and known to represent a potentially life-threatening condition. It has become common practice to request an abdominal radiograph to exclude obstruction and very little attention is being given to other critical findings visible on plain abdominal radiographs[9].

Radiological reporting and escalation

When the radiograph was finally reviewed by a reporting radiographer[10], the subtle appearance of intramural gas was identified and escalated to a gastrointestinal radiologist, who agreed with the findings and concern for bowel ischaemia. The report was issued on Tuesday evening, recommending an urgent CT of abdomen and pelvis with both arterial and portal venous phase imaging, and the clinical team was informed of the findings via email.

Systemic challenges and culture of practice

This case illustrates the need to re-emphasise the value of abdominal radiographs in acute care settings. In many departments, these films are often perceived as low-yield, leading to reduced attention and vigilance. Fortunately, at this trust, there are a few particularly enthusiastic and skilled radiologists and reporting radiographers who routinely engage with abdominal radiography and recognise its diagnostic value. Nonetheless, systemic reliance on CT imaging, combined with reduced emphasis on plain film interpretation skills, creates a vulnerability in the diagnostic process, especially over weekends when staffing is limited.

"This case illustrates the value of abdominal radiographs in acute care settings"

Figure 1. Abdomen radiograph. Arrows highlighting the subtle but important findings of a 'double wall' within the sigmoid colon and mild dilatation. The subtle intramural lucency represents gas within the bowel wall, raising concern for bowel ischaemia.

Figure 2. CT slice coronal. Hypoenhancement of the sigmoid bowel wall with extensive associated pneumatosis confirming bowel ischaemia. Using the coronal plane can make comparison with abdominal radiographs much easier.

Figure 3. CT axial LW. Using the lung window on the axial CT better demonstrates the gas within the bowel wall, which can sometimes be missed on the standard abdominal soft tissue window.

Figure 4 CT axial lung window. Further demonstration of the intramural gas within the large bowel.

Outcome

Following the CT findings, which confirmed features consistent with bowel ischaemia – namely focal hypoenhancement of the sigmoid colon, marked pericolonic fat stranding, and extensive pneumatosis intestinalis – the patient underwent an emergency surgical laparotomy. During the procedure, the affected segment of bowel was resected and a stoma was formed.

Postoperatively, the patient was admitted to ICU for close monitoring and supportive care. She received several blood transfusions during her ICU stay due to perioperative blood loss and postoperative anaemia. Over the course of her admission, the patient responded well to treatment, was stepped down from intensive care, and eventually transferred to a general ward.

Approximately one month after her initial presentation to the emergency department, the patient was discharged from hospital. She continues to receive follow-up care for stoma management and monitoring of her pre-existing medical conditions. At follow-up, no further complications related to bowel ischaemia were reported.

Discussion

Bowel ischaemia is a potentially life-threatening condition that requires prompt diagnosis and intervention. It can present with non-specific symptoms, such as nausea, vomiting, abdominal discomfort, or

bloating, features that were evident in this case. The subtlety of the initial presentation can make early recognition challenging, particularly in post-operative patients where symptoms may be attributed to recent intervention or general recovery.

Plain abdominal radiography has historically played a central role in the assessment of acute abdominal complaints. Although its utility has diminished in the era of widespread cross-sectional imaging, this case demonstrates that abdominal radiographs can still yield critical diagnostic information, such as the presence of intramural gas, a critical finding that can demonstrate bowel ischaemia[12]. Pneumatosis intestinalis, while rare, is an important radiological sign and must not be overlooked. It may also be associated with benign conditions (e.g. post-endoscopy or COPD) but, in the correct clinical context, it should raise serious concern[13].

Current guidelines from The Royal College of Radiologists and other bodies often prioritise CT imaging in cases of suspected bowel obstruction or ischaemia, due to its superior sensitivity and ability to assess vascular perfusion. However, abdominal radiographs remain a first-line tool in many emergency departments, especially when CT is unavailable or delayed. As demonstrated in this case, careful interpretation of these films can lead to earlier recognition of pathology and improve patient outcomes.

A study by Davarpanah et al.[14] highlighted that missed radiographic signs of bowel ischaemia were associated with delayed surgical intervention and increased morbidity. Similarly, a review by Khalil et al.[15] emphasised that pneumatosis intestinalis, visible even on radiographs, may represent anything from a benign process to a life-threatening condition and should never be dismissed without careful clinical correlation.

This case also underscores systemic issues in radiographic practice, particularly during weekends or out-of-hours periods. The delay in formal radiological reporting meant the abnormal radiographic findings were not acted upon for several days. While the CT scan ultimately led to timely surgical management, earlier recognition on plain film could have expedited care and potentially reduced the patient's clinical deterioration.

In addition, it reflects the need for improved radiographic education and confidence in interpreting abdominal images. Encouraging radiographers and referrers to remain alert to subtle but significant signs on plain films is vital. At a departmental level, fostering a culture that values plain film interpretation – even in the shadow of CT imaging – can prevent diagnostic delays.

Learning meetings

This case was presented at a local learning meeting and subsequently at Norfolk's REALM (Radiology Events and Learning Meetings) forum. These sessions provide a valuable platform for shared learning, reflective discussion, and collaborative improvement. By openly examining cases such as this, where a subtle yet critical radiographic finding was initially overlooked, radiographers at all levels are encouraged to develop sharper observational skills, greater clinical curiosity, and increased confidence in flagging concerns. REALM meetings foster a non-judgmental environment where learning is prioritised over blame and systemic improvement is the collective goal. Through these initiatives, there is a clear opportunity to raise awareness around the diagnostic value of abdominal radiographs and to improve escalation pathways, particularly out of hours. It is hoped that, as a result of such learning cultures, future cases may benefit from faster recognition, reporting and intervention – ultimately leading to better patient outcomes. ■

About the authors

David Skinner is a newly qualified Reporting Radiographer at the Norfolk and Norwich University Hospital. He was supported by **Douglas Appleby**, Advanced Practice Reporting Radiographer, and **Dr Hameed Rafiee**, Consultant Radiologist, both also at the Norfolk and Norwich University Hospital.

Use this article for CPD

Reflect on the article and scan the QR code below to record your learning on CPD Now.

- Review a series of abdomen radiographs within your department and start with the basics of anatomy. Then look closely for any subtle signs of pathology. Try to review 10 to 15 cases.
- After looking through some cases yourself, try to arrange a session with either a reporting radiographer or radiologist to go through these cases together to expand your knowledge and understanding of abdominal radiographs.
- Personal reflection is important to progressive practice. Try writing a short reflective piece to consolidate your learning.

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Mentoring in CT head reporting

A personal reflection on the essential need for mentoring and leadership in radiographer CT head reporting practice

Karolina Czescik

Qualifying as a radiographer in CT head reporting was a surreal milestone. When it became reality, it brought a host of challenges: foremost among them, the expectation to meet the diagnostic accuracy of a consultant radiologist and achieve 95% sensitivity and specificity in my reports as per my trust policy[1,2]. While undertaking the postgraduate course, with limited departmental support for study time or in facilitating structured supervision from a neuroradiologist, I often wondered how I, a newly qualified reporting radiographer with no prior experience, could realistically meet such essential benchmarks.

I believed the solution lay in working harder, studying more and, crucially, finding a mentor. The first two were entirely within my control – but mentorship proved more complicated. At the time, there were no active CT head reporting radiographers in my trust, radiologists had little capacity for one-to-one guidance and I was awaiting a response to be allowed to join stroke MDT meetings.

In my search for a mentor – a leader – I came across the Facebook Special Interest Group (SIG) in CT Head Reporting. I joined immediately. Reflecting on it now, this was one of the best decisions I've ever made, and here's why.

The group is led by Gary Holdsworth, a Clinical Specialist Neuro-Radiographer, who, at the time, had over 16 years of experience in reporting and worked in a team of four CT head reporting radiographers at his trust. Gary helped found the SIG in 2011 and launched the Facebook group in 2018[3]. Today, the group has grown to over 1,000 members, welcoming not just reporting radiographers but anyone with an interest in CT brain imaging[4].

A few months after I joined, Gary became one of my lecturers at Birmingham City University (BCU), delivering modules on dementia, trauma and stroke reporting. When group members requested an additional weekend teaching session, Gary willingly arranged it in his own time, free of charge, without hesitation.

At the time of writing, Gary has retired from clinical work. Yet, as the main driving force of the online SIG, he continues to encourage members to take ownership of the group's monthly live meetings (more on those later) to maintain the legacy he and the SIG team have built. The SIG provides a wide array of resources: articles, newsletters, case studies, pre-recorded tutorials, live monthly sessions and occasional in-person meetings. While others contribute, most of content and coordination still comes from Gary.

Some articles date back many years but remain remarkably relevant. One standout is the 2011 paper, "CT stroke window settings: an unfortunate misleading misnomer?", co-authored by Gary[5]. It highlights how using 'harsher' window width and level settings on CT brain scans can improve detection of subtle abnormalities, such as acute infarcts or difficult-to-see lesions, which may be missed on default brain windows. The authors advocated for the routine use of 'stroke windows' in all CT head examinations. Today I use it in my daily practice and teach others same as the guidance still holds value, enhancing diagnostic accuracy of each report.

Among the group's earlier offerings were *Bits & Bobs* (2016–2018), informal newsletters shared as PDFs[6]. They featured fascinating guest contributions. One that stayed with me was Karen Kerr's insightful explanation of the ora serrata, an anatomical structure I had never encountered before. Eye pathologies are uncommon in head CT, so learning about this serrated junction between the retina and the ciliary body, located around the 10 and 2 o'clock positions on axial images, was eye-opening. Understanding how it helps distinguish choroidal from retinal detachments is crucial for patient management[7,8]. While it's a pity these PDF newsletters were discontinued, their legacy continues through the SIG's online materials: videos, articles and monthly case discussions.

One of the most transformative aspects for me was the monthly anonymised case postings. These allowed me to privately discuss my interpretations with Gary – marking the start of my personal responsibility for image evaluation. I quickly realised that my impressions could influence clinical decisions, and I became more conscious of the clinical history and symptom onset in each case. I understood that assessing images and the possible pathology is just part of the job, looking for what could cause those acute or chronic symptoms and recommending further investigations or imaging is important for prompt and accurate diagnosis. Gary's approach was always thoughtful and probing, guiding me to adopt structured thinking. Each case was posted later with a detailed explanation and annotated images – these colour-coded illustrations were invaluable to my learning. Though these private sessions have since ceased, likely due to time constraints, they were replaced in July 2020 by monthly live meetings.

For the past five years, members of the SIG have met online via Microsoft Teams at 7pm on the last Wednesday of each month. These one-hour sessions, accredited by CPD Now and The Royal College of Radiologists, begin with a case presentation or practice-changing experience shared by a speaker[4]. This is followed by Gary's interactive case review, when members are asked what can be seen on the scan and how we would construct the report. The sessions foster discussion, critical thinking and reflection. Structured questioning encourages participants to narrow down differentials and identify pathologies consistent with both the images and clinical history. These meetings have become an essential part of my reflective practice and ongoing development.

So, what should a reporting radiographer look for? While the methodology of reporting falls outside the scope of this reflection, it's vital to adopt a consistent, methodical approach, carefully considering clinical context, using appropriate window settings, slice thickness and multiplanar reconstructions. Thorough review of any CT head examination, including both intra- and extra-cranial structures, may surprisingly lead to the diagnosis of pathology within the thorax, as outlined in the peer-reviewed article, "CT heads diagnosing chest pathology? Whatever next?", co-authored by Gary[9]. While learning about the above, I realised that the MDT meetings should be mandatory for every reporter to create a culture of exploring and sharing, for service users' benefit and for professional development. Unfortunately, regular attendance at these meetings requires departmental time to be allocated to this activity, necessitating staff back-fill and/or restricting services. This means MDT involvement can often be ad-hoc or involve using personal time to attend and, as such, tends to be intermittent.

Furthermore, the reporter must guard against 'satisfaction of search' – the tendency to stop searching after identifying an abnormality. This cognitive bias accounts for 20% of diagnostic errors in radiology, second only to 'under-reading' errors resulting in missed diagnoses[10]. As Gary often says: "If you look for it, you will see it – if it's there. If you don't look for it, you'll miss it."[11,12]

As life expectancy increases, CT scanning for Alzheimer's and dementia becomes more prevalent. Although more sensitive modalities exist – such as MRI, EEG, SPECT and PET – these are not always readily accessible[13,14]. CT remains a rapid, cost-effective modality that can help identify anatomical changes, such as tumours, hydrocephalus and brain atrophy. While traditional reporting often followed national guidelines, Gary introduced a standardised, evidence-based approach within his trust. His methods involved quantifying volume loss and evaluating ischaemic changes using volumetric CT and multiplanar reconstructions[15]. This not only enhanced local practice but also influenced many

students, like me, through his teaching at BCU. I learned to assess and score key features, such as global cortical atrophy, leukoaraiosis (Fazekas scale), medial temporal lobe atrophy, and parietal lobe changes (Koedam score), while identifying or excluding strategic infarcts[15,16]. My reports became clearly structured, outlining lobar predilection and degree of involutional and microangiopathic changes, when present. CT can be limited, for instance, small hypodense areas in the basal ganglia may represent either lacunar infarcts or enlarged Virchow-Robin spaces, which MRI can better distinguish[14]. Yet, due to contraindications, access issues and patient tolerance, MRI isn't always feasible. CT, therefore, remains a valuable first-line tool. Imaging should support – but never replace – clinical assessment, and MRI should be recommended when clarity is lacking on CT.

Every element of the SIG described here is driven by Gary's selfless investment of time, expertise and passion for teaching. I have also benefitted from private MS Teams calls with him to discuss my own reporting challenges – particularly in outpatient contexts, where my confidence initially lagged behind my acute reporting training. In my three years as a reporting radiographer, I have never met anyone who offers such unwavering kindness, insight, and encouragement. Gary's rare style of teaching – genuine attention, thoughtful critique and positive reinforcement – has shaped my development profoundly.

His guiding principle to think about what's going on – anticipate secondary effects, go and look for them and report them when they're there – is a constant reminder that there is always more to a case than first meets the eye.

CT head reporting radiographers need support from, and exposure to, experienced radiologists, neurologists and stroke consultants to flourish. I am now lucky and grateful for departmental assistance, help from supporting radiologists and taking part in the Radiology REALM meetings, which have helped to broaden my knowledge of brain abnormalities that can be missed, overlooked or misinterpreted. Still, in my practice in an extended radiographer's role reporting acute and outpatients' brains on CT imaging, I haven't been able to join neuro/stroke MDT meetings, although I continue to pursue this. However, I am a proud member of the CT Head Reporting SIG, which provides extremely valuable learning and network opportunities.

I am aware that many different SIGs exist, covering a whole gamut of practices and interests, which can be found via the SoR website[17]. The CT Head Reporting SIG provides a platform to expand our knowledge and skills, without judgment or barriers, and we owe it to Gary. The group's legacy is the expertise we've gained collectively. Our task now is to pass it on and become the kind of mentors he has been to us.

I wrote this article to show how one exceptional individual can elevate the practice of many – not just the radiographers who benefit directly but the patients we serve through better, more accurate reporting. If there were a Radiology MBE, Gary Holdsworth would be first in line. Thank you. ■

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Reflect on the article and scan the QR code below to record your learning on CPD Now.

- What support did you get as a newly qualified reporting radiographer and did you feel ready to match consultant radiologist skills in your first year of practice?
- Where you welcomed into stroke/neurology MDT meetings and, if yes, can you identify some immediate and long-term impacts on your practice from being part of them?
- Why is it important to use 'stroke windows' on all CT head studies?
- Considering the impact of radiologists/neuroradiologists on your practice, what mentor do you want to be?

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Rare multinodular epithelioid malignant mesothelioma

Ultrasound presentation of a rare multinodular epithelioid malignant mesothelioma of the tunica vaginalis without asbestos exposure: a case report

Chidi Uchenna Ollawa, Eyo Akpan, Yannick Yangue, Ruchi Nasa, Emmanuel Abiola Babington, Ernest Ruto Upeh

Malignant mesothelioma is a rare, aggressive cancer that affects the mesothelial cells lining the pleural, peritoneal, and pericardial cavities and the tunica vaginalis[1]. Mesotheliomas of the tunica vaginalis (MMTVs) account for 1–3% of all mesotheliomas and originate from mesothelial cells in this area[2].

Within the scrotum, the visceral layer of the tunica vaginalis serves as the outer covering of the tunica albuginea, which encases the testes. The parietal layer of the tunica vaginalis is proximal to the scrotal wall muscles, fascia and skin[3]. This leaves potential space between the tunica layers to accommodate fluid build-up. Hydrocele is characterised by fluid accumulation between the visceral and parietal layers of the tunica vaginalis, leading to scrotal swelling[4]. This condition can arise from various aetiologies, including trauma, infection or idiopathic causes.

Ultrasound is the primary imaging modality used to assess scrotal swelling or potential tumours. This is due to its easy availability, use of non-ionising radiation, cost-effectiveness and real-time features. However, ultrasound is highly operator-dependent and, therefore, requires adequate training. Other modalities, such as magnetic resonance imaging (MRI) or computed tomography (CT), can be considered when ultrasound findings are equivocal. Histology analysis of surgically removed (or biopsied) scrotal tumours is the gold standard for diagnosis[5].

Although rare, tumours of the tunica vaginalis include fibrous pseudotumours and malignant mesotheliomas[4]. They both primarily affect middle-aged men and are characterised by painless nodules and scrotal enlargement[4]. The common sonographic appearance suggestive of malignant mesothelioma of the tunica vaginalis includes the presence of singular painless nodules in the tunica vaginalis with hydrocele[6]. This case report aims to present a multinodular variant of MMTV associated with a complex hydrocele.

Case presentation

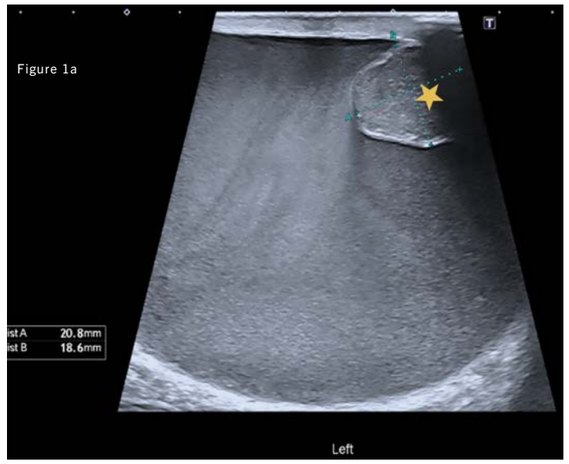
A 69-year-old Caucasian male consulted the hospital for gradually enlarging, painless scrotal swelling that appeared suddenly and persisted for 12 months. The patient's medical history revealed no exposure to asbestos, no previous scrotal surgeries and no infections. Routine blood tests yielded normal results. On physical examination, a nontender hydrocele was identified, with no palpable masses, leading to an initial clinical diagnosis of a benign hydrocele. A scrotal ultrasound was subsequently requested to determine the aetiology.

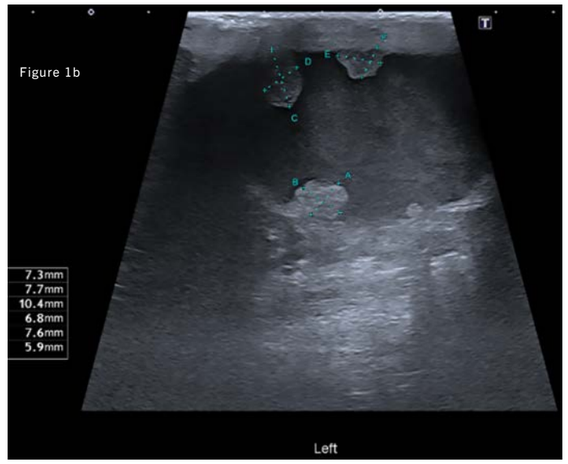
A scrotal ultrasound was performed per the departmental protocol via a high-frequency linear transducer. Ultrasound imaging revealed a complex left hydrocele with internal echoes producing a 'snowstorm' appearance. Four hypoechoic, irregular, nodular lesions adhered to the tunica vaginalis (Figure 1a–d), with the largest nodule measuring 21mm × 19mm (Figure 1a). The largest nodule showed internal vascularity on power Doppler interrogation (see Figure 1d). The testes and epididymis appeared sonographically normal in size, shape and echotexture, with normal arterial and venous vascularity on power Doppler imaging (see Figure 1d). The presence of multiple nodules in the tunica vaginalis raised suspicion of malignancy, and the sonographer issued a cancer alert per departmental policy.

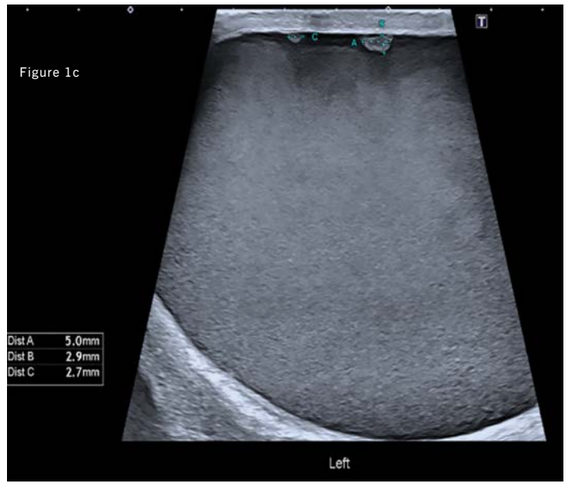
The urologist arranged an urgent scrotal MRI scan, which revealed a large complex left encysted hydrocele with peripheral nodular opacities attached to the wall (Figures 2a and 2b). The MRI was not specific regarding the nature of the hydrocele or the characterisation of the nodules. MRI was extended to include the thorax, abdomen and pelvis as per the protocol, and no extra-testicular distant spread in the abdomen or locoregional lymphadenopathy was observed. This case was discussed in subsequent urology multidisciplinary team (MDT) meetings, where it was decided to proceed with radical treatment. Thus, a radical left orchiectomy was performed.

Histopathological analysis of the radical orchiectomy sample revealed large islands of epithelioid cells separated by fine fibrovascular septa, indicating a tightly packed papillary architecture consistent with epithelioid malignant mesothelioma. The tumour cells presented indistinct cell borders, moderately pale eosinophilic cytoplasm and oval, enlarged nuclei with prominent nucleoli. There was abundant mitotic activity, and areas of necrosis were observed (Figure 3). Notably, the tumour did not invade adjacent structures, suggesting an early stage of the disease, and the specimen margins were clear. The largest tumour nodule was polypoid, exhibiting surface fibrous degeneration. Immunohistochemistry (IHC) findings revealed that the cells were diffusely

Figure 1(a–d). Longitudinal section through a turbid hydrocele showing multifocal nodules with the largest nodule (yellow star in Figure 1a) measuring 21mm × 19mm







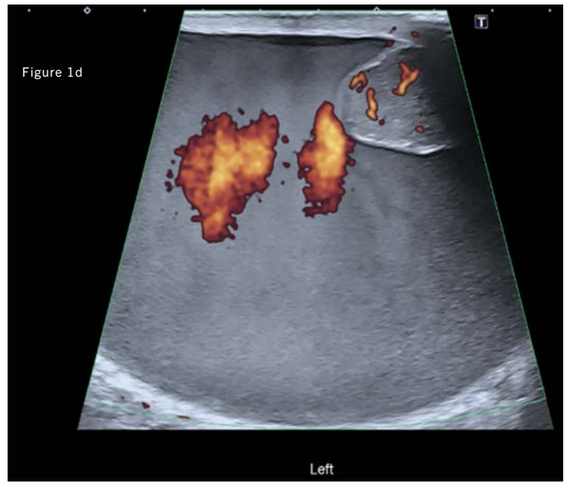
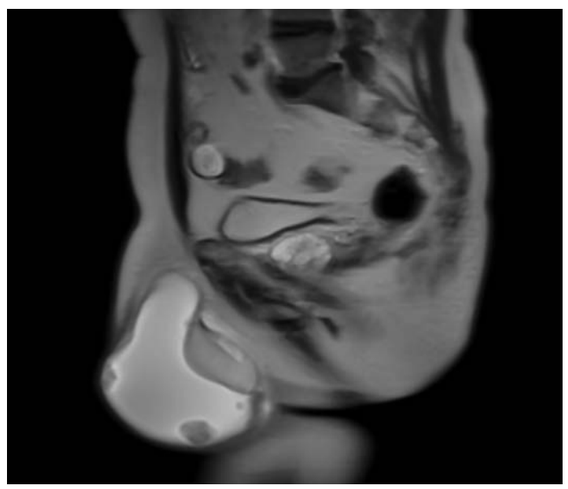
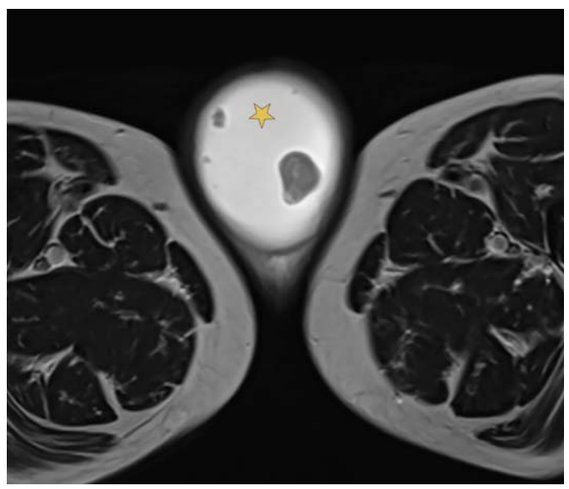


Figure 2. MR images of an encysted hydrocele (indicated by yellow star) with peripheral nodular opacities attached to the wall





“Fewer than 100 MMTV cases have been reported in literature since 1957”

positive for CK AE1/3, calretinin, WT1 and vimentin, as well as patchy positivity for CK5/6 and CK7. Focal patchy positivity was also noted for BerEP4. The histological and IHC findings confirmed the diagnosis of malignant mesothelioma (MMTV). The negative markers included mCEA and D2-40.

Discussion

Globally, fewer than 100 cases of MMTV have been reported in the available literature since 1957, emphasising its rarity[7]. In the UK, according to Cancer Research, mesothelioma incidence rates in females have increased by nearly 90% since the early 1990s, whereas rates in males rose by more than 40% from 2017 to 2019. Most mesothelioma cases are linked to asbestos exposure[2], although some patients have no known history of exposure[8]. The connection between asbestos and tunica vaginalis mesothelioma is particularly unclear, indicating that other factors may contribute to its development in this location. Diagnoses of tunica vaginalis mesothelioma often occur incidentally during surgeries for other scrotal conditions. The uncommon nature of the condition further complicates the collection of comprehensive epidemiological data and contributes to the lack of standardised diagnostic and treatment protocols[7].

The diagnosis of MMTV presents challenges due to nonspecific clinical manifestations, such as hydrocele or a painless scrotal mass[9]. These symptoms are also common in several benign conditions, which may lead to delays in diagnosis and further investigation[9]. Despite its rarity, MMTV shares similar clinical, histological, and molecular characteristics with mesotheliomas found at other sites, including epithelioid and biphasic morphologies, as well as gene mutations, such as NF2 and TP532. Unfortunately, despite aggressive treatment approaches, the prognosis of the biphasic variant remains poor[8]. Therefore, increasing the degree of clinical suspicion in high-risk patients and achieving the right result during a scrotal ultrasound examination may improve the MMTV prognosis, similar to that of most cancers.

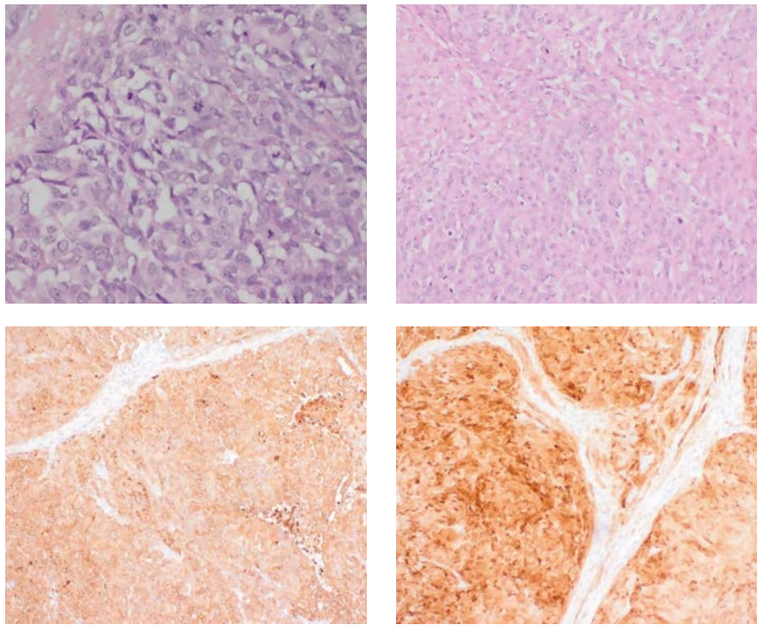
A vague clinical picture often necessitates a thorough diagnostic approach. Ultrasound is the first-line imaging modality for evaluating scrotal pathology. The rarity of MMTV means that sonographers might lack experience in interpreting its specific ultrasound characteristics[4]. In addition, the authors believe that the rarity of MMTV may also be attributed to the underreporting of the condition, which can stem from the sonographer’s lack of confidence in raising a radiological concern about a potential malignancy when ultrasound-specific features are present. This issue is also compounded by clinicians’ low index of suspicion regarding the condition from the outset. Typically, an inconclusive ultrasound finding would warrant a multimodality imaging approach, including CT and MRI scans, to aid in comprehensive evaluation and staging[10]. Ultimately, histopathological examination through surgical excision or biopsy is essential for confirming the diagnosis of MMTV[2,8].

Our case highlights the diagnostic importance of detailed ultrasound assessment in the early detection and intervention of MMTV, which can significantly impact patient prognosis. A systematic and thorough evaluation of the tunica vaginalis during the initial ultrasound is crucial for identifying nodules and papillary excrescences, which are key features of MMTV. These excrescences provoke local inflammatory responses that can lead to hydroceles and thickening of the tunica[11].

The extent of cellular desquamation and debridement varies depending on the degree of inflammation and the aggressiveness of the MMTV subtype, resulting in differing complexities of the ensuing hydrocele[11]. This emphasises the critical role of the ultrasound operator (sonographer, sonologist or radiologist) in early diagnosis and appropriate referral, aligning with the Getting It Right the First Time (GIRFT) initiative of the National Health Service (NHS) in England. Despite the potential of ultrasound for diagnosis, the subtlety of MMTV findings and the absence of specific serum biomarkers require a high suspicion index in any atypical chronic hydrocele case.

Imaging modalities such as ultrasound, CT and MRI are essential for diagnosing MMTV. They are critical for identifying the tumour morphology, assessing local invasion, guiding tissue sampling and staging the disease[12]. However, the sensitivity and specificity of these modalities in diagnosing MMTV are not well established due to the rarity of the disease. While ultrasound is highly sensitive for detecting structural abnormalities, its specificity for diagnosing MMTV is limited because it may not differentiate MMTV from other benign or malignant conditions, such as testicular germ cell tumours[12].

Figure 3. Microscopic sections of the testicular neoplasm



In cases of pleural mesothelioma, ultrasound-guided percutaneous needle biopsy has shown high sensitivity (83.39%) and specificity (100%) for diagnosing malignant mesothelioma[13]. Based on the findings from pleural mesothelioma and general imaging principles, ultrasound is highly sensitive but has limited specificity. Therefore, the authors recommend that sonographers receive training to enhance or advance their practice in fine needle aspiration cytology and ultrasound-guided biopsy of nodules of the tunica vaginalis within a one-stop rapid-access clinic to expedite the diagnosis of MMTV. This will ensure the collection of comprehensive epidemiological data and contribute to the standardisation of diagnostic and treatment protocols for MMTV.

Conversely, the sensitivity and specificity of CT and MRI in diagnosing malignant mesothelioma of the tunica vaginalis have not been well established. However, CT and MRI offer complementary advantages in staging and assessing local invasion. Further research is needed to determine the diagnostic accuracy of these modalities, specifically for MMTV.

The primary treatment for MMTV is radical orchiectomy, which is often supplemented by adjuvant therapy in aggressive or metastatic cases. This underscores the challenging nature of managing MMTV[11]. The prognosis varies significantly, with five-year survival rates ranging between 30% and 50%[2], further emphasising the need for ongoing research into more effective treatment options.

Conclusion

Scrotal ultrasound is the main imaging technique used to diagnose mesothelial tumours of the tunica vaginalis (MMTV). In our case, the sonographic features indicative of MMTV included multiple nodules along the tunica vaginalis, accompanied by a complex hydrocele. Ultrasound practitioners must be aware of these distinct features, they must thoroughly assess the scrotum and raise a cancer alert upon their initial observation of these malignant features. In addition, while most cases report a single nodule or papillary excrescence in the tunica vaginalis, our case illustrates a multinodular variant with a chronic complex hydrocele. These findings suggest that MMTV can also present as multiple nodules without prior asbestos exposure. ■

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- Multinodular MMTV is a rare morphological subtype scarcely described in the literature.
- Absence of asbestos exposure does not rule out MMTV.
- Chronic complex hydrocele may mask aggressive malignancy and should not be assumed benign.
- Detailed ultrasound evaluation of the tunica vaginalis for all cases of chronic hydrocele and early MDT involvement is critical for ruling out MMTV and for favourable outcomes.

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Advanced practice accreditation

Two routes to NHS England advanced practice accreditation: the sonographer's perspective

Cat Lee, Nicki Davidson

Advanced practitioners (APs) are now well established in the National Health Service (NHS) as part of workforce development in response to service need. This initiative presents significant opportunities for professional progression and is anticipated to support the retention of skilled, experienced staff who add immense value to patient care within multi-disciplinary teams.

Within the world of imaging, the *Richards Report*[1] identified a significant shortage of radiologists and suggested a valuable opportunity for radiographers to help expand services' capacity through advanced practice (AP) roles. AP is one solution to addressing the increasing demand in diagnostic imaging services.

More recently, the widely published debate[2] regarding physician associates has highlighted the need for robust professional regulation of non-medical practitioners. Such regulation reassures the public of practitioners' capabilities and competencies, using standardised qualifications and governance structures. One approach by NHS England (NHS-E) has been the introduction of digital badges for APs, serving as a visible marker of quality-assured practice and education[3].

In England, practitioners can use various national frameworks to uphold consistent standards across the professions and organisations delivering patient care. *The Multi-Professional Framework for Advanced Practice in England*[4] is typically most applicable to Diagnostic Radiographers (DRADs), while the Society and College of Radiographers' *Education and Career Framework*[5] provides more profession-specific guidance. Equivalent frameworks exist for other UK nations and the *Career Framework* is applicable to the whole of the UK[6-8].

These two frameworks divide workplace activities into four pillars – clinical practice, leadership and management, education and research – with a defined standard of capability or skill that a practitioner must demonstrate in each pillar in order to be operating at AP level.

This personal reflection from two sonographers will explore two different routes available to radiographers for replication to allow a successful application for an accredited NHS-E digital badge.

"With accreditation we can represent ourselves as safe, cost-effective and excellent healthcare professionals"

MSc Advanced Clinical Practice (degree apprenticeship) route

Cat Lee: Practitioners who are newly appointed or currently in trainee AP roles may choose to complete an academic qualification in Advanced Clinical Practice. Ensuring the programme is accredited by an NHS-E approved higher education institution is important. The list of accredited courses is held and regularly updated by NHS-E[9].

The degree apprenticeship route offers the benefit of protected study time for the student and financial efficiency for the employer through use of the apprenticeship levy[10]. Additional funding may also be available to support both the student and their clinical mentor. The Advanced Clinical Practice (ACP) MSc course is usually spread over three years on a part-time basis.

However, some downsides of the apprenticeship route include the requirement to undertake the national end-point assessment and there are typically fewer elective module options compared with a standard MSc programme.

Generally, the MSc will incorporate combinations of modules (requiring 180 credits at Framework for Higher Education Qualifications (FHEQ) level 7), which assess students' understanding of the principles of AP, such as educational theory, leadership models and research skills. This is alongside more bespoke modules of clinical practice, dependent on the clinical role the practitioner will occupy in practice. In this personal reflection, the following modules were mandated for the award to provide an example, but different institutes will have other options on their courses (Table 1).

Table 1. Example of modules and credits

Year	Module	Credits
1, 2, 3	Principles of/transitioning to advanced clinical practice	55
1	Advanced clinical assessment and decision-making skills	30
2	Advanced skill development	45
3	Advanced clinical practice improvement project	30
3	End-point assessment	20
TOTAL		180

Prerequisites and requirements

Prerequisites will vary between each institute and it is important to check with the course provider websites. Applicants will generally require BSc at 2:2 or above in a relevant healthcare subject, with a minimum of three years post-registration experience[11-14]. Registration with the appropriate professional statutory registration body, such as the Health and Care Professions Council (HCPC), is usually required, which is a limitation for those sonographers who do not have statutory registration.

Applicants also need support from their employer in the form of a statement of individual capability, ongoing financial support and dedicated study time. In addition, a suitable clinical mentor, who is either a qualified AP or doctor registered with the General Medical Council, is needed to ensure clinical competency is safely assessed in-house. For applicants who take the degree apprenticeship route, level 2 English and Maths will need to be achieved (if they do not already have them) before they take the end-point assessment at the end of the award[15].

One of the most critical, yet often overlooked, elements in developing a successful AP role is a clearly defined job description, scope of practice and role objectives. This ensures professional protection, promotes patient safety and justifies workforce investment. This governance framework helps to set expectations both for the employee and employer. The importance of clear objectives for an AP role was discovered through personal experience during the course of this award but had, in fact, already been identified as a key recommendation after a national study into AP roles[16] in 2021. This demonstrates how important it is to use the existing evidence base for lessons already learned, not only for clinical techniques but also for workforce development.

There are several publications available to support the development of AP roles. The Society of Radiographers has recently released guidance[17] to ensure compliance with legislation. A job planning toolkit from the College of Radiographers and NHS-E[18] and national job descriptions from NHS Employers[19] are useful resources to reference for reviewing or creating AP roles. It is worth exploring procedures locally as many NHS trusts now have their own internal AP document libraries with standardised job descriptions and processes for developing roles, alongside frameworks for evidence of ongoing competency.

Challenges of this route

A personal difficulty, which other sonographers who are considering this route may also face, was the prospect of completing an additional MSc while one was already held in Medical Ultrasound. This situation is applicable to any radiographer who has completed postgraduate study in their area of clinical speciality. It seemed unnecessary and this stipulation felt frustrating when there was existing evidence of FHEQ level 7 study from an award that included most, if not all, of the knowledge, skills and behaviours (KSBs) required to meet the multi-professional framework for AP. This opinion is echoed in the literature[20-22]. A full MSc is a big personal commitment over a significant period of time and should be a consideration for aspiring APs.

In addition, as a DRAD, I found the course was not particularly well aligned to daily clinical practice when compared with the registrant professions (paramedics and primary care nurses) of the other students in the cohort. This meant completing some assessments not relevant to an AP sonographer role, and left a potential gap in the development of clinical competency specific to radiography/sonography. This was identified by Woznita et al. in their 2017 national survey of AP in radiography[23]. For those who feel this would be a significant downside, there are now specific AP radiography postgraduate awards available, which can be found via the College of Radiographers[24]. Some AP courses also offer bespoke radiography modules.

Despite these drawbacks and challenges, the completion of the generic AP award has enabled an enrichment of knowledge

about AP as a whole. This has led to a deeper understanding of wider health system issues, and access to a fantastic multi-professional peer group in the student cohort. This was an abundant resource, which promoted the sharing of insights between professions and NHS organisations on the course, which can be taken forward into future practice and collaborations.

What went well and implications for future practice

Thinking about other benefits of the MSc route, a clear positive is that the KSBs required for AP were easily evidenced. In addition, the ePortfolio route was not available at the time of commencing this role and another consideration is that it might not be available indefinitely and there is currently a waiting list for enrolment[25]. The assurance that the award assigns the individual with mapped KSBs to the multi-professional framework makes it easy to apply a standardised trust-wide AP job description. The importance of reducing variation in job descriptions, and attributing value to the non-clinical pillars of AP, particularly in radiography, is discussed by Harris et al.[26] in their analysis of AP radiography posts. This assists in aligning DRADs with more established healthcare professions, such as nursing, and asserts that radiographers can also contribute to better patient care through AP, via independently accredited academic awards.

Alongside the great sense of achievement gained through obtaining the MSc, it has felt like it has highlighted the ability of DRADs within our trust when, as a profession, we can sometimes feel undervalued and unseen – a sentiment not isolated to the UK[27]. This may be due to the extreme service pressures faced by diagnostic radiography departments, which limit DRAD professional progression[28], or professional protectionism experienced within our specialty[29].

Despite these barriers, it is important that DRADs continue to aspire to progress through the career framework, demonstrating our proven ability to be innovative, flexible and agile healthcare professionals with the benefit of our incredible insight into a huge variety of patient pathways in healthcare systems[30]. Through accreditation from NHS-E, we can represent ourselves as safe, cost-effective and excellent healthcare professionals for the patients we serve.

I feel that my ACP MSc has allowed me to bring evidence-based and balanced opinion when advocating for our profession during professional debates within our department, which can, understandably, sometimes focus on targets and clinical output, given the current NHS climate. Hopefully I am forging a path and pipeline for potential AP DRADs of the future within our trust.

In short, I have not regretted embarking on and completing an ACP MSc. Provided the support and planning is in place to develop you professionally, I would wholeheartedly recommend it if you are thinking about the next steps in your career. If an MSc does not feel like a good fit for you or your role, the alternative route to NHS-E accreditation as an advanced practitioner is through the ePortfolio, which will now be explored.

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Advanced Practice (AP) ePortfolio route

Nicki Davidson: The ePortfolio was introduced by Health Education England/NHS-E for experienced practitioners who are currently working at AP level but who have not completed a formal accredited AP course. These practitioners usually have extensive clinical experience, are active in research and may also have formal leadership or educational roles.

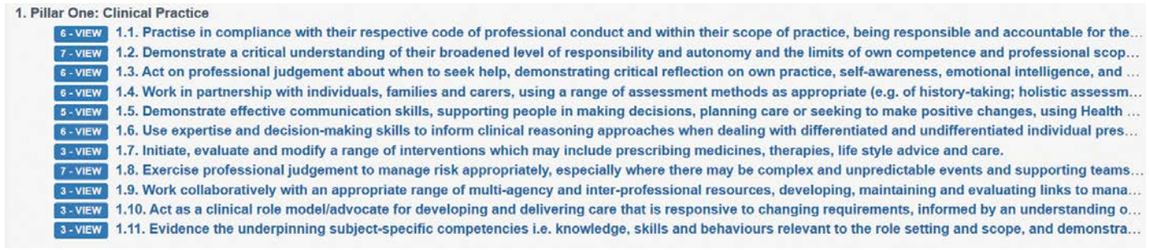
The ePortfolio route enables experienced practitioners to submit evidence via an electronic portfolio that demonstrates how they meet the criteria mapped within the *Multi-Professional Framework for Advanced Practice*[4]. The framework is based on the four pillars of AP (clinical, leadership and management, education and research) and provides a list of criteria/capabilities for each pillar. It is important to note the evidence provided must support all four of the pillars of AP and needs to have taken place in the past five years.

The ePortfolio is an option for those who completed their AP education prior to 2017 or via a non-accredited programme. The ePortfolio would not be suitable for those who are not in an AP role at present or who would need substantial support to meet the full criteria/capabilities within 12 months of embarking on the ePortfolio route. If you have completed an MSc in Advanced Practice since 2017, you can check to see if your course has been assessed retrospectively and meets the AP criteria[25]. The long-term aim is that future practitioners would need to complete a formalised Advanced Clinical Practice MSc to be eligible to hold the advanced practitioner title. The ePortfolio option is due to end in 2027.

Prerequisites and requirements

Initially, a learning needs analysis (LNA) is conducted, which details your experience and qualifications and identifies evidence that can be provided for each of the four pillars. This is reviewed by an educational supervisor, who is assigned from a supporting university. They will assess the LNA form to determine whether the individual meets the criteria currently or will require further development in one or more areas.

Figure 1. Example of competency framework with links to supporting evidence



Eligibility criteria[25]:

- Be working clinically in an AP role currently.
- Have support from your employer.
- Have commitment from your employer to provide supervision or support for any additional training identified in the LNA.
- Be able to provide FHEQ level 7 (master's equivalent) evidence demonstrating capabilities across the four pillars of AP.
- Be prepared to sign a learning agreement with employer/university.

It is a requirement that the ePortfolio is completed and submitted within 12 months of this LNA meeting. If the educational supervisor deems that additional components would not be completed within 12 months, the candidate would not be eligible to enrol at that time. As the framework is a multi-disciplinary document, it may sometimes feel that, as a radiographer/sonographer, it is challenging to meet certain criteria, but it is important to consider all aspects of your role and look for examples that could be provided as reflections or case studies.

After the initial LNA meeting and agreement from the educational supervisor, you can start building the ePortfolio. Some of the evidence may be readily available, for example: qualification certificates, evidence of CPD, presentations/posters delivered at conferences, courses attended, and audits undertaken. When adding each piece of evidence, it is electronically linked to the capability framework within the ePortfolio. At least one piece of evidence is required for each capability identified in the framework, with at least four to six per pillar, meaning approximately 24 pieces of evidence in total and a maximum of 35 (Figure 1).

Examples of evidence can include[25]:

- Clinical – reflective accounts (minimum of 200–800 words each), case studies (minimum of 200–800 words each), clinical competency sign off, feedback from patients and colleagues, job description and CV.
- Leadership – course attendance, 360 reviews, feedback from staff. A summary of a leadership experience/incident, for example, a business proposal or change or service development.
- Education – evidence of providing learning, such as conferences, university course or in-house CPD lectures.
- Research – details of research activity, development of guidelines/policies, especially if influenced by national guidance, audits and service improvement.

The final aspect of the ePortfolio is to complete a critical narrative. This is a structured and reflective piece assessing and detailing the AP role, written at FHEQ level 7. It identifies how all of the capabilities within the AP framework are achieved. The narrative will cover all aspects of the role and how the four pillars are achieved by using evidence within the portfolio to underpin each of the listed capabilities. It is important that the candidate acknowledges the challenges they have faced, the opportunities they have had and has looked critically at how they have overcome challenges.

The evidence uploaded must use a specified naming system (Table 2) that is then electronically linked, allowing the reader to access the evidence as the document is read. The critical narrative is required to be 3500–5000 words in length. There are many webinars on the NHS-E ePortfolio homepage to support candidates in developing the critical narrative[25].

Table 2. Example links to evidence with naming criteria

E:15 EDU: H&N group education session	17/04/2024
E14: AU: Attendance at H&N cancer MDT business meeting	04/09/2023
E13: TRAIN: POCUS study day faculty member	13/05/2023
E12: OTHER: Development of competency sign off documents	22/02/2024
E11: OTHER: Departmental protocol development	14/02/2024
E8: CS1: Metastatic melanoma	30/10/2023

A broad range of evidence is required to ensure that all four pillars are covered and that all the capabilities are met. Once started, it will identify where the strengths and weaknesses are within the ePortfolio and this will identify what further evidence is required to bridge any gaps. My supporting evidence included clinical competency sign off documents, patient feedback, case studies, reflective accounts and feedback from radiologist and sonographer colleagues. Evidence provided within the ePortfolio must be peer reviewed by a colleague, who understands the AP framework and is aware of the scope of practice and the role being undertaken. All of this was sent and reviewed electronically via the ePortfolio, which made keeping track easy.

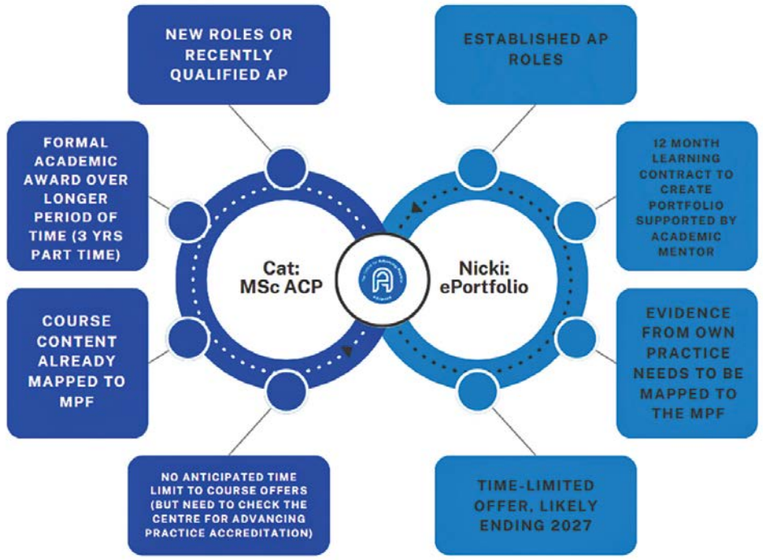
What went well and implications for future practice

Through the ePortfolio route, experienced individuals are able to obtain recognition for the role and be accredited by the Centre for Advancing Practice. This accreditation enables practitioners who have completed the ePortfolio to download the centre's 'Advanced' digital badge in the same way as those who have completed an accredited MSc programme, verifying to employers or individuals[31] that the educational and training standards have been met.

Whilst the opportunity to undertake a recognised MSc in Advanced Practice may be a good option for those at the start of their career, those who have been in roles for many years may not necessarily want to return to study to continue performing the same role. In ultrasound, many DRADs will already have completed several years of study and will hold a postgraduate qualification or MSc in Medical Ultrasound. The ePortfolio route would not be a good option for those who are about to commence a new AP role.

The NHS Long Term Plan[32] details how developing AP roles can be fundamental in developing a more adaptable workforce. This is essential in radiology because we are aware of the increasing workload and 30% shortfall in radiologists, as detailed in the 2023 workforce census[33]. It is important

Figure 2. Comparison of both routes



that, as DRADs, we seize these opportunities to show how roles can be developed in radiology departments and continue to push the boundaries. Although the *Multi-Professional Framework for AP*[4] does seem daunting for those outside of nursing, it is important that we continue to show the diversity and aptitude that radiographers and sonographers have in supporting patients and developing unique roles that support patient pathways.

What were the challenges of the route?

As a sonographer from a DRAD background, it initially felt like a challenge to identify evidence/areas of practice that meet all four pillars of AP due to the diverse range of capabilities in a multi-professional framework[4]. This is because our roles are very different from those of nurses or other allied health professionals. Many of the aspects around health promotion and clinical assessment and advice did not initially seem to fit with the role I was undertaking. However, once you start looking in depth at what your role involves, there are often many examples that can be demonstrated as a case study or reflection.

Before embarking on this route, it is important to consider the range of capabilities within all four pillars. As clinical practitioners, we are often confident with the clinical aspects of our role but struggle with components of the other three pillars. To achieve accreditation via the ePortfolio route, all of the capabilities within all four pillars must be attained. For some, this may not be a viable option due to the role they are undertaking, which may be heavily focused on one of the pillars.

Completion of the ePortfolio has been a great experience. I had the opportunity to look in depth at my role and was often surprised by how much I was doing and had achieved. I have been lucky to have the support of a great educational supervisor, who acted as a mentor and encouraged me to be braver in highlighting all that I had accomplished.

Conclusion

Radiographers and sonographers are well placed to develop into AP roles to provide flexibility and strengthen the imaging workforce in supporting patient pathways. Following an accredited route of AP gives employers and patients confidence that an individual has achieved all of the necessary training and educational components to hold the title of advanced practitioner. For those involved in workforce development, the opportunity to recognise those currently in AP roles should be encouraged, and the use of a structured MSc programme to develop any new AP roles should be incorporated into a training programme. ■

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- **Does your Trust have an AP development process and template documentation? Who is your AP lead? Is there a Trust AP forum you can join?**
- **Where are you currently in the SoR ECF? Where are you aiming for, and what would you need to achieve this?**
- **How much time do you spend in each of the four pillars of AP? Are there any that you can easily increase, for example completing an audit or Quality Improvement Project in your department?**
- **What opportunities are in your Trust/ Health Board for apprenticeships, leadership or research at the moment? What can you do to be in a strong position to apply for these?**
- **Read and reflect on the Multi-professional Framework for Advanced Practice. Where are your weaknesses and what capabilities are you doing already?**

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Interventional radiology

Advancing practice in interventional radiology

Michael Williams, Caitlin McLarty, Emma Rose

Interventional radiology is developing at speed in the UK. As the number of departments and cases grow, so does the need for well-trained staff. Here we look at the developing practice of radiographers working in this area as their roles advance, taking a look at what happens currently and considering what should happen next.

What is interventional radiology?

Interventional radiology (IR) is a clinical specialty that treats a wide range of conditions through minimally invasive surgical techniques. Because of its use of image guidance, it traditionally falls under the broader department of diagnostic medical imaging. IR departments are made of multidisciplinary teams, the core of which are normally interventional radiologists, nurses, radiographers, anaesthetists and operating department practitioners. They may also include assistant practitioners and healthcare assistants, and the service provision and case complexities can vary greatly from trust to trust. Services may include vascular, genitourinary, gastrointestinal, neurology, cardiac, acute trauma, stroke and oncology. Whatever the specialty, the team is highly skilled and services are evolving rapidly with technology and innovative practice.

Why is advancing practice developing in IR?

The breadth and scope of the IR service is ever growing, with the use of minimally invasive treatments widely recognised as a benefit for patients to improve recovery times and reduce bed stays[1]. Investing in an expanded IR service can provide a huge cost saving to the NHS. Without increasing the IR workforce, there are not enough resources to establish new, innovative and complex IR procedures whilst also still providing efficient and safe services for the 'bread and butter' procedures, such as vascular access, drains and diagnostic angiograms.

The Royal College of Radiologists *Clinical Radiology Workforce Census*[2] states that 52% of trusts have inadequate IR services. Whilst this describes the need to provide 24/7 services for specialties such as stroke services, this need for out-of-hours staffing subsequently results in reduced staff in the daytime. There are not enough interventional radiologists to meet the demand for services, and there are significant differences in staffing levels across the regions of the UK.

With the limitations on interventional radiologists' time, departments have used radiographers and other healthcare professionals to undertake additional training to be able to perform a range of procedures aimed at decreasing waiting times and increasing capacity. Outside of the direct clinical-aspect intra-procedures, there are also areas of development, such as pre-procedure and post-procedure care – including sedation services, day-case admit units, scrubbing and sterile practice, and patient preparation – provided through a clinic or prior to procedure. This article will focus on the development of radiographers.

What are extended, enhanced and advanced practice?

The terms 'extended practice', 'enhanced practice' and 'advanced practice' all centre on the four pillars recognised by NHS England (NHSE) (formerly Health Education England). These are: clinical practice; leadership and management; education; and research. Extended, enhanced and advanced practice have differences in how involved each is with the four pillars and with the level of autonomous working as a formal definition. However, we know practically that these terms are interchangeable and can be ambiguous regarding the healthcare professionals using them.

Extended practice is not a term currently used by NHSE and it does not feature in the College of Radiographers (CoR)'s *Education and Career Framework* (ECF)[3]. The terminology is now, therefore, outdated. However, the Council for Healthcare Regulatory Excellence in 2010 identified extended practice to mean when a healthcare professional takes on a role that is usually associated with another profession.

Enhanced and advanced practice have been defined by NHSE[4,5] and feature within the ECF[3] with clear and important distinctions. NHSE[4] defines enhanced practice as a level of practice beyond novice and competent but not yet working at advanced level. Enhanced practitioners are expected to work within all four pillars but this is limited to their specific scope. They will undertake complex work as an autonomous professional who manages daily risk while performing leadership and education duties (such as mentoring) and participates in research to lead and inform practice. The CoR compliments this in the ECF[3]: enhanced practitioners contribute towards all four pillars but the emphasis is within their clinical practice, developing skills and knowledge beyond that of their initial registration requirements. The full range of knowledge, skills and attributes that enhanced practitioners are expected to demonstrate are in the ECF, and education providers must map to this. It is not essential that enhanced practitioners have postgraduate qualifications but this is encouraged.

Advanced practice, on the other hand, is a level of practice with a high degree of autonomy and complex decision-making – these practitioners must judge risk and use clinical reasoning for patient care at an advanced level[5]. Advanced practitioners will lead or redesign services, lead teams and manage self and peer review. Not only will advanced practitioners be responsible for maintaining their own learning, they should be actively involved in the education and training of others and actively partake in or lead research projects and audit. As with enhanced practice, the ECF defines and provides details of the key attributes, skills and knowledge expected of advanced practitioners. Education for advanced practitioners should be up to the level of a full master's degree[3].

Building further upon advanced practice, a consultant practitioner must demonstrate expertise in all four pillars at a micro, meso and macro level in the healthcare system[6]. The ECF describes a consultant practitioner as an independent decision-maker in all four areas of practice, with a focus on working strategically outside of just the local organisation with influence in patient care at regional, national and international levels[3]. They should hold a master's degree and be working towards a doctoral-level qualification.

The differences between the levels of practice can be subtle, and Table 1 summarises the main differences through a clinical example in IR. Throughout the rest of this article, the term 'advancing practice' will be used in reference to enhanced, advanced and consultant practice.

Where does advancing practice in IR already exist?

Though it is poorly documented, it is known that radiographers and nurses have long been undertaking a variety of procedures in IR. The recent definitions of enhanced/advanced practice recognise this as an area needing firm definitions instead of anecdotal and ambiguous terminology. This is also a response to the rise of radiographers and nurses performing procedures of advancing complexity as the need for IR has increased. Radiographers can provide support in all types of centres, from primary care through to tertiary referral centres. Patient populations include those that can be challenging, such as paediatric patients, oncology centres and time-critical stroke or vascular centres.

Some IR centres are heavily involved with vascular access services, and many centres now have radiographer-led vascular access services. Radiographers have also documented experiences of other radiographer-led programmes, such as nephrostomy exchanges[7] and fluoroscopically guided lumbar punctures[8]. Through professional networks and special interest groups, we know there is a vast amount of practice being undertaken across the country by radiographers but there is a significant gap in the literature to evidence these practices.

What are the benefits and pitfalls of advancing practice?

Some benefits for patients and services have already been discussed in this article. Without increased staffing to perform the bulk of the 'day-to-day' IR work, the opportunity for innovative and complex procedures is reduced, and there is no ability to reduce waiting list times for patients. The benefits to the radiographers themselves are additional skills and knowledge, an increased sense of job satisfaction, and the ability to climb the career ladder without necessarily advancing into a managerial position. It also improves recruitment and retention of radiographers, who themselves are experiencing a 10% shortage and, when reviewing reasons for leaving, regularly cite a lack of career progression[9]. Having a clinical leader like an enhanced or advanced practitioner can significantly boost the morale of other radiographers as well as encourage a variety of career opportunities, another factor that causes early-career radiographers to leave[9].

Advanced practice in nursing, such as clinical nurse specialists, is more established than it is for radiographers, with many centres having nurse-led practice. While there is precedence here to help train other healthcare professionals, there are new limitations when training across professions, such as different drug-prescribing conditions. So, while multidisciplinary teams can provide excellence of care to patients by utilising niche areas of each other's base professions, there is still a responsibility for each practitioner to work within their professional scope of practice and within their job description. Those undertaking procedures without these accurate job descriptions could put themselves at risk of both breaching their scope of practice or not being adequately covered by indemnity insurance. Thus, a major pitfall of current enhanced and advanced practice is the lack of governance here, especially in the training pathways.

Training for enhanced and advanced practice

The content and intended outcomes of the curriculum of enhanced and advanced practice training varies from course to course between different higher education institutions (HEIs) and providers. However, for radiographers, courses that prepare someone to work at an enhanced or advanced practice level must map to the standards set by the ECF[3] and evidence that students will learn and be assessed across all four pillars of practice: clinical, leadership, education and research. Enhanced practice education should be up to either postgraduate certificate (PgCert) or diploma (PgDip) and advanced practice education should be the minimum of a full master's degree. Similarly, for a course to result in students having formal accreditation as advanced practitioner upon successful completion of the programme, they must meet the standards for education set by NHS England[10].

What are the specific training opportunities in IR?

In 2024, using information from the Society of Radiographers, British Institute of Radiology (BIR), British Society for Interventional Radiology (BSIR) and a standard search engine, only two study days were found that were specifically for radiographers and nurses working in IR. These were run by BSIR and BIR respectively. For more formal education, there are up to 10 PgCert–MSc level opportunities for radiographers and allied healthcare professionals (AHPs) that may integrate IR into postgraduate education. However, these support advancing practice or self-guided research instead of including specific taught content in IR.

London South Bank University's PgCert in Interventional Radiology almost stands alone (but for a 30-credit module

Table 1. Summary of four pillars with enhanced, advanced and consultant level practice with IR example. Adapted from the College of Radiographers' *Education and Career Framework*[3]

Level of practice	Clinical expertise with IR example	Leadership qualities	Educational qualities	Research and service development involvement
Enhanced	Skill above that expected at registration level. e.g. Placing peripherally inserted central catheter (PICC).	Some leadership within clinical area.	Teach locally to students or staff members within the clinical area.	Undertake clinical audit or service evaluation.
Advanced	Decision-maker in the area of clinical expertise. e.g. Placing PICCs and being able to perform venoplasty when required to troubleshoot device placement.	Leadership within the clinical area including interprofessional teams. Act as supervisor or mentor.	Teach locally and in a wider community (i.e higher education training or within a wider healthcare setting).	Use research to ensure practice is aligned to best evidence. Undertake data collection and be active part of research, clinical audit or service evaluation.
Consultant	Expert knowledge of clinical areas and implements protocols and policies at a strategic level. e.g. Implementing pathway for difficult venous access, performing venoplasty, and placing vascular access device.	Leadership locally, including operational management. Collaborate at a strategic level. Develop leadership in others.	Create opportunities for others to undertake teaching skills. Be an experienced facilitator, mentor, supervisor. Contribute to curriculum development.	Undertake audit, service improvement and research and encourage a culture of sharing best practice at a wider level.

at University College Dublin) in being designed for and specifically teaching IR. The education opportunities for IR appear lacking when compared with those relating to other modalities for radiographers, such as breast imaging, computed tomography (CT), magnetic resonance imaging (MRI), image reporting, ultrasound and nuclear medicine, which each have 10–15 postgraduate taught courses across HEIs in the UK, plus numerous short courses and study days run by manufacturers and professional bodies.

What are the current education and training standards?

There is a disparity between the modality training opportunities described above and the available standards. There are no specific training standards for CT or MRI but there is an abundance of university postgraduate courses in these modalities to develop the professional's knowledge and understanding. Sonography and nuclear medicine technologists are not registered professions and yet there are education standards by CASE[11] and JRCPTB[12] that influence the need for formal education and university training and CPD programmes, of which there are many courses nationally.

Similarly, areas of advancing practice within diagnostic imaging, such as radiographic reporting and CT colonography, require formal education and have set standards to influence the need for formalised training[13,14,15]. And yet there is no equivalent formal requirement for training or standards of education that should be met by non-medical professionals in IR.

But as advancing practice is relatively new for IR, it may be that this will take some time to develop. After all, while radiographers have been undertaking extended roles with reporting conventional radiography for approximately 30 years, training standards for MSK[14] and chest[15] interpretation have only been published in the past three years. Given that there are radiographers nationally who are undertaking clinical training within their departments to increase their scope of practice to enable them to perform procedures unassisted, there is a clear need for formal recognition of this training. Furthermore, education standards are required for healthcare professionals progressing to IR enhanced/advanced practice.

The Royal College of Radiologists (RCR) has a specific *Sub-Specialty Training Curriculum for IR*[16] that must be followed for radiology training to obtain a certificate of completion of training (CCT). This identifies knowledge, skills and behaviours that must be demonstrated in a variety of interventions to include vascular, non-vascular and neuroradiology, with different levels of competence expected from a general IR consultant to an IR consultant with a specific field of practice.

Given that RCR Standards for Reporting[17] have influenced the creation of joint standards with the RCR and CoR for radiographers undertaking reporting[14,15], one could envision the creation of a similar set of joint training standards for healthcare professionals enhancing their practice in IR by appropriately adapting the current RCR IR Curriculum[16].

Getty Images

What is the current training picture?

Most radiographers specialised in IR will train internally, on the job. This will build upon fundamental fluoroscopy and IR training at pre-registration level, which is the most common route of entry for a UK-based radiographer at present. Since 2018, the Association of Vascular and Interventional Radiographers has called for standardisation in the training of the profession in the United States through formal education to recognise the complex skills required[18], which is similar to the picture in the UK.

We know that advancing practice is happening across the country but the design of this is dependent upon the individual department and team. While the evidence supports that patient outcomes and service quality are maintained when radiographers perform procedures, there are contextual differences in when medical professionals perform roles and when non-medical professionals do, as referred to earlier in this article. Thinking about radiographer vs medical training, there are inherent skills and experiences that mean professional practice will differ, and using a simplistic comparison does not demonstrate the depth of the benefits advanced practice can offer[19]. Enabling a space of AHP-led education to teach from the same context may allow the benefits of these differences to be seen.

Conclusion

So where does the growing role, skill and knowledge of IR radiographers fall within the enhanced or advanced practice definition? With the development of radiographers performing interventional procedures on patients, they have certainly taken on some aspects that are traditionally part of a radiologist's role. But the management of the patient peri-operatively, leadership of the team during the procedure, and assessment and management of risk are certainly enhanced clinical practice at least. It is the involvement with the other pillars of education, research and leadership that will truly differentiate between enhanced, advanced and consultant practice. Advancing practice in IR is developing rapidly, therefore there is a need for formal training standards, provision of postgraduate education, clear guidance on the application of the pillars to IR and recognition of advancing practice capability/scope of practice. ■

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- **Reflect upon advanced and consultant practice roles that exist within your departments – do they fulfil the definition of enhanced, advanced and consultant practice? Or, if you are an advanced practitioner, do your day-to-day role and responsibilities reflect this definition and level of work?**
- **Considering your interventional radiology department and service, look into whether any non-medical members of the team are currently training or have previously trained to extend their practice and perform procedures unassisted. What does this training look like and how will it benefit the service?**
- **Reflect upon your specific training as an interventional radiographer (or rotational radiographer through IR). Think about the training and education you have received to develop your knowledge and skills. Was it all in-house, on-the-job training? What further training or education opportunities would you like to have and how would they benefit you? What are the barriers to further education and training opportunities?**

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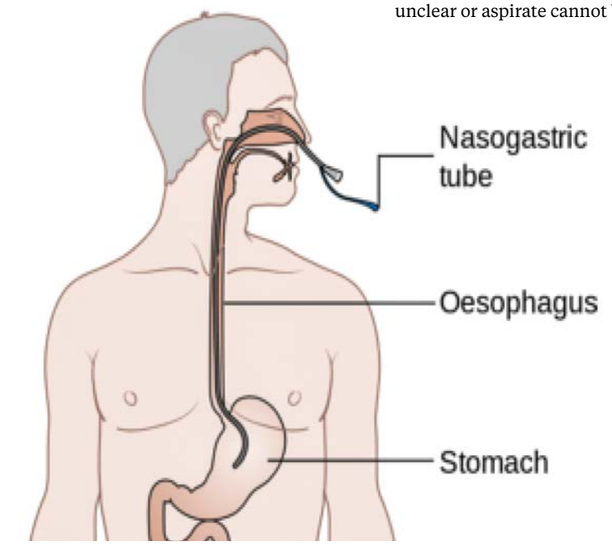
CXR confirmation of nasogastric tube placement

How to improve radiographers' confidence in recognising misplaced NG tubes to enhance patient safety

Yaseen Obaid

Nasogastric (NG) tubes are primarily used for feeding, with thousands inserted daily without incident[1]. However, misplacement of an NG tube into the lungs can lead to life-threatening complications or even death if it is then used for feeding[2]. Therefore, verifying correct tube placement before use is critical. The first-line method for confirming gastric placement is by testing the NG tube aspirate. The pH of gastric aspirate (stomach contents) typically ranges from 0 to 5, indicating an acidic environment. This acidity helps confirm correct placement of an NG tube in the stomach. Misplacement of an NG tube can lead to serious complications. While pneumothorax is a rare outcome, more common risks include aspiration pneumonia and respiratory distress. If not promptly identified and managed, these can progress to a pulmonary abscess due to infection.

Figure 1. Correct placement of nasogastic tube[5]



If aspirate cannot be obtained or if the pH level is greater than 5.5, a chest X-ray (CXR) should be performed to confirm the tube's position[1,2].

Considering reports indicating 21 fatalities and 79 instances of harm resulting from the use of mispositioned NG tubes, a safety alert has been issued[3]. Despite subsequent alerts, these incidents, classified as 'never events', persist due to misinterpreting chest CXR images[2]. Radiographers are pivotal in performing a preliminary clinical evaluation (PCE) of NG tube placement, as observed in CXRs[4].

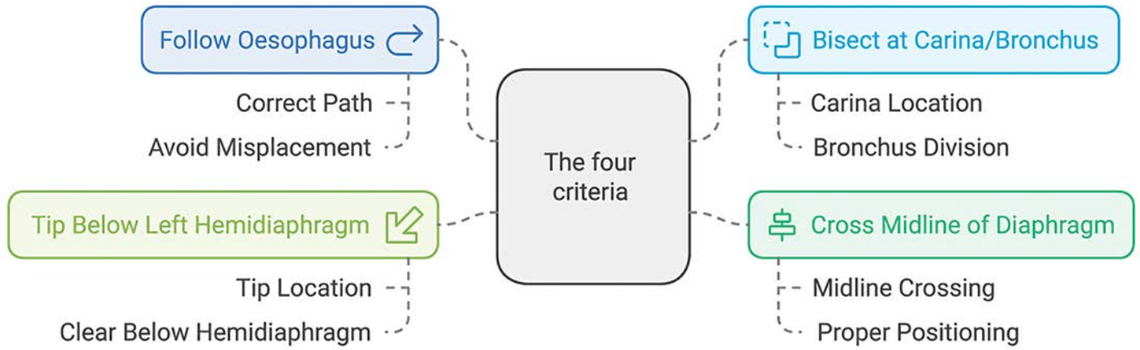
If the NG tube is correctly positioned, it should run vertically or slightly to the patient's left, reaching the diaphragm before passing through the gastroesophageal junction. The radiopaque tip of the tube should be visible at least 10cm below this junction[6]. The first method is to aspirate gastric contents to check for proper placement. A pH level between 0 and 5 indicates correct positioning. If this test is unclear or aspirate cannot be obtained, a CXR is performed to confirm placement, which is considered the 'gold standard'[7]. Misidentification of incorrectly placed NG tubes can happen due to improper patient positioning and reporting errors[8].

When assessing the image, it's essential that the entire lung field is visible, extending from the apices to the costophrenic angles. In addition, the chin should not overlap with any other anatomical structures, the sternoclavicular joints should maintain equal spacing, and at least eight posterior ribs must be seen above the diaphragm[9]. To verify the proper reporting of the X-ray, there are national guidelines established by the British Association for Parenteral and Enteral Nutrition (BAPEN), referred to as the 'four criteria'[10]. These are illustrated in Figure 2.

The four criteria must be considered when assessing misplaced NG tube complications. A misplaced NG tube can enter a bronchus and be positioned in the lung or curl up in the oesophagus. Using an improperly placed NG tube can result in serious complications, some of which may be fatal, such as respiratory distress syndrome (ARDS), which is classified as a 'never event'[11]. Figure 3[3] demonstrates what a correctly placed NG tube should look like, adhering to the four criteria. In contrast, Figure 4[12] shows the appearance of a misplaced NG tube that does not meet these criteria.

This study seeks to determine the reasons radiographers may not accurately report misplaced NG tubes. Inaccurate reporting can occur due to factors such as patient positioning and failure to adhere to the four imaging criteria. This oversight can lead to missing the crucial anatomy needed to confirm proper tube placement, increasing the risk of never events and necessitating repeated CXRs. Such repetitions expose patients to unnecessary radiation, contravening the UK's Health and Safety Legislation of 'As Low as Reasonably

Figure 2. The four criteria for confirming NG tube placement



Practicable' (ALARP)[13]. Moreover, delays in reporting may postpone patient feeding until the next day, as many hospital trusts typically only evaluate NG tube positioning X-rays during business hours, between 9am and 5pm.

The Lean Six Sigma (LSS) methodology[14], a service improvement framework, has been implemented in this study to tackle the challenges associated with the inaccurate reporting of NG tubes. This approach follows the 'DMAIC steps'[15] – define, measure, analyse, improve, and control (Figure 5) – aimed at identifying the root cause of the problem and ensuring the solution is sustained. Specifically, the 'define' phase[16] focuses on the misidentification of incorrectly positioned NG tubes and aims to decrease instances of never events, enhancing patient safety. In addition, it emphasises the development of service improvement skills among the staff responsible for identifying these misplacements. Key stakeholders in this project include radiographers, patients, dieticians, radiologists and nurses involved in patient care.

Literature review

A thorough literature review was conducted using the Primo, PubMed and Medline databases, concentrating on studies published within the timeframe of 2011 to 2024. The search process involved the strategic use of keywords, such as 'nasogastric', 'NG', 'tube', 'placement', 'confirmation' and 'X-ray'. To maintain the review's integrity, specific exclusion criteria were applied – studies that were over 15 years old, those that focused exclusively on paediatric populations, and articles that explored NG tube confirmation methods other than CXR were omitted from consideration. From this meticulous search, two articles that closely aligned with the research objectives were identified and selected for further examination.

In parallel with the literature review, the National Patient Safety Agency (NPSA) published a significant patient safety alert, entitled 'Reducing the harm caused by misplaced nasogastric feeding tubes in adults, children, and infants.' This alert underscores the importance of ensuring accurate placement of nasogastric tubes to prevent potential patient harm. Released in February 2005, the alert was prompted by alarming reports of injuries and fatalities related to improper tube placement[17,18]. Notably, between September 2005 and March 2011, the National Reporting and Learning System (NRLS) documented 45 incidents of patient harm and 12 deaths

Figure 3. A correctly placed NG tube[3]

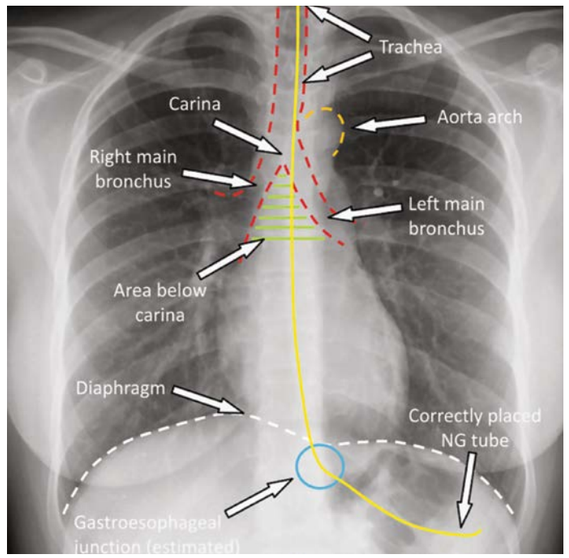


Figure 4. A misplaced NG tube[12]

Figure 5. Description of DMAIC methodology stages[15]

due to the misinterpretation of X-ray images, which alarmingly represented 45% of reported 'never events' associated with the use of NG tubes[11,18].

In response to these serious concerns, the NPSA advocated implementing competency-based training to enhance medical professionals' skills in accurately interpreting X-ray images. This recommendation highlights the critical role that adept image interpretation plays in ensuring patient safety and preventing adverse outcomes. Although the NPSA report was published in 2011, its implications remain relevant today as it established the misplacement of NG tubes as a recognised 'never event' within healthcare settings[18].

The collaborative effort of the NPSA team to produce the report and develop new guidelines further guarantees the objectivity of the results. However, the dependence on hospital trusts to honestly report 'never events' raises concerns; minor incidents may remain unreported to the NRLS, influencing the data used by the NPSA[19].

Research by M. Tierney et al.[20] underscores the failure to adhere to these guidelines, which are considered national standards, regarding the established four criteria. In this study, 34 medical registrars from diverse specialities evaluated a CXR to determine the proper placement of the NG tube. Alarmingly, only 17.6% of respondents correctly identified all four criteria, and just 23.5% noted even one criterion. Furthermore, 20.5% of interpretations were incorrect, with 82.4% deemed inadequate due to improper use of the four criteria, posing significant risks for patient safety.

The study compellingly advocates for establishing an ongoing educational programme to enhance the safe interpretation of NG tube placements in CXRs. Published recently in 2017, this research used well-defined tasks for data collection, supporting its credibility and replicability. Consistent with its findings, the study reinforces the urgent need for more comprehensive training. However, it is essential to note the limitations, including a relatively small sample size of 34 junior doctors from the Wessex region, all with varying levels of experience from ST3 to ST7[21] and different specialty training. While the results highlight pressing deficiencies among healthcare professionals in using the criteria, expanding the participant base across a broader geographic area in the UK could ascertain whether these challenges are confined to a specific NHS trust or indicative of a more significant, nationwide issue. Both pieces of literature underscore the critical importance of accurately reporting NG tube placements to prevent never events, advocating for educational initiatives to improve healthcare professionals' ability to identify NG tube misplacement effectively.

Methodology

The 'measure' phase[22] involved conducting a survey to pinpoint which aspects of identifying incorrectly positioned NG tubes were overlooked. The study participants included 27 radiographers from an NHS hospital trust in the UK who work in plain film departments and regularly perform confirmation X-rays for NG tubes as part of their routine. All participants willingly participated in the study, and their identities were kept anonymous to ensure confidentiality and prevent any impact on their professional competence among colleagues.

The sample group participated in a survey sent to radiographers via Microsoft Forms[23]. The survey featured a combination of qualitative short-answer questions and quantitative questions about the positioning techniques necessary for accurately imaging and reporting a patient's NG tube CXR. The survey questions focused on these key areas: X-ray interpretation, NPSA guidance, and identifying potential training opportunities to enhance the trust's practices. This survey had previously been administered as a baseline with three reporting radiographers to verify its effectiveness in gathering results.

The survey consisted of 11 mandatory questions (Table 1). Two of them concerned the interpretation of CXRs. The aim was to determine the average percentage of NG tubes that might be misinterpreted and explore potential developments to enhance patient safety[24]. Another question focused on the radiographers' continuing professional development (CPD).

Using a survey was the most effective method for gathering the data as it encouraged radiographers to be open about their knowledge without the stress of time constraints typical in a busy hospital setting. This approach allowed participants to respond thoughtfully when they had the opportunity, facilitating quick general conclusions[25]. In addition, the inclusion of multiple-choice questions helps remove researcher bias[26], which is essential for pinpointing the sources of difficulties related to identifying misplaced NG tubes.

To advance to the 'Measure' stage[22] of DMAIC, a process map (Figure 6) was developed to depict different categories of issue and to pinpoint exactly where the problem occurs.

Figure 6. Process map

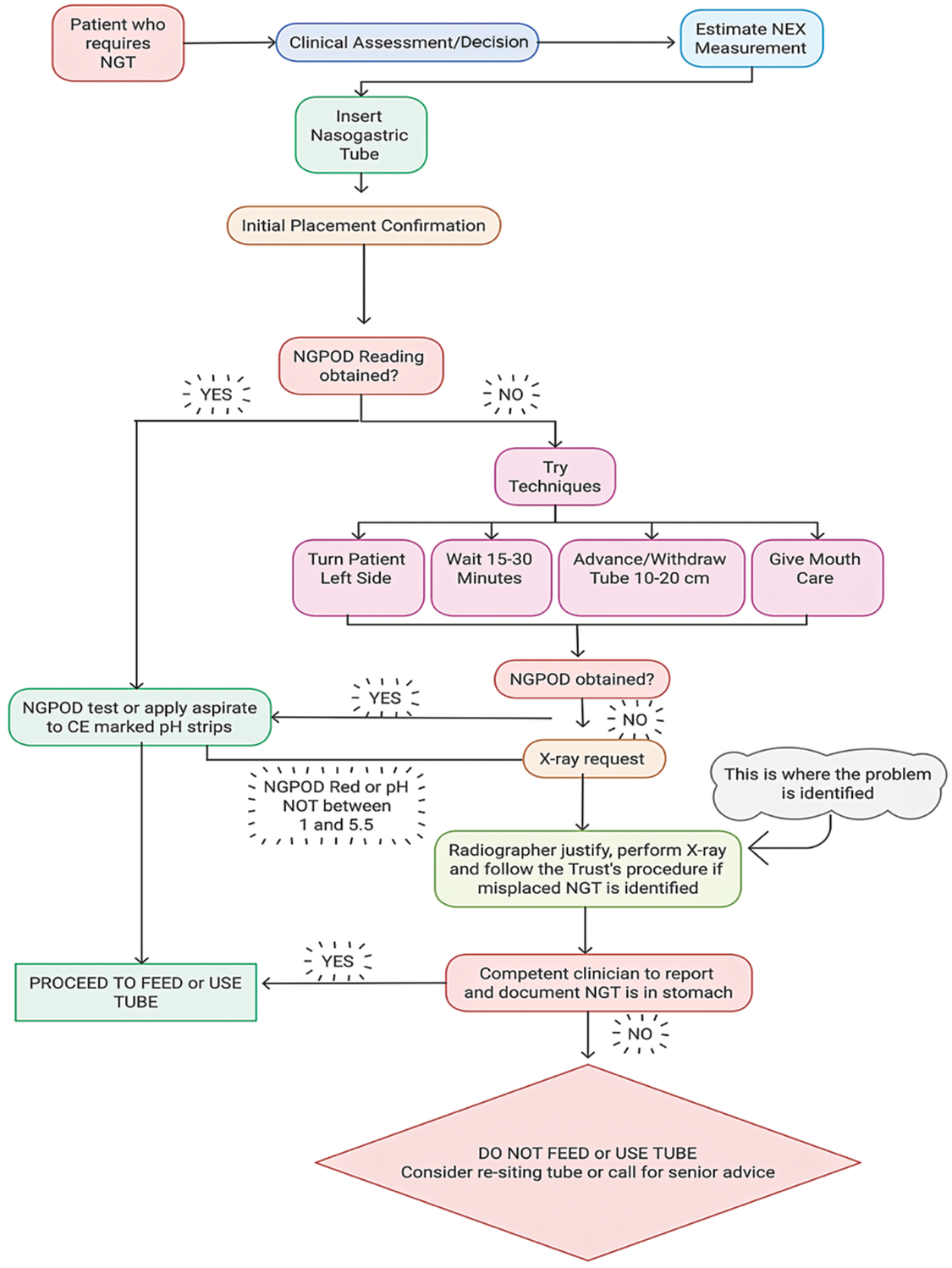


Table 1. Questionnaire distributed to radiographers

Questions	Answers options
1. How confident are you in identifying the correct placement of an NG tube on a chest X-ray?	Very confident, somewhat confident, neutral, somewhat not confident, not confident
2. Have you received any formal e-learning or competency-based training on NG tube placement checks?	Yes, no, unsure
3. Have you read and understood the local NHS trust policy regarding NG tube placement on chest X-rays?	Yes, no, unsure
4. How often do you perform chest X-rays for NG tube placement confirmation in your current practice?	Daily, weekly, monthly, yearly, never, other (open answer)
5. Would you be confident removing a misplaced NG tube if you have had training?	Yes, no, unsure
6. Do you agree that more training on NG tube placement confirmation would improve patient safety?	Strongly agree, agree, neutral, disagree, strongly disagree
7. Have you ever taken a chest X-ray for NG tube confirmation outside of regular reporting hours, knowing the scan would not be reported on until the following morning?	Yes, no, unsure
8. In your opinion, how helpful can posters illustrating the four criteria for NG tube placement be displayed in the department?	Very helpful, somewhat helpful, neither helpful nor unhelpful, somewhat unhelpful, very unhelpful
9. Do you know the “four criteria” used to assess NG tube placement on a chest X-ray?	Yes, no, unsure
10. What improvements do you think can be made to ensure radiographers are better at identifying NG tube misplacements on chest X-rays?	Open answer question
11. What challenges, if any, do you encounter when assessing NG tube placement on chest X-rays?	Open answer question

Results

Figure 7. Radiographers' confidence in identifying the correct position of NG tube on CXRs

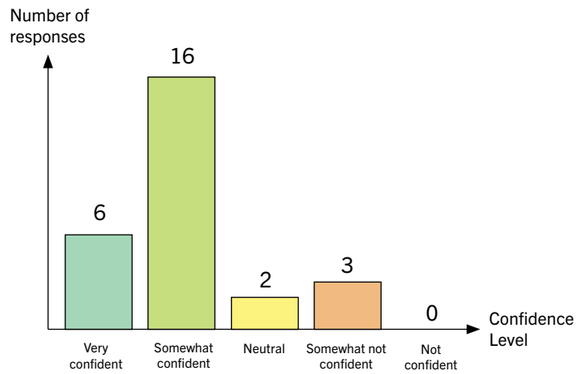


Figure 8. Number of radiographers who received formal e-learning or competency-based training on NG tube placement checks

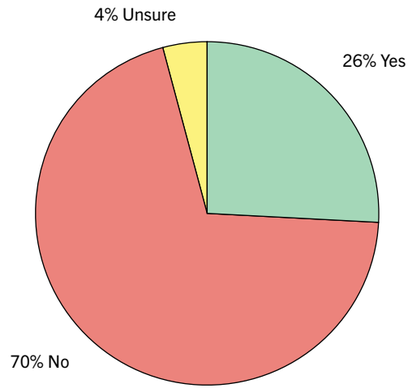


Figure 9. Number of radiographers who read and understood the local NHS trust policy regarding NG tube placement on CXRs

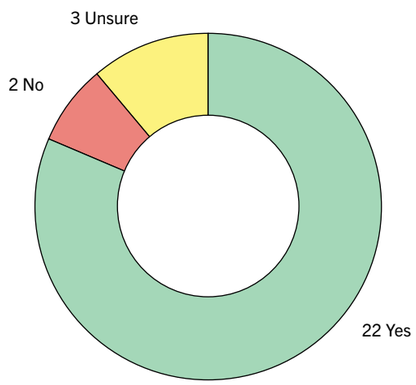


Figure 10. How often radiographers perform CXRs to confirm NG tube position

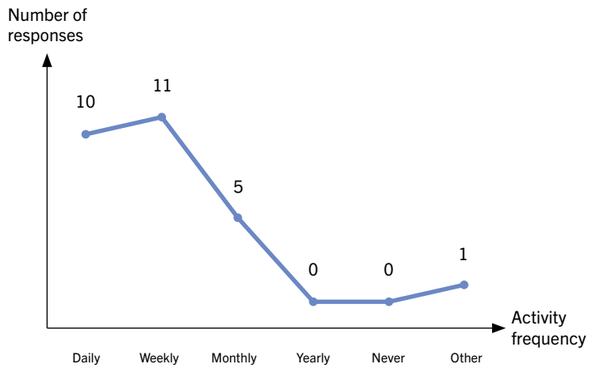


Figure 11. Radiographers that will feel confident removing a misplaced NG tube if they have had training

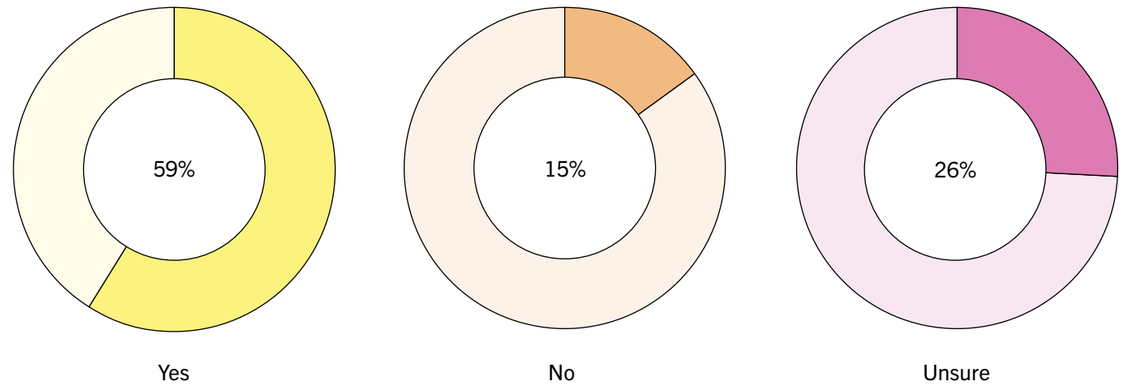


Figure 12. Number of radiographers that took CXRs for NG tube confirmation outside of regular reporting hours

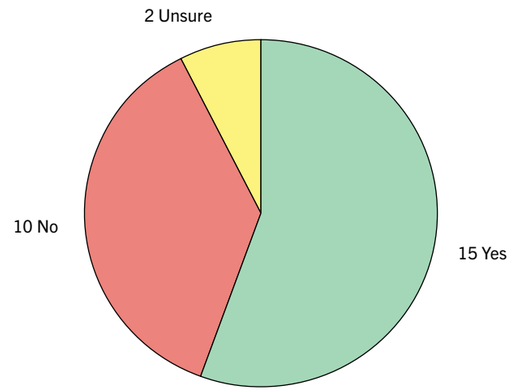


Figure 13. Radiographers who agree that more training on NG tube placement confirmation would improve patient safety

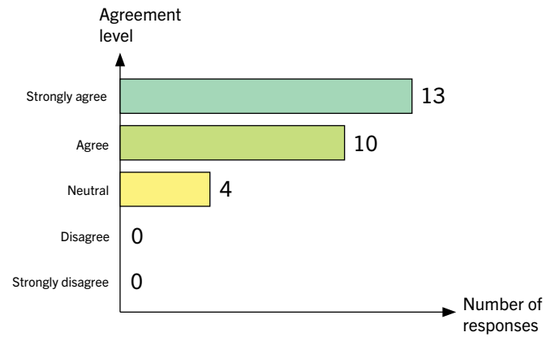


Figure 14. How radiographers feel about posters illustrating the four criteria for NG tube placement being displayed in the department

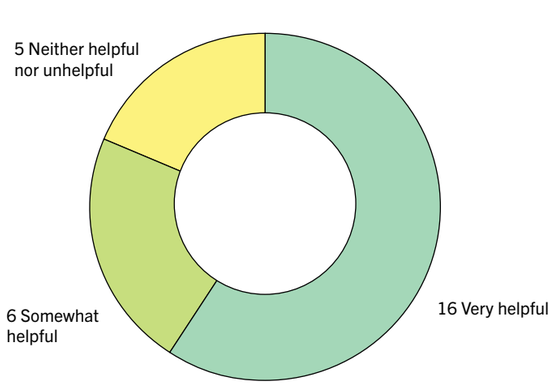


Figure 15. Percentage of radiographers who know the four criteria

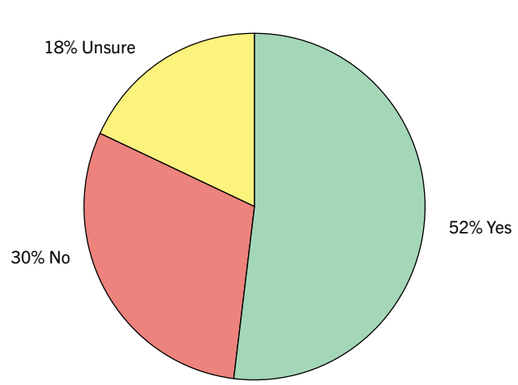


Figure 16. Challenges the radiographers faced when assessing NG tube placement on chest X-rays

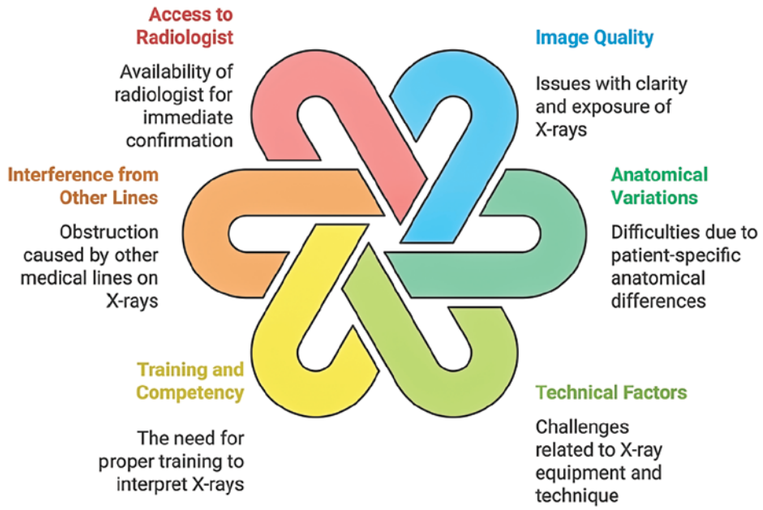
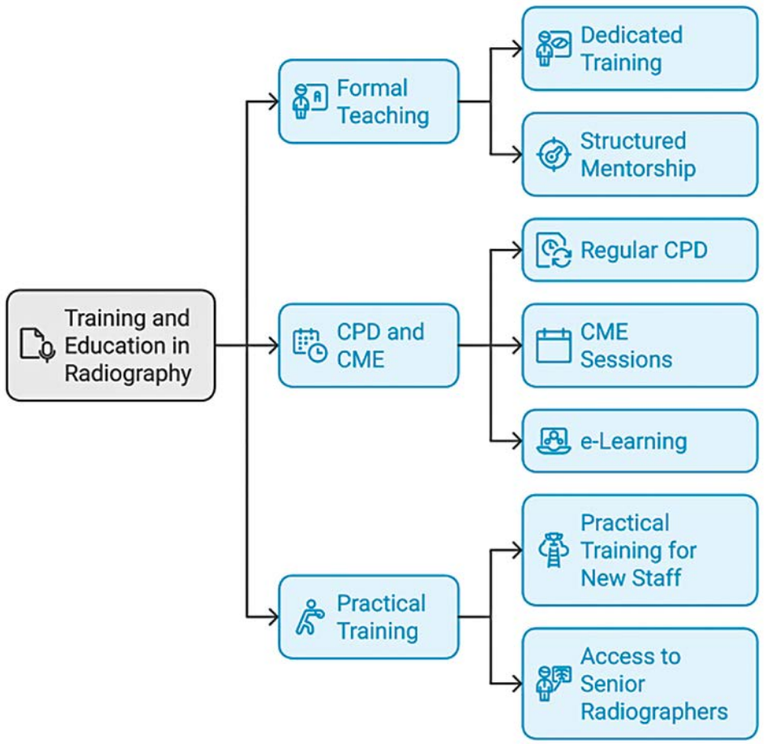


Figure 17. Improvements the radiographers suggested



Discussion

In the analysis stage[27], the data revealed themes and connections related to patient safety concerning NG tubes in the X-ray department. The results suggest that improving service necessitates additional training for recognising NG tube misplacement. Placing posters throughout the department detailing the four essential criteria for correct placement would also be beneficial. Only six of 27 participants expressed high confidence in correctly identifying the NG tube's position on chest X-rays (Figure 7). Ideally, all 27 participants should be confident, as any inaccuracies can result in serious 'never events'. This result could be because only 52% of participants knew the four criteria for assessing the correct NG tube placement (Figure 15). Furthermore, only 26% of participants engaged in formal e-learning or competency-based training (Figure 8) during their CPD, which could have enhanced their skills in image evaluation.

Continuing the discussion on training challenges, only 22 of 27 radiographers (81.4%) have reviewed their local trust policy regarding NG tube placement (Figure 9), which underscores the essential elements the radiographer must consider while imaging the patient. Fifteen radiographers X-rayed a patient for NG tube confirmation outside regular reporting hours, knowing the scan would not be reported until the following morning. Ten radiographers did not X-ray, while two were unsure (Figure 12), indicating discrepancies in the correct course of action. In the study, 59% of the radiographers expressed confidence in removing an incorrectly placed NG tube after receiving training (Figure 11). This competency enhances patient safety by preventing accidental feeding if a misplaced NG tube is not removed before the patient returns to their ward.

The results suggest that the 'improve' phase[28] reveals that improper NG tube comments stem from insufficient CPD and a lack of awareness about the four criteria. In comparison, the NPSA patient safety alert report[17,18] indicates that 45% of 'never events' arise from misinterpretations of images by radiologists and reporting radiographers.

In addition, only 22% of the surveyed radiographers expressed high confidence in identifying misplaced NG tubes on CXRs. This result aligns with the findings of a multi-case, multi-reader study, which concluded that Diagnostic Radiographers without formal qualifications in CXR interpretation can assess NG tube positioning on CXR images with moderate accuracy. However, they need additional training, including strategies for identifying

"Many radiographers appear to be unaware of the four criteria that should be used to assess correct placement"

poorly visualised tube tips, to reach the 100% accuracy required for this safety-critical task[29].

This study highlights the lack of significant improvement. It is worth noting that the evaluation excluded 'never events' and did not span six years, unlike the NPSA data. Despite the NPSA's patient safety alert from 2011, issues with patient safety remain, mainly due to non-compliance with the recommendation for competency-based training. Consequently, radiographers have struggled to improve their image interpretation skills for NG tubes. The study demonstrates this, revealing that only 26% of the radiographers completed the necessary competency-based training, underscoring that this NHS trust has not implemented the guidance.

Building on M. Tierney et al.'s findings[20], which indicated that only 17.6% of participants identified the four criteria for interpreting NG tube X-rays, this study found that 59% of participants could do so. Although there is an improvement, more is needed for safe practice. Continuous training programmes and departmental posters illustrating the four criteria are recommended. The observed improvement may vary by region, as studies were conducted at different NHS trusts. A 'control' phase[30] could be introduced to sustain progress, with annual audits to assess the effectiveness of educational initiatives and monitor radiographers' skills in interpreting NG tube images.

Limitations

This study had limitations, such as the potential for voluntary response bias[31] due to the small sample size. The survey might have primarily attracted participants who strongly believed that the misplacement of NG tubes was an issue, possibly leaving out views from radiographers who did not perceive it as a problem or those who did not have time to participate. In addition, the findings might only be generalisable to some radiographers in the UK as the focus was limited to improvements within a single NHS trust. On a positive note, the anonymity of participants ensured that the data collected was reliable, valid and replicable.

Conclusion

In conclusion, the persistent problem of misidentifying misplaced NG tubes reveals critical areas for improvement in radiographers' skill sets and knowledge bases. This issue suggests there is a significant disconnect between practice and awareness, as many radiographers appear unaware of the four criteria that should be used to assess the correct placement of NG tubes on CXRs. These criteria are vital indicators for correctly positioning NG tubes, and a lack of understanding in this area can lead to serious clinical consequences.

In addition, many radiographers have not engaged in e-learning modules or competency training programmes that could significantly enhance their image-evaluation skills. Without this training, their ability to assess images accurately is compromised, raising the likelihood of misdiagnosis or incorrect interventions. Therefore, the Society of Radiographers (SoR) is promoting a radiographer-led pathway for checking NG tube placement, urging NHS trusts to test it with training and support from the Society and The Royal College of Radiologists[32].

Furthermore, there is significant confusion regarding the guidelines radiographers should follow when evaluating NG tube placements. This confusion worsened because some of the study participants still needed to consult the local policies their trusts had established regarding NG tubes. This lack of adherence to protocol undermines patient safety and contributes to the inconsistency in radiographic practices.

A pressing need exists to implement more extensive and mandatory CPD opportunities throughout a radiographer's career. These educational initiatives would allow radiographers to update their knowledge and skills regularly, ensuring they remain proficient in the latest standards and practices related to NG tube placements.

However, the study has limitations, including reliance on a relatively small sample size, which may affect the findings' applicability to a larger population. Despite this limitation, the results highlight a significant correlation between the lack of compulsory training and the enhancement of radiographers' proficiency in identifying misplaced NG tubes.

Conducting a follow-up survey after one year would be beneficial to evaluate whether implementing structured CPD initiatives and using informational posters outlining the four critical criteria would significantly improve the accuracy of identifying misplaced NG tubes. This study should assess any advancements made and determine whether these improvements result in meaningful changes in practice for radiographers in various clinical settings. Such insights could help refine training programmes and policies, enhancing patient safety and care outcomes. ■

About the author

Yaseen Obaid is a newly qualified Diagnostic Radiographer at Cambridge University Hospitals NHS Trust.

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- **Keywords.** State up to six keywords that reflect the content of the intended piece.
- **Title.** This should be a concise description of the intended work to give the reader a clear idea of what to expect in the article.
- **Aim.** A short statement detailing the purpose of the article.
- **Body.** A brief overview of the entire article describing the areas that will be reported (for example, methods, results, outcomes).
- **Conclusion.** State what conclusions may be drawn from the work, what any results may indicate, what the implications of the findings may have on clinical practice, and give consideration to recommendations for future studies.
- **References.** Include some key references to support the basis of the work.

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- Take a clear line of argument.
- Analyse (not just describe) your thoughts

and feelings about the experience.
- Refer to evidence from existing literature on the topic.
- Discuss different perspectives.
- Detail your own points of learning.
- Suggest how your future practice might change.

Case study

A case study is an intensive, systematic study of an episode of care, a person, a group of people or a unit[1,2] and may be written with the team involved. The case must be relevant to readers and support their learning and should, therefore, be engaging. It is not necessary to look for rare or exotic occurrences. In everyday practice, radiographers and students may encounter complications, unusual occurrences, ethical or management challenges, near misses and potential pitfalls. Such experiences result in reflection, learning and perhaps a review of practice from which other practitioners may also benefit.

Writing a case study

Case studies should be around 2,000 words, excluding references, CPD learning points, tables and figure headings.

Tip A summary of up to 150 words to summarise the case and outcome may help you to draw out the important elements.

The following headings should be used:
- **Abstract.** Up to 150 words to summarise the case and outcome.
- **Case presentation.** Brief description of the situation or patient presentation to capture key features about how the incident occurred, or patient presented, what were the main issues and why this is relevant.
- **Management.** (This may include sub-headings). Include actions that were taken to manage this experience with a brief explanation of what influenced your decisions and the resulting outcomes. If you needed to adapt practice guidelines, indicate where in the pathway this was done and how.
- **Outcome.** Include follow-up data where possible to support readers' understanding of the outcome. Indicate the follow-up period. State the impact.
- **Discussion.** Include a brief review of similar published literature including relevant clinical guidelines and/or protocols.
- **Learning points.** What did you learn from this case? Please give three to five points. This is the most important part of your case study.
- **CPD activities.** Please also provide three points, questions or activities for readers to reflect upon, answer or look up.

"Your work will be reviewed by the Editorial Board and constructive feedback will be provided"

Review paper

Review papers address topical clinical, ethical and policy issues that matter to radiographers, patients and health policymakers. The topic should be timely.

Writing a review paper

Review papers should be around 2,500 words, excluding references, CPD activities, tables and figure headings.

The following subsections should be considered in order to develop a structured paper:
- **Introduction.** A succinct introduction is necessary to establish what is already known, identify the gap in the field and outline the motivation for the review. A good motivational statement will steer away from simply stating that 'this has not been done before'. Include clear definitions of key terms, where appropriate. Outline what the structure will be and why this is helpful.
- **Main content of review.** The content should analyse, synthesise and interpret the literature to present a clearly reasoned argument. Use subheadings in the main body of the text so it is logical and easy to follow.
- **Discussion and conclusion.** Include a discussion and conclusion section. A clear message is an important endpoint.
- **CPD activities.** Please provide three points, questions or activities for readers to reflect upon, answer or look up.

Research paper

Original research papers should be around 2,500 words, although up to 4,000 words is acceptable for a qualitative research paper. This excludes references, CPD activities, tables and figure headings.

Original research papers involve research or audit that may improve practice in the clinical environment, influence policy development, education and/or research. All submissions should include an abstract of 300 words (see opposite). Research involving people should include relevant information about ethical issues. Please also provide three points, questions or activities for readers to reflect upon, answer or look up.

The article should be written in the standard scientific format:

- Abstract
- Introduction
- Method
- Results
- Discussion
- Conclusion
- CPD activities

Poster

Posters are visual communication tools for engaging people in your research or clinical project. They may also be displayed in your department to raise awareness of your work and spread knowledge. Therefore, the design and physical appearance are important features for successful promotion[3].

When published, your poster will appear as a quarter-page image to showcase the design. The main text or a summary will appear alongside, and readers will be able to download the full poster from the SCoR website.

For submission, poster files should be labelled with the author's name, and you will be asked to insert the text separately to the submission form.

Developing a poster

The poster should convey the main points about your work. The following headings, therefore, should be included to organise your content:
- **Title.** Your title should be brief, eye-catching and results oriented. Avoid clever titles.
- **Introduction.** This should be succinct, consisting of a few sentences providing sufficient context using the most relevant references. A lengthy review should be avoided. The aim(s), hypothesis or research question(s) should be presented at the end of this section.
- **Methods and materials.** This outlines your research design, procedures, group/participant characteristics, equipment/material and/or the chosen outcome measures. Include data analysis methods. Keep it brief, use bullet points, tables and figures where appropriate.
- **Results.** Begin with the hypothesis or question(s) to remind your audience. Present an overview of your findings and include charts, graphs and figures where appropriate. Avoid too much text and keep paragraphs brief.
- **Discussion/conclusions.** Address your aim(s)/research question(s), explaining why your findings are important. How do your findings relate to previous work? How do they apply to your field? What should happen next? Be concise and use bullet points where appropriate.
- **Citations and acknowledgments.** Use current references, avoid grey literature. Thank those who have helped you and funded your project. Declare conflicts of interest, if appropriate.

Design tips
- Use a limited colour scheme that complements the rest of your poster.
- Use white space effectively to allow your audience to focus on the content.
- Use high-quality photographs.
- Limit the use of clip art.

Visual elements

Images, figures, charts and tables should be numbered consecutively, in accordance with their appearance in the text, using Arabic numerals (1, 2, 3 etc.) and figures with multiple parts should be labelled alphabetically (for example, 1a, 1b).
- Insert a caption into the text when you first refer to an item. Captions should consist of a brief title and description and should include an explanation of any abbreviations and symbols used.
- Do not include the caption on the image or figure itself.

Charts and tables
- These must be submitted as editable text, not in image formats, for example, screenshots.
- Reference must be made in the text but data presented in charts and tables should not be discussed elsewhere in the article to avoid repetition.
- Avoid shading the table cells.

Photographs and medical images
- These should be original materials. Photocopies of photographs are not acceptable.
- People should not be identifiable in photographs (masking the eye area alone does not guarantee anonymity). If people are recognisable, a consent form from the subject for the use of the photograph must accompany the submission.
- Label all photographs and medical images with the figure number and ensure correct orientation.
- Remove non-essential areas from the photograph or medical image.
- Copyright agreement and acknowledgments should be provided where necessary.

Diagnostic images
- These must be fully anonymised original files and consent gained in line with GDPR (see below).
- Resolution must be 300dpi and files approximately 1mb in size. Images downloaded from the internet are unlikely to be of a high enough resolution for print purposes. Please contact the editor for advice at insight@haymarket.com if such images are used in your work.
- All images usually produced for an examination should be included, that is, two projections where this is normal practice, and be presented in the correct orientation, that is, how they would be viewed in normal practice.
- Images must have the correct anatomical marker and, where technically relevant, the data on the image should identify projection. For example, AP/PA; erect/supine; slice orientation if cross sectional (sagittal/coronal/transverse, etc).
- Information accompanying the image should include, where appropriate, the relevant clinical history and clinical question (especially if the image is to be reported), the source of the image (clinical image title/downloaded from the web, including website address).

References
- References must be listed according to the Vancouver system, a numeric system where the references are numbered sequentially as they occur in the text and correspondingly numbered in the reference list.
- In the text use superscript when citing references, for example[1]. The reference number should appear within the punctuation if it is at the end of a sentence, that is, before a full stop or quotation mark. Do not bracket the numbers.
- If the reference appears more than once, use the original number assigned to it on subsequent appearances.
- Please do not use footnotes – these cannot be accepted.

CPD activities

Please provide three points, questions or activities for readers to reflect upon, answer or look up. This is a way of highlighting the important parts of your article for others to learn through in a broader sense, and to reflect on how your article impacts on their practice. Readers will be able to scan a QR code on the article and record their learning on the CPD Now website.

Submitting your article

All articles and abstracts should be submitted to the *Insight* online submissions portal at www.sor.org/insightauthor.

You will be asked to register on the system through which the whole submission and review process will be managed. You will be guided through the process step by step, inserting your text and additional elements in the formats detailed above.

Review process

While reviewing your anonymised submission, the members of the board will be assessing:
- **Relevance of the topic.** Is the content relevant to the current readership and to the objectives of *Insight*?
- **Content.** Is the content applicable to the current situation in clinical practice?
- **Structure.** Does the structure comply with the general format expectations?
- **Standard of writing and coherence.** Is it easy to read and does it flow well? Does it make sense?
- **Referencing.** Is it suitably referenced with current and relevant literature referenced in the correct way?
- **Accuracy.** Are there any technical errors?

The reviewers will decide if the article needs revision prior to publication. Each reviewer will submit comments and you will be alerted to when you can log in to view the comments. The Editorial Board aims to provide feedback within four weeks of submission. You will be expected to submit a revised version within four to six weeks, depending on the changes requested. ■

References

1. Gustaffson J. Single case studies vs. multiple case studies: a comparative study (thesis). Halmstad, Sweden: Halmstad University 2017.
2. Woods NF, Calanzaro M. *Nursing Research: Theory and Practice*. St. Louis: Mosby 1980.
3. Dragan I, Rowe N. What is the evidence that poster presentations are effective in promoting knowledge transfer? A state of the art review. *Health Info Libr J* 30(1): 4-12. Available at https://doi.org/10.1111/hir.12015 Accessed 23 November 2020.

Can *you* help?

Head and neck radiotherapy for secretory carcinoma

The Rad Chat Image Library aims to improve the experiences of ethnically diverse people during cancer care and beyond.

To help address health inequalities worldwide, Naman and Jo (Rad Chat) need photos of your cancer related skin changes.

To contribute, email:
rad_chat@outlook.com

Scar on person with brown skin

Scan the code to view the Rad Chat Image library or visit

www.radchat.co.uk ➤