Understanding Therapeutic Radiographers' Confidence in Assessing, Managing & Teaching Radiation Induced Skin Reactions (RISR): A national survey in the UK.

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Manuscript

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Introduction
The standard toxicity tools adopted for assessing Radiation Induced Skin Reactions (RISR) do not currently reflect how skin changes occur across all skin tones.
A one size fits all approach is adopted currently for RISR assessment. The aim of this study was to understand what evidence-based practice and RISR tools are being used across the therapeutic radiography workforce and the levels of confidence in using these tools.

Methods
A survey using Likert scales to assess confidence in RISR assessment and management was made available to 77 departments in the UK between August-November 2021. The departments included private and satellite centres according to the SOR internal database. Descriptive statistics were used to understand respondents' confidence in assessing, managing, and teaching RISR between white, brown, and black skin tones; Fisher's exact test was used to assess the significance of differences between groups.

Results
Complete responses were received from 406 therapeutic radiographers. Radiation Therapy Oncology Group (RTOG) was the most used RISR assessment tool (58% of respondents n=237). Most respondents (74.2% n=303) reported use of locally produced patient information on skin care, rather than the Society and College of Radiographers evidence-based patient leaflets. Confidence in assessing and managing RISR in white skin was higher than that in brown and black skin. Similarly, confidence was higher in teaching of appropriate RISR assessment and management in white skin tones when compared to brown and black skin.

Conclusion
White skin tones appear to be more confidently assessed and managed for RISR along with taught appropriate assessment and management, than brown and black skin tones in the sample of the workforce that responded.

Implications for Practice:
A greater understanding of the reasons for these differences is required but this study aims to instigate change and positive growth within this area.

Introduction

Radiation Induced Skin Reactions (RISR) are one of the most common side effects of external beam radiotherapy[1-4]. The development of a RISR is a function of total radiation dose received, skin area, external beam radiotherapy, use of bolus material and factors individual to the patient such as diabetes[1-4]. The severity of a RISR is dependent on the total radiation dose received, the area treated (i.e.: where there are skin folds skin reactions are often more severe) and use of additional bolus material that removes the skin sparing effect of mega voltage treatments. With this, the use of concurrent chemotherapy and potentially individual lifestyle choices can also increase the severity. In the United Kingdom (UK), the Society and College of Radiographers (ScoR) have led on research into understanding RISR and establishing guidelines for the radiotherapy workforce.

Harris et al., surveyed therapeutic radiographers in 2011 to understand radiotherapy skin care practice in the UK identifying variability in practice[3]. These variabilities include use of topical agents such as creams, evidence base within local department leaflets and the use of a baseline assessment tool to assess risk of severe RISR, amongst others. A recurrent recommendation within the radiotherapy skin care setting is to implement pre-treatment assessment, gather baseline data, use consistent skin toxicity scoring and use evidence-based practice to guide patients and health and care practitioners (HCPs)[2-4]. Pre-treatment assessments stratifying risk of more severe RISR have been found in evidence to be beneficial in small centre trials focusing on specific RISR risk factors within breast, head and neck, and gynaecological cancer treatment plans[6,10,11].

The SCoR produced an extensive practice guideline on skin care in 2020 along with patient and staff RISR guidance leaflets[4]. These include the recommendation for gathering baseline data to help stratify risk of patients developing severe RISR. The guidance was based on available evidence on interventions tested to reduce or prevent RISRs thus the guidance does not provide insight into how RISR interventions perform across all skin tones as the evidence rarely measured skin tone or did not report RISRs by ethnicity or skin tone. Of the journal articles and randomised controlled trials reviewed for this guidance (n=33) only one study incorporated skin tone within their results with a small population of people of colour within the study[12]. This highlights the need to understand skin tone differences and seek a wider evidence base to ensure inclusivity.

Jagsi et al., found evidence of ethnicity-related differences in radiotherapy related toxicities following breast cancer radiotherapy from patient cohorts between 2012-2019 (n= 8,711) [7]. Black and Asian patients reported a statistically significant increase in pain scores and patients with black skin tone had greater irritation from breast symptoms (including itching, stinging, burning, or swelling of the breast) odds ratio 1.33 (white skin reference =1) [7]. Abdelkarem et al., found ethnicity related differences when evaluating research studies that included 28,354 individuals from 1996-2021 where it was identified that patients from white backgrounds had more severe toxicities following prostate (n= 9,357) or breast cancer (n= 7,372) [8]. This difference between ethnic groupings may be due to low samples of people of colour participating in trials during this time period[13]. The research by Jagsi and

Abdelkarem would indicate a need for evaluating ethnicity within reported outcomes[7-8].

Aligned to this gap in understanding of differences in radiotherapy outcomes between different ethnic groupings is the lack of ethnically inclusive language in current toxicity scoring[9]. These tools, Common Terminology Criteria for Adverse Events (CTCAE) and RTOG, were developed by consensus, utilising the Fitzpatrick scale, a scale that, Jothishankar and Stein[14] found, was developed primarily for white skin tones, and does not cater for many ethnically diverse skin tones. This leads to concern that existing RISR grading tools may not be effective across all skin tones as they presume RISR affects all skin in a consistent manner. Baines et al., found widespread disparities in how RISR is identified depending on patient condition, levels of experience, room lighting and training[15]. In addition, the most widely used tools are the Radiation Therapy Oncology Group (RTOG) and Common Terminology Criteria for Adverse Events (CTCAE) scoring systems; neither tool has been validated across a broad range of ethnicities despite widespread use in clinical practice and across radiotherapy clinical trials[16]. These tools use terms such as erythema or redness to evaluate RISR on patients' skin. The British Association of Dermatology (BAD) state that the term redness can be misleading and that there is no straightforward way to determine what colour erythema will be on an individual's skin[9,17-18]. The bias towards the term, 'redness,' which can present differently across skin tones, has created a bias that may lead to individuals with brown and black skin tones to receive inadequate care[9, 17-18].

Patient experience and patient reported outcome measures (PROMS) are notably absent from these tools. The Radiation-Induced Skin Reaction Assessment Scale (RISRAS) is a tool which incorporates PROMs but is not widely used in the UK[19]. More recently, a lay tool incorporating the RTOG scoring system has been trialled with individuals undergoing breast cancer treatment as part of the Support 4 All study (S4A)[20]. Initial results from the S4A clinical feasibility trial showed good patient compliance with this co-designed patient self-monitoring tool; the tool now needs further testing as part of a broader validation process. A crucial detail that is not present within these tools is the understanding and direction of how RISR presents on different skin tones[9].

With the publication of the new SCoR skin care guidelines and a decade passing since the first survey of skin care practice was conducted, it was time to re-assess current practice within the UK. This was to understand how skin care practice is delivered across the UK a national survey was undertaken to evaluate the current service provision. The primary aim of the survey was to identify consistency or variation in skin care practice for managing RISR. A secondary aim was to understand whether practitioners are confident in utilising the skin toxicity assessment tools employed within their centre and how confidence in using the tools may differ across different patient skin tones.

Method

A national survey of UK therapeutic radiographers, student radiographers and assistant radiographers working in radiotherapy was conducted.

Questionnaire design:

A 25-question survey was designed by the primary author and reviewed by a panel of experts with professional and lived experience of cancer that included two therapeutic radiographers and an oncology nurse. The 2011 survey was used as the starting point for design of a new questionnaire[3]. The questionnaire was divided into 6 sections (see Table 1). A combination of multiple-choice and open-ended questions were used to allow understanding of individual responses. For questions measuring confidence, a Likert scale was adapted from a confidence tool by Hecimovic, Styles and Violet; 0-5 (0 being 'not at all confident' and 5 being 'very confident')[21-22]. With 0 and 1 representing low confidence, 2 and 3 as moderately low and high confidence respectively, 4 and 5 representing high confidence. Confidence data for each skill was collected independently for each participant. The questionnaire was piloted on 19 therapeutic radiographers and assessed for face and content validity by 3 independent reviewers with experience of survey design and skin care research.

Section	Survey Question Sections	Number of Questions
1	Respondent demographics	1
2	Job role and responsibilities	3
3	Knowledge of existing Radiation dermatitis guidelines and patient information resources	3
4	Local departmental approaches to skin care assessment and management	2
5	Confidence in assessing, managing, and teaching assessment of RISR	12
6	Wound management and further training needs on RISR	4

Table 1: Survey question sections

Table 2 below highlights the descriptive data analysis for the questions this survey intended to answer.

Questions to Answer	Analysis
Have staff heard of and/or read the SCoR guidelines along with the patient and staff leaflets?	Descriptive
Do departments use the SCoR evidence-based leaflets and guidance document? Do departments use local departmental leaflets? What toxicity scoring system they normally use?	Descriptive
How confident are staff at assessing, managing, and teaching assessment of RISR with white vs brown and black skin tones?	Fisher's exact test for statistical significance to test if there is significance between skin tone and confidence of staff when assessing that that type of skin tone
Who manages skin reactions in the department? Does a department use a baseline assessment tool?	Descriptive

What type of training have staff undertaken on radiotherapy skin care? Are there areas staff feel that the SCoR guidelines do not cover and require further research? Would people want to be a skin care champion for their team?	Descriptive

Table 2: Questions to answer through the survey and type of analysis

Questionnaire Sampling distribution:

A service evaluation was conducted through a national survey delivered by the SCoR. Therapeutic radiographers, therapeutic radiography students and assistant practitioners in radiotherapy were encouraged to participate. The questionnaire was online only and generated on the Alchemer™ survey tool platform. Responses to the survey were obtained by distribution of the survey link via radiotherapy department managers in the UK and the Society of Radiographers (SoR) ran advertising campaigns through their social media channels, the SoR radiotherapy specific special interest groups (SIGs) and via email to SoR members with a link to the survey. The departments included private and satellite centres according to the SOR internal database. The survey was available online between August and November 2021. The full survey can be found in Supplementary text 1. Depending on the user's experience, as multiple choices and open answers were included, the completion time could vary between 15 and 20 minutes.

Data processing and analysis:

Responses were collected using Alchemer™. The data was reviewed to improve data quality and no identifying data was collected. The responses were transferred to Excel for analysis and stored on an NHS Trust password protected computer.

All appropriate responses were reviewed, categorised, and analysed with descriptive statistics. Likert responses were processed through basic analysis and Fisher's exact test utilised to determine statistical significance. Qualitative results from the open-ended questions were analysed to offer further insight and enrich findings.

Results

Responses were received from 88 managers who shared the survey link with all of their qualified staff, resulting in respondents from 74 (96%) of UK radiotherapy departments. A total of 408 responses were received, equating to a response rate of 10.6% of the therapeutic Radiographer profession registered with the CoR; it is worth noting that therapeutic radiographers registered with the CoR also include those working in education.

Demographics

Characteristic		Number (%)
Ethnicity	White	348 (85.2)
	Asian or Asian British	38 (9.3)
	Black, African, Caribbean or Black British	12 (2.9)

	Mixed or Multiple Ethnic Groups	6 (1.4)
	Other ethnic group	1 (0.2)
	N/A	3 (0.7)
	Total	408 (100)
Role	Student radiographers	10 (2.5)
	Assistant practitioner	1 (0.2)
	Practitioner	137 (33.6)
	Expert practitioner	37 (9.1)
	Advanced practitioner	125 (30.6)
	Consultant practitioner	26 (6.4)
	Manager	23 (5.6)
	Other	49 (12.0)

Table 3: Demographics of Respondents

Understanding Job Role and Responsibilities

A wide range of job roles were identified from assistant practitioner to manager roles along with 10 student participants. Only 48% (n=195) of respondents believed they reviewed patients as part of their role.

Radiation Dermatitis Guidelines and Information

Looking closely at the SCoR radiation dermatitis (also known as RISR) guidelines, 58% (n=238) of respondents said they had read the guidelines, with 50% (n=203) and 54% (n=220) having read the staff and patient skin care leaflets respectively. The majority of participants used Radiation Therapy Oncology Group (RTOG) RISR assessment tool (58% of respondents n=237).

Departmental Approaches on Skin Care Assessment and Management

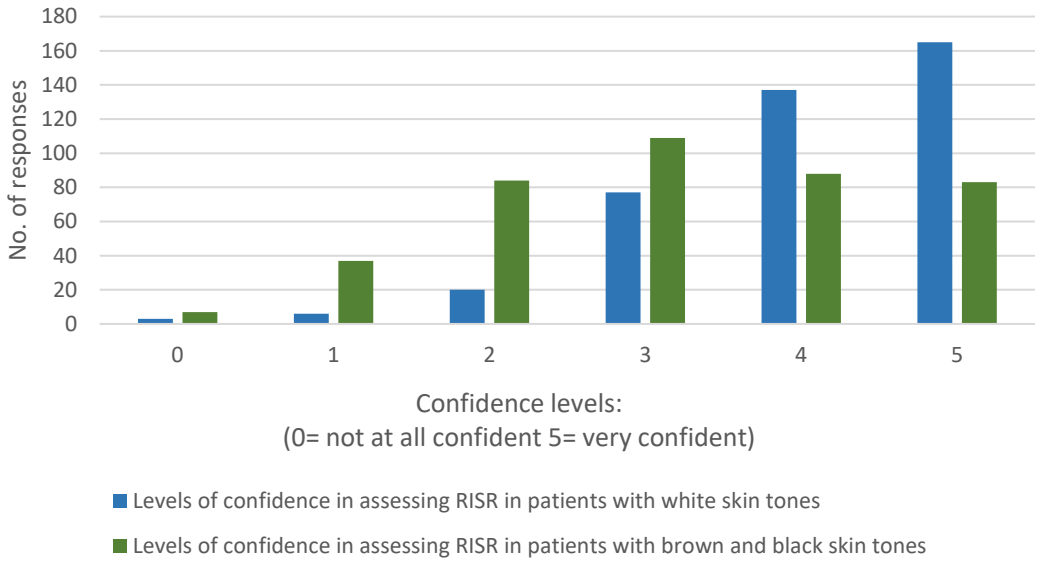
Most respondents (74% n=303) said that their department uses locally developed patient skin care information with just over a third (40% n=155) indicating they use the SCoR patient skin care leaflets. The majority of respondents (84% n=341) indicated that a treatment review therapeutic radiographer managed acute RISR within their department. When asked about the use of a baseline assessment tool to identify predisposing risk factors for more severe RISR, only 31% (n=125) said they use a tool to identify risk factors. It is important to note that due to the nature of how the survey was distributed, there is potential for multiple responses from the same department.

Understanding levels of confidence in assessing, managing and teaching assessment of RISR

Assessing RISR

Overall, respondents reported higher confidence (score 4 and 5) in assessing RISR in white vs. brown and black skin 74% (n=302) vs. 42% (n=171) ($p<0.0001$) see Figure 1.

Figure 1: Comparison of confidence levels in assessing RISR between patients with white, and brown and black skin tones



Looking closer at demographic specific levels of higher confidence (4 and 5):

For those therapeutic radiographers who identified as being from a white ethnic background (n=348), 75% reported high confidence when assessing RISR in white skin tones but only 41% of these respondents were confident in assessing brown and black skin tones.

Those that self-identified their ethnicity as Asian or Asian British (n=38), 66% of these respondents also reported higher confidence assessing changes in white skin while 50% had high confidence with brown and black skin.

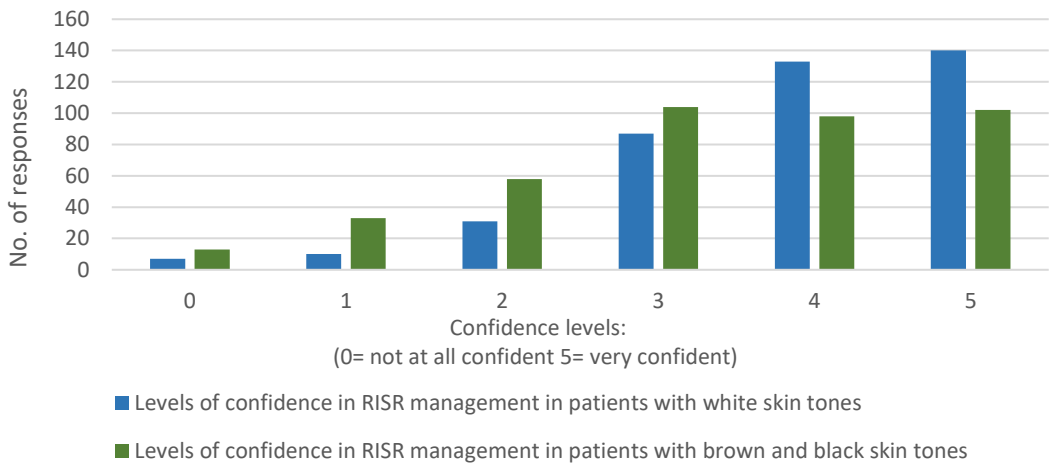
For those self-identifying as Black, African, Caribbean, or Black British background (n=12), 58% had high confidence with assessment of RISR in white skin tones but only 25% were confident with brown and black skin.

Of the 6, Mixed or Multiple Ethnic Groups background therapeutic radiographers, 83.3% reported high confidence with white skin while 50% had high confidence assessing brown and black skin.

Managing RISR

Reports of confidence in managing skin reactions showed similar trends to those reported for RISR assessment. Reports of confidence in managing RISR were higher when considering RISR in white skin tones compared to brown and black skin tones 67% (n=273) vs 49% (n=200) ($p<0.0001$) (see Figure 2).

Figure 2: Comparison of confidence levels in managing RISR between patients with white and, brown and black skin tones



Looking closer at demographic specific levels of higher confidence (4 and 5):

For those therapeutic radiographers who identified themselves as from a white background (n=348), 69% reported high confidence when managing RISR in white skin tones but only 50% were confident in managing brown and black skin tones.

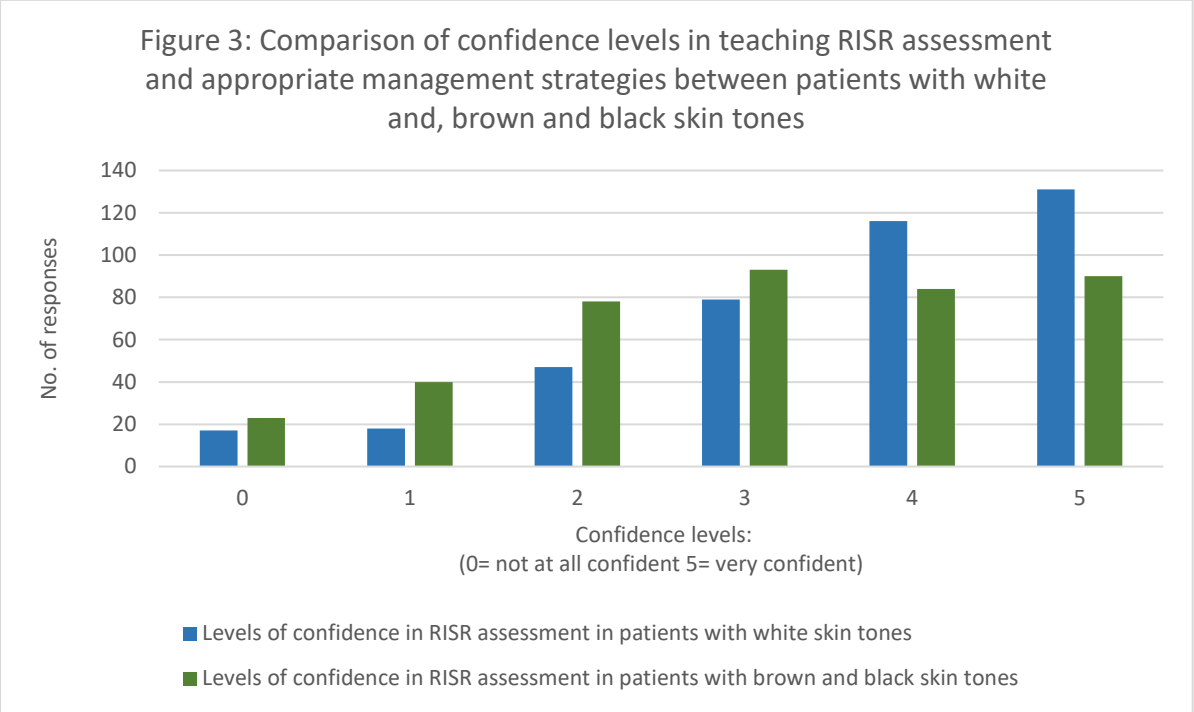
Asian or Asian British background therapeutic radiographers (n=38), 61% also reported higher confidence with white skin while 53% had high confidence with brown and black skin.

For those respondents from Black, African, Caribbean, or Black British background (n=12), 50% had high confidence managing RISR in people with white skin whereas only 17% were confident with brown and black skin.

Of the 6, Mixed or Multiple Ethnic Groups background therapeutic radiographers, 50% reported high confidence with white skin while 50% had high confidence managing brown and black skin.

Teaching the management of RISR to others

Respondents were more confident in teaching assessments in white compared to brown and black skin tones 61% (n=247) vs 43% (n=174) ($p<0.0001$).



Looking closer at demographic specific levels of higher confidence (4 and 5):

For those therapeutic radiographers who identified themselves as from a white background (n=348), 61% reported high confidence when teaching RISR assessment and appropriate management strategies in white skin tones but only 43% were confident in teaching these across brown and black skin tones.

Asian or Asian British background therapeutic radiographers (n=38), 82% also reported higher confidence with white skin while 47% had high confidence with brown and black skin.

Respondents from Black, African, Caribbean, or Black British background (n=12), 33% had high confidence teaching others about RISR where the focus was with white skin whereas only 17% were confident with teaching others about RISR for brown and black skin.

Of the 6, Mixed or Multiple Ethnic Groups background therapeutic radiographers, 50% reported high confidence with white skin while 33% had high confidence managing brown and black skin.

Wound Management Training and further Training Needs on RISR

When questioned about training on wound management, 32 respondents had completed training at master's level, 67 had completed a continual professional development course, 138 participants had completed self-directed study and 168 had completed local departmental training only. Over two thirds of respondents (63.6% n=252) indicated they would consider the opportunity to become a skin care champion in their department.

Discussion

Demographics, Understanding Job Role and Responsibilities

This evaluation had a high representation from a white British respondent (n=348), with Asian or Asian British the highest group identifying as people of colour (n=38) and Black, African, Caribbean, or Black British as the next highest (n=12). There are limited resources available to indicate the ethnic diversity of the UK therapeutic radiography staff base. While the majority of survey respondents identified as being white British, the differences in confidence reported in assessing, managing and teaching RISR across a range of skin tones may highlight an area worthy of further study. Survey respondents were from a range of roles within therapeutic radiography. However, only 48% (n=195) of respondents described reviewing patients as part of their daily tasks.

Radiation Dermatitis Guidelines and Information

The results indicate that the majority of respondents (72%) utilised locally produced patient information leaflets within their departments. This is despite the SCoR releasing nationally agreed radiation dermatitis guidelines and leaflets for the UK. These guidelines from the SCoR bring patient-centred strategies into radiotherapy within the UK. A similar study conducted in Canada in 2018 highlighted the benefits of collaborating with a professional association[23].

Departmental Approaches on Skin Care Assessment and Management

These results indicate that only 31% (n=125) of respondents are collecting baseline data from their patients prior to starting radiotherapy. The SCoR guidelines highlighted the importance of evaluating risk factors that can lead to more severe RISR, stratifying this risk to ensure each patient receives appropriate support and management.

Respondents appear to be more confident with RISR in white skin tones than brown and black skin tones. Geographically, it could be argued that some therapeutic radiographers may not be exposed to seeing different skin tones and thus feel less confident.

RTOG scoring tool was the most common RISR tool adopted by respondents, but this tool may be limited by a lack reliability and validity data in its use[16]. Both the RTOG and the CTCAE tools have continued to use the term erythema in their terminology which the British Association of Dermatology have stated is misleading and does not cover all skin tones[9,17-18].

We do not currently know how effective some RISR assessment tools are in assessing acute skin toxicity across all patient skin tones. This is important to ensure we provide inclusive, person-centred care for all radiotherapy patients without bias towards people with certain skin tones. Behroozian et al., also found that clinician reported outcomes, despite being standardised, are subject to varied inter-clinician differences in interpretation and fail to represent all patient's experiences[23].

Understanding levels of confidence in assessing, managing, and teaching assessment of RISR

The analysis of participant's level of confidence in assessing RISR in both white and brown and black skin tones, demonstrates an alarming difference in assessment. A lack of confidence could lead to a delay in the diagnosis of RISR despite evidence of RISR[25]. With this, the data could indicate that either therapeutic radiographers find the RISR assessment scales to be more difficult to apply across different skin tones or that more training is required to apply them, or both. The lack of representation in RISR training of images of reactions on people of colour could amplify this training gap. Similarly in dermatology, this lack of representation was seen through the COVID-19 pandemic where Lester et al., found that from 36 published articles, out of 130 images of COVID-19 related skin lesions only 9% (n=7) were of brown skin and 0% were of black skin[26]. Another study evaluated the New England Journal of Medicine between 1992-2017 and found only 22% (n=5694) images were of people of colour[27]. Buonsenso et al., found that in a paediatric setting, confidence was higher in clinicians that trained with a mix of skin tones across the world[28]. Notably the study highlighted that 3% (n=19) of participants who used only white skin-based resources felt confident in diagnosis skin changes in other skin tones. This is clearly an area that requires an urgent call to action to rebalance medical imagery to address this discrepancy between confidence levels across skin tones[28-33]. Mitigating this deficiency could help improve the confidence of professionals to assess skin more confidently[9,29].

When exploring the management of RISR, the data above draws comparisons with that of the previously discussed levels of confidence for distinguishing RISR. Measuring and managing RISR in people with brown and black skin tones appears to be an aspect of practice that requires further training and hands on practical training[9,26]. There are limited published articles within radiotherapy specifically for this however, within dermatology Andrews et al., have highlighted urgent care when assessing brown and black skin tones for various dermatological conditions[9,18].

There is a trend for decreased confidence in teaching appropriate assessment and management strategies of RISR within brown and black skin tones which has been discussed in numerous journal articles for over a decade[9,13-17,33-39]. There is promise in e-learning modules for training the workforce following successful work by Ooi et al., with junior doctors[40]. They have successfully integrated a wide range of dermatological conditions on people of colour within this to educate trainees[40]. This would begin to address comments from respondents for further training on how RISR presents on people of colour. To be able assess, manage, and teach skin changes requires ample training resources that include people of colour[9,14-18,25-41].

The majority of respondents reported using locally produced skin care leaflets rather than the nationally approved SCoR skin care patient leaflets and guidelines. Further research is needed to understand the barriers to using the national guidelines and the SCoR standardised patient leaflets. A national platform to discuss commonalities

and variations in locally produced skin care leaflets to inform practitioners on areas of good or poor practice could be beneficial.

Wound Management Training and further Training Needs on RISR

There is a limited number of skin care specific study days available in the UK. A total of 63.6% (n=252) would consider the opportunity to become a skin care champion in their department which could present as an area for development for staff. While outside the scope of this evaluation, study days or webinars around skin care could be beneficial for the current and future workforce.

Limitations of the evaluation

This survey has several limitations affecting how the results can and should be viewed. As the survey was sent electronically to all radiotherapy service managers, promoted via social media channels and through the SCoR special interest groups, this could have led to an unequal weighting of responses across centres, with some departments having more responses than others.

Some radiotherapy departments have entirely nurse-led review teams, which could have resulted in limited responses from these departments. Nurses were not the primary target for this survey. However, some comments from respondents have suggested there may be differences between nurses and therapeutic radiographers in how RISR are assessed. Four radiotherapy managers did not respond which may have resulted in a reduced number of responses from their respective departments.

The survey was open to all assistant practitioners and therapeutic radiographer students however, a low number responded n=1 and n=10 respectively.

A higher proportion of respondents identifying as white British (n=348) responded to the survey with a lower number of individuals from a minoritised ethnic background (n=57). Hence the results give limited insight into the role of practitioner ethnicity in determining confidence in measuring, assessing, and managing RISR across different skin tones.

A key limitation of the survey is that confidence does not equate to competence. Further research is needed to establish inter-rater variability in assessment of RISR outside of well controlled clinical trials. For example, if a participant has been using the same grading tool and applying it to every skin tone for several years, this does not necessarily mean they are proficiently assessing RISR.

The survey and subsequent analysis intended to open up the conversation around RISR presentation differences across skin tones and to highlight potential areas for further detailed evaluation or research. The aim of the survey was also to give some indication of the use of the evidence based, standardised SCoR skin care guidelines.

Conclusion

White skin tones were reported as more confidently assessed for RISR than brown and black skin tones in the sample of the radiotherapy workforce that responded to the survey. Confidence does not necessarily suggest competence, and these findings require further exploration. There is an opportunity to work with higher education institutions to develop educational and training resources to support good and consistent patient care. The recommendations below are aimed at stimulating further areas for discussion and research.

Recommendations

1. A greater understanding is needed in how educational establishments teach students how to assess acute radiation skin toxicity across different patient skin tones.
2. Research is needed to objectively evaluate the consistency (inter-rater and intra-rater reliability) of existing acute RISR scoring tools alongside patient reported outcome measures.
3. Further research to understand the barriers or challengers for practitioners in implementing the SCoR skin care patient and staff leaflets along with wider recommendations in the guidance.
4. The main recommendation from this service evaluation is to develop a special interest group on RISR to help take forward in a co-ordinated manner best practice and standardised practice on the measurement, assessment, management, and training in RISRs.

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