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Research ethics training, challenges, and suggested improvements across Europe: Radiography research ethics standards for Europe (RRESFE)

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ABSTRACT

Introduction: The Radiography Research Ethics Standards for Europe (RRESFE) project aimed to provide a cross-sectional view of the current state of radiography research ethics across Europe. This included investigating education and training in research ethics, and identifying the key challenges and potential improvements associated with using existing research ethics frameworks.
Methods: This cross-sectional online survey targeting radiography researchers in Europe was conducted between April 26 and July 12, 2021. Descriptive and analytical statistics were used to identify research ethics education and training trends. Content analysis of qualitative responses was employed to identify significant challenges and proposed improvements in research ethics frameworks of practice.
Results: There were 232 responses received across 33 European countries. Most (n = 132; 57%) respondents had received some research ethics training; however, fewer participants had received training on safeguarding vulnerable patients (n = 72; 38%), diversity and inclusivity (n = 62; 33%), or research with healthy volunteers (n = 60; 32%). Training was associated with a greater perceived importance of the need for research ethics review ($p = 0.031$) and with the establishment of EQF Level 6 training ($p = 0.038$). The proportion of formally trained researchers also varied by region ($p = <0.001$). Time-to-ethics-approval was noted as the biggest challenge for professionals making research ethics applications.
Conclusion: Early and universal integration of research-oriented teaching within the radiography education framework which emphasises research ethics is recommended. Additionally, study findings suggest research ethics committee application and approval processes could be further simplified and streamlined.
Implications for practice: The survey contributes to a growing body of knowledge surrounding the importance of education and training in research ethics for assuring a high standard of research outputs

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in Radiography and has identified hurdles to obtaining research ethics approval for further investigation and address.

Introduction

With the advent of evidence-based practice as the gold standard for developing professional practice, radiography was transformed from a historically vocational occupation into a robust, evidence-based profession.[1,2] This increasingly research-centric ethos is sustained by the steady growth in radiographer participation at scientific congresses and the rapidly expanding pool of radiographic contributions to scientific journals.[3,4] The growing prominence of radiography research is further evidenced by the 110,000 radiographers, 8,500 radiography students, 40 national societies/professional bodies, and 60 academic institutions that make up the European Federation of Radiographer Societies' (EFRS) membership.[5] A community with a strong commitment to progressing the profession of radiography through evidence-based practice.

Radiography, a rapidly changing, technology-enabled and patient-centred profession, invariably depends on consistent, high-quality research, a suitably trained workforce, and interdisciplinary collaboration, including in research. It is essential to effectively design, implement, integrate, and appraise research for the benefit of clinical practice and, ultimately, for optimising radiography service delivery, both diagnostic and therapeutic, and customising patient care.[6] A robust and well-structured education and training framework, which offers the necessary skills to uphold and advance evidence-based practice, with emphasis on research integrity principles, international ethical standards, and associated regulations and legislation, can help foster and sustain a healthy research culture.[7,8] The EFRS, with support from the national societies that make up the federation's membership, has made great strides towards advancing and harmonising comprehensive radiography training across Europe through efforts such as developing benchmark documents for European Qualifications Framework (EQF) Level 6 (Bachelors) and Level 7 (Masters).[9,10] However, the effort of integrating research into education is ongoing, with variable content and structure of undergraduate and postgraduate radiography research curricula reported across Europe; this variation is perhaps a result of the differing history of the development of the profession across countries.[7,11]

From previous examples of poor ethical conduct in medical research, it is evident that there can be dire consequences for both research participants and the researchers themselves. After the atrocities that occurred under the guise of clinical investigation during World War II, and subsequent medical research scandals, numerous safeguards have been put in place over the past 80 years to foster good ethical practice and protect research participants.[12] The *Code of Ethics of the World Medical Association (Declaration of Helsinki)*[13] is one such safeguard, prioritising the health, well-being, safety, and autonomy of research participants above all else. The core principles set out in this document informing the development of subsequent ethical guidelines are incorporated into professional codes of ethics and conduct, including aspects of the radiography specific *EFRS Code of Ethics*.[14] Adherence to established ethical principles is facilitated if healthcare professionals, including diagnostic and therapeutic radiographers, are aware of and competent in the ethical framework governing their profession through appropriately structured education and training. Insufficient training and subsequent uninformed decision-making leaves room for ethical issues to arise including issues surrounding informed consent, autonomy, data protection, and reporting.[15–17]

The Radiography Research Ethics Standards for Europe (RRESFE) was led by City, University of London, endorsed by the EFRS, and steered by a consortium of research radiography and research ethics academics and experts. RRESFE aimed to provide a cross-sectional snapshot of current research ethics systems, processes, and awareness of such, across Europe together with the associated challenges, improvements, and education and training needs. The present article focuses on key survey findings surrounding the current status of education and training along with significant challenges and suggested future improvements for research ethics frameworks.

Methods

A cross-sectional survey of radiography researchers in Europe was conducted between April 26 and July 12, 2021. The novel questionnaire was developed using the SurveyMonkey® (California, USA) online platform and piloted by a small group of radiography researchers (n = 21) who reviewed the survey's content and readability. Following reviewer feedback and amendment, a snowball sampling approach was employed to facilitate study recruitment. The survey link was distributed via email to stakeholders within the EFRS network. These invitees were encouraged to further spread the survey link to fellow radiography researchers within their networks to increase overall responses. The target population for this survey was trained radiographers, 18 years of age or older, working in Europe within radiography practice (as a clinician, academic, or researcher, including students), with some previous or ongoing experience with conducting radiography research. Ethics approval for this study was obtained by the City, University of London SHS Research Ethics Committee (Reference: ETHI920-0977). Gatekeepers approval was secured from the EFRS (as the access manager/gatekeeper for the target population) to approach their member organisations before study commencement.

As previously described,[18] the mixed methods survey consisted of 42 questions across six sections and comprised multiple choice, checkbox, rating scale, and open-ended question types. Voluntary submission of the survey was taken as implied consent. A cover letter accompanied the survey form to outline the study's aims, scope, estimated time to completion, and overarching data management procedures so individuals could make an informed decision about their participation. All responses were anonymous and were stored as encrypted and access-controlled electronic records in full and direct compliance with the General Data Protection Regulation (GDPR) and nationallegislation.[17,19,20] Participants could edit their responses at any point throughout survey completion; however, upon final submission no further editing could occur.

Response frequencies, percentages, and central tendency were used to analyse quantitative data descriptively. The Chi-Square test of independence, Fisher's Exact test, Fisher-Freeman-Halton

test, and the Mann-Whitney U test were employed to conduct subsequent subgroup analyses. As part of the subgroup analyses, regional comparisons were conducted to investigate geographical areas across Europe; only regions which met the inclusion criteria of ten or more submissions were included. Additionally, secondary analyses which utilised previously collected data from EFRS education and training surveys[21,22] were conducted to explore the impact of undergraduate programme duration, EQF Level 6, and postgraduate training on research ethics. Qualitative responses were analysed using a content analysis[23] approach with vote count, in which responses were categorised by theme and the frequency of responses per category tabulated. The initial review and thematic categorisation was conducted by a single member of the research team (SB) and subsequently reviewed by an additional researcher (JMcN) to validate generated themes and categorisation. The CHERRIES checklist for online survey reporting and the STROBE guidelines for observational studies have been used for project reporting herein.[24,25]

Results

In total there were 232 partial (i.e. >15% of non-demographic questions answered; n = 42) and complete (100% of questions answered; n = 190) submissions received across 33 European countries (Fig. 1). When asked to state their main area(s) of focus within radiography, the majority of respondents (n = 172; 74%) stated they work in medical imaging/diagnostic, 57 (25%) individuals selected radiotherapy/radiation therapy, and 25 (11%) declared they work in nuclear medicine. Furthermore, there was good representation from education (n = 110; 47%), research (n = 96; 41%), and clinical (n = 88; 38%) sectors, as well as prominent student engagement (n = 64; 28%). Diversity in participants' level of seniority was also observed among the 232 participants with representation from novice (i.e. very limited experience in research; n = 37, 16%), early-career (i.e. researcher at the beginning of their research career; n = 67, 29%), mid-career (i.e. researcher with some experience; n = 67, 29%), and experienced (i.e. an

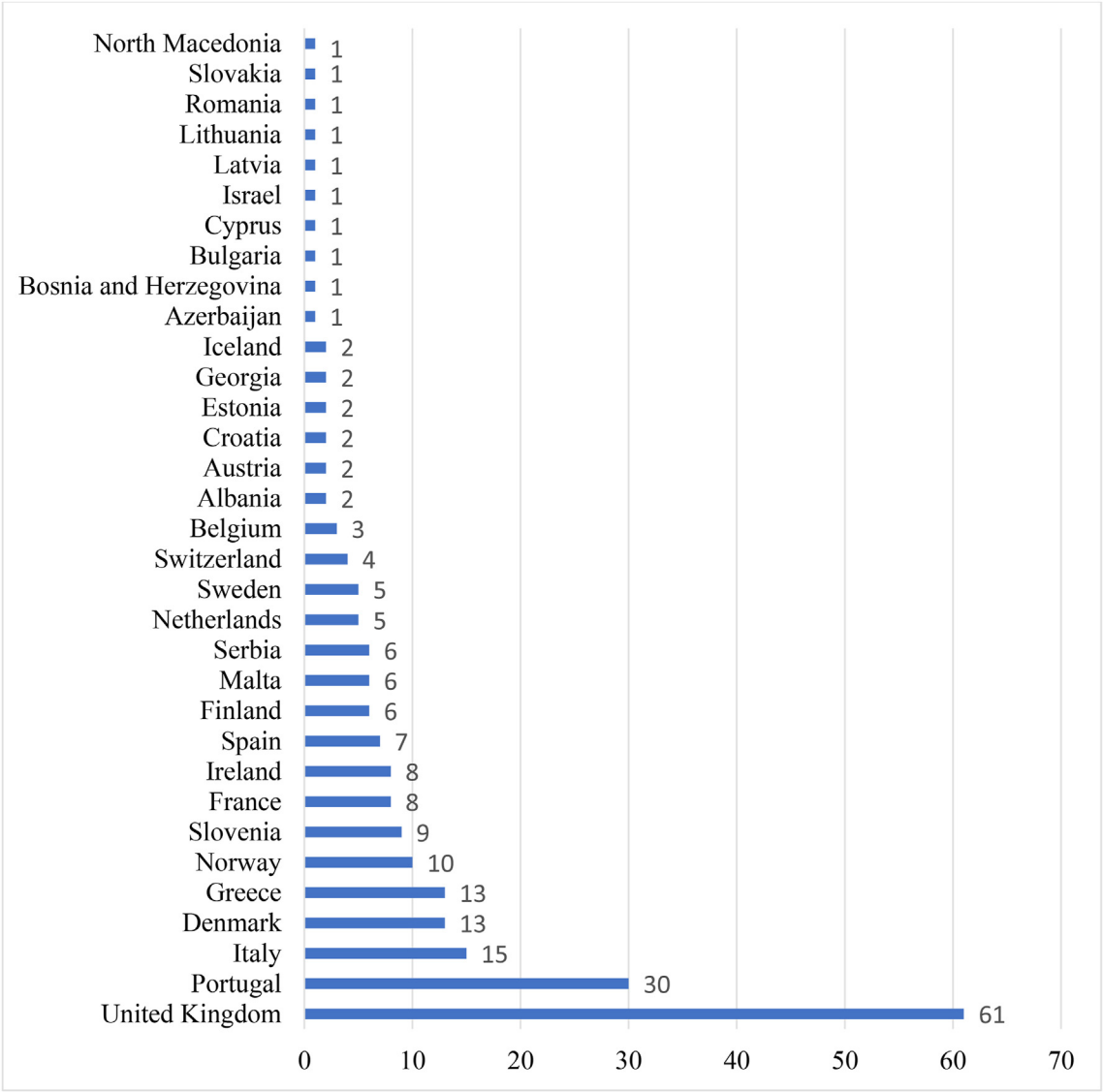

Figure 1. Distribution of respondents by country.

Table 1
Respondent demographic characteristics and relevant research training.

Characteristic	n (%)	Proportion of Formally Trained Participants (n/N (%))
Main area(s) within radiography[a]		
Medical Imaging/Diagnostic	172 (74%)	105/172 (61%)
Radiotherapy/Radiation Therapy	57 (25%)	28/57 (49%)
Nuclear Medicine	25 (11%)	17/25 (68%)
Role(s) in research[a]		
Radiography educator	110 (47%)	69/110 (63%)
Radiographer researcher	96 (41%)	67/96 (70%)
Doctoral student	37 (16%)	23/37 (62%)
Master's student	27 (12%)	14/27 (52%)
Clinical radiographer/practitioner	88 (38%)	40/88 (45%)
Level of seniority in research		
Novice	37 (16%)	18/37 (49%)
Early-career	67 (29%)	29/67 (43%)
Mid-career	67 (29%)	44/67 (66%)
Experienced/Established	55 (24%)	40/55 (73%)
Other	6 (3%)	1/6 (17%)

[a] Respondents could select more than one option.

established researcher; n = 55, 24%) researchers. A full breakdown of respondent demographics can be found in Table 1.

Formal research education and training

The majority (n = 132; 57%) of survey respondents reported having undergone some type of formal research training (formal being defined as a structured course or training) throughout their career and/or academic studies with an association observed between experience and training; more experienced researchers were significantly more likely to have completed formal research training compared to their earlier-career counterparts ($X^2(3, n = 167) = 10.219$, $p = 0.015$) (Table 1). When broken out by the type of research training received, the most frequently reported course content was data protection (n = 113; 59%), followed by research integrity (n = 109; 57%), and consent training (n = 105; 55%) (Table 2). Conversely, formal research training on safeguarding vulnerable patients, diversity and inclusivity, and research with healthy volunteers was reported by only 72 (38%), 62 (33%), and 60 (32%) respondents respectively. When asked about the content of formal research training available within respondents' organisation/country, data protection (n = 98; 52%), consent (n = 86; 45%), and research integrity (n = 80; 42%) were again the three most frequently selected topics (Table 2). Interestingly, across each subcategory of training content, approximately one quarter (median = 48 (IQR, 0.75)) of respondents were unsure of the training opportunities currently available to them. When asked how important respondents' felt it was to have research ethics approval prior to analysing patient data, even if the data is anonymised, 64% (n = 149) of participants selected 'very important' and a further 31% (n = 71) indicated 'important,' while a concerning 2% (n = 4) and 1% (n = 2) of participants respectively noted such approval to be 'unimportant' or 'not important at all.' The remaining 6 (3%) individuals stated they were unsure about the importance of such approval processes. These results informed a subsequent subgroup analysis which revealed that individuals with formal research training placed greater importance on research ethics approval than their untrained contemporaries (U = 1763, p = 0.031). Similarly, formal research training was consistently associated with higher reported confidence levels (cumulative median 100 (IQR, 1.25) vs 79 (IQR, 12)) in the items that should be prepared for a research ethics committee submission (Table 3). Analysis into the geographic distribution of formally trained radiography researchers revealed significant variability across regions in the overall number of formally trained radiography researchers (X^2 (4, n = 100) = 27.534, p = <0.001), these regions being Balkan countries (n = 24), Nordic countries (n = 36), and the United Kingdom and Republic of Ireland (n = 69). When broken out by the specific content of formal research training received, the Balkan region demonstrated a significantly lower frequency, and the UK and Republic of Ireland presented with a significantly higher frequency of trained researchers in data protection, safeguarding vulnerable patients, and diversity and inclusivity (Table 4).

Secondary analyses were then conducted based on data previously collected by the EFRS regarding research training availability in relation to undergraduate programme durations, EQF level, and availability of postgraduate training throughout Europe.[21,22] With regards to the duration of undergraduate radiography programmes, submissions were grouped based on whether the respondents' country offered 2-year programmes (n = 13), 3-year programmes (n = 71), 3.5-year programmes (n = 21), 4-year programmes (n = 57), or more than one undergraduate radiography programme duration (n = 70) (e.g. the United Kingdom where 2-, 3-, and 4-year degrees are offered). The number of respondents who received formal research training varied across programme duration subgroups ($X^2(4, n = 168) = 13.734$, $p = 0.006$) with countries offering 3.5-year undergraduate degrees or more than one programme duration option associated with a higher proportion of radiography

Table 2
Content of formal research training received by survey respondents and available in respondents' country/organisation.

Content of Formal Research Training Received	Response Frequency			
	Yes	No	No Response	
Data protection Training	113	77	42	
Training on Research Integrity	109	81		
Consent Training	105	85		
Safeguarding Vulnerable Patients	72	118		
Diversity and Inclusivity	62	128		
Research with Healthy Volunteers	60	130		
Content of Formal Research Training Available	**Response Frequency**			
	Yes	No	I am not sure	No Response
Data protection Training	98	45	47	42
Consent Training	86	56	48	
Training on Research Integrity	80	64	46	
Safeguarding Vulnerable Patients	74	68	48	
Diversity and Inclusivity	72	70	48	
Research with Healthy Volunteers	67	75	48	

researchers formally trained in research ethics than countries offering 2-, 3-, and (to a lesser extent) 4-year programme lengths. Additionally, respondents from countries where EQF Level 6 has been established (n = 217) were more likely to have received formal research ethics training compared to respondents from countries where EQF Level 6 has not been put in place (n = 15) (X^2(1, n = 168) = 5.155, p = 0.038). Similarly, researchers from countries where postgraduate training is available (n = 170) appeared to have had a higher frequency of formal training on research ethics compared to researchers from countries where no postgraduate training is offered (n = 62); however, this difference was not found to be statistically significant (X^2(1, n = 168) = 3.021, p = 0.102). That being said, when broken down by specific training content, researchers from countries offering postgraduate radiography education were found to have significantly more training in research with healthy volunteers (X^2(1, n = 168) = 5.549, p = 0.023), safeguarding vulnerable patients (X^2(1, n = 168) = 4.545, p = 0.047), and diversity and inclusivity (X^2(1, n = 168) = 8.255, p = 0.005).

An association was also observed between the different aspects of the radiography education framework, i.e. programme duration, availability of postgraduate education, the establishment of EQF Level 6, and the different training content/courses (Table 5). Countries with multiple undergraduate programme durations in place consistently demonstrated more widespread availability of training courses in each content area (see Supplementary Material). This was also the case for countries which offer postgraduate training, though a significant difference was only observed for the availability of training in research with healthy volunteers (X^2(2, n = 190) = 9.601, p = 0.008), safeguarding vulnerable patients (X^2(2, n = 190) = 8.562, p = 0.013), research integrity (X^2(2, n = 190) = 6.511, p = 0.037), and diversity and inclusivity (X^2(2, n = 190) = 23.150, p=<0.001). No such difference could be

Table 3
Participants' confidence level in the items (i.e., documentation) that must be produced for a research ethics committee (REC) submission regarding high-risk research. Confidence was submitted via a sliding scale from 0 to 100.

Item for REC Submission	Received Formal Research Training?	n	Mean	SD	Median	IQR	Mean Rank	p-value
Participant information sheets	No	36	71.3	28.8	77.0	50.0	51.4	<0.001
	Yes	132	93.0	14.7	100.0	4.3	93.5	
Participant consent forms	No	36	77.0	28.1	88.5	45.8	60.9	<0.001
	Yes	132	93.4	14.4	100.0	5.0	90.9	
Strategies to request consent and/or assent	No	36	68.2	29.5	74.5	48.8	55.7	<0.001
	Yes	132	86.8	20.9	100.0	21.5	92.4	
Strategies for data anonymisation and patient confidentiality	No	36	77.5	29.2	95.0	43.0	63.7	<0.001
	Yes	132	92.1	15.8	100.0	7.5	90.2	
Strategies to report and document adverse events resulting from research	No	36	68.2	30.3	74.5	48.8	56.4	<0.001
	Yes	132	87.3	19.6	100.0	20.0	92.2	
Research proposal (which includes aim or research question, methodology, data collection and data analysis, among other information)	No	36	78.6	27.4	90.0	39.0	59.1	<0.001
	Yes	132	92.2	16.7	100.0	4.8	91.4	
Strategies to report and document incidental findings	No	36	65.5	27.0	68.5	42.8	57.7	<0.001
	Yes	132	80.8	23.7	96.5	98.0	91.8	
Strategies for safe data management	No	36	81.0	24.4	91.5	33.0	67.7	0.01
	Yes	132	90.1	18.6	100.0	14.0	89.1	
Strategies for safe data storage	No	36	80.8	25.7	94.0	34.8	66.7	0.006
	Yes	132	90.1	19.6	100.0	9.5	89.4	
Strategies for safe data reuse, where applicable	No	36	73.1	25.2	79.0	48.5	65.5	0.006
	Yes	132	83.0	23.3	98.0	31.5	89.7	
Strategies on using data after participant withdrawal	No	36	69.9	25.3	67.5	45.5	58.9	<0.001
	Yes	132	83.3	26.5	100.0	27.3	91.5	
Strategies for data transfer, if needed	No	36	71.3	28.7	80.0	50.0	66.7	0.01
	Yes	132	83.1	22.9	99.0	37.5	89.3	
Strategies for safe data disposal	No	36	75.4	27.7	84.5	45.3	67.6	0.011
	Yes	132	85.1	25.2	100.0	26.5	89.1	
Strategies to safeguard vulnerable people/groups	No	36	71.5	31.7	81.0	49.8	59.8	<0.001
	Yes	132	88.7	20.8	100.0	15.0	91.3	
Strategies to support participants, if they become distressed due to the research project	No	36	66.8	30.0	72.5	42.5	63.4	0.002
	Yes	132	81.4	26.3	98.5	39.8	90.3	
Strategies for safe use of human tissue, where applicable	No	36	65.6	36.9	74.0	50.0	63.9	0.002
	Yes	132	84.0	26.2	100.0	27.5	90.1	
Strategies for safe use of chemical substances, where applicable	No	36	64.5	35.1	77.0	58.8	62.5	0.001
	Yes	132	80.7	28.0	100.0	39.0	90.5	
Strategies for safe use of ionising radiation or electromagnetic fields, where applicable	No	36	80.7	24.9	90.5	36.0	63.3	0.001
	Yes	132	91.4	16.4	100.0	10.8	90.3	
Strategies for safe use of experimental drugs for RCTs and reporting their side effects, where applicable	No	36	66.3	37.1	80.0	52.5	61.9	<0.001
	Yes	132	84.9	24.8	100.0	27.8	90.7	
Strategies to explicitly confirm mental capacity to consent, if this applies to the study participants	No	36	69.7	31.2	76.0	48.5	67.1	0.012
	Yes	132	81.1	27.5	98.5	37.3	89.2	
Strategies for incentives for research volunteers or participants	No	36	65.2	31.0	70.0	44.3	65.7	0.007
	Yes	132	77.8	26.1	92.5	47.0	89.6	
Sample questionnaires/sample interview schedules	No	36	73.1	27.3	82.0	47.8	66.9	0.011
	Yes	132	83.9	22.9	99.0	25.8	89.3	
Strategies for assessing risks to researchers and participants, i.e. in a formal risk assessment document	No	36	67.4	29.2	74.5	44.8	61.1	<0.001
	Yes	132	81.9	29.2	97.0	30.8	90.9	

Table 4
Comparison of formal research training content, both the content of training received and training available, across different European regions.

Content of Training Received	n	X^2	Df	p-value
Data Protection	102	8.509	2	0.013
Consent	102	5.995	2	0.054
Research with Healthy Volunteers	102	3.998	2	0.123
Safeguarding Vulnerable Patients	102	7.79	2	0.018
Research Integrity	102	5.242	2	0.076
Diversity and Inclusivity	102	10.393	2	0.005
Content of Training Available	**n**	**X^2**	**Df**	**p-value**
Data Protection	102	18.258	4	<0.001
Consent	102	15.495	4	0.002
Research with Healthy Volunteers	102	14.333	4	0.005
Safeguarding Vulnerable Patients	102	27.473	4	<0.001
Research Integrity	102	4.663	4	0.319
Diversity and Inclusivity	102	34.286	4	<0.001

observed for the availability of data protection training ($X^2(2, n = 190) = 2.685$, $p = 0.271$) or consent training ($X^2(2, n = 190) = 4.44$, $p = 0.115$) (Table 5). Regarding the EQF, the availability of training content only varied for diversity and inclusivity when comparing countries with versus countries without EQF Level 6 established ($X^2(2, n = 190) = 6.068$, $p = 0.044$); where diversity and inclusivity can be considered as how to foster a research environment where those involved (researchers & research participants) are reflective of the society/population and where all individuals are treated respectfully and provided equal access to opportunities and resources.

Identified challenges for research ethics

Within the open-ended response section of the survey form, respondents were asked to report on what they considered to be the significant challenges for research ethics within their country. A total of 148 responses were received. Six responses were eliminated due to erroneous or incomprehensible content, five respondents indicated they were unsure of the key challenges, and three individuals explicitly stated there were no significant challenges to report. The remaining 134 responses were subsequently reviewed and 14 overarching themes were identified through which responses were categorised and corresponding categorical frequencies tabulated, with some responses applicable to more than one generated category. The results of this content analysis are outlined in Table 6. The *onerous and time-consuming processes for obtaining ethics approval* (n = 42) and the *complexity and/or variability of ethics applications and approval processes* (n = 28) were identified as the two biggest challenges radiography researchers face with regards to research ethics.

Proposed improvements for ethical research

When asked to report on what improvements respondents would like to see regarding research processes to better facilitate ethical research in their country 132 responses were submitted; of these 11 were excluded. The remaining 121 responses could be categorised into ten overarching themes as outlined in Table 7,

Table 6
Frequency of responses by category following content analysis of open-ended responses to the question *"Which do you consider as the big challenges for research ethics in your country?"*

Category	Frequency
Onerous and time-consuming processes for obtaining ethics approval	42
Complexity and/or variability of ethics applications and approval processes	28
Lack of clear guidelines and standard procedures	14
Adherence to strict rules, regulations, and expectations	14
Lack of understanding and knowledge regarding processes/procedures for research ethics	12
Access to data (including obtaining informed consent)	10
Difficult to obtain necessary funding/resources	10
Lack of adequate research ethics processes/procedures/regulation	7
Proper data management	7
Other	5
Accessibility of research ethics committees	4
Development and communication of sufficient patient/participant information	3
Protecting patients' safety	2
Proper analysis and reporting	2

Table 5
Comparison of the availability of formal research training content/courses by undergraduate program duration, availability of postgraduate education (i.e., offered vs not offered), and EQF Level 6 status (established vs not established) (see also Supplementary Table 1).

Content of Training Available by Undergraduate Programme Duration	n	X^2	df	p-value
Data Protection	190	23.019	8	0.003
Consent	190	31.175	8	<0.001
Research with Healthy Volunteers	190	24.223	8	0.002
Safeguarding Vulnerable Patients	190	39.720	8	<0.001
Research Integrity	190	29.231	8	<0.001
Diversity and Inclusivity	190	52.642	8	<0.001
Content of Training Available by Postgraduate Education (offered vs not offered)	**n**	**X^2**	**df**	**p-value**
Data Protection	190	2.685	2	0.271
Consent	190	4.44	2	0.115
Research with Healthy Volunteers	190	9.601	2	0.008
Safeguarding Vulnerable Patients	190	8.562	2	0.013
Research Integrity	190	6.511	2	0.037
Diversity and Inclusivity	190	23.943	2	<0.001
Content of Training Available by EQF Level 6 Status	**n**	**X^2**	**df**	**p-value**
Data Protection	190	0.951	2	0.577
Consent	190	1.115	2	0.599
Research with Healthy Volunteers	190	2.341	2	0.308
Safeguarding Vulnerable Patients	190	1.379	2	0.516
Research Integrity	190	1.948	2	0.388
Diversity and Inclusivity	190	6.068	2	0.044

Table 7
Frequency of responses by category following content analysis of open-ended responses to the question *"what improvements would you like to see in research processes for ethical research to take place in your country?"*

Category	Frequency
Simplify and streamline the research ethics committee application and approval processes, particularly for multi-site studies (e.g., centralised approval) and low-risk research projects (e.g., retrospective studies)	38
Speed up the approval process (e.g., via more frequent research ethics committee meetings, increased collaboration, computerization etc.)	31
Provide greater clarity around the application process with in-depth guidance/instructions and worked examples	25
Standardise the ethics application and approval processes	18
More support (from universities, hospitals, companies, funding bodies, etc.) to conduct ethical research with greater access to resources (including research ethics committees)	14
Adopt more rigorous research ethics processes and standards.	7
Other	5
Increase/Improve research ethics training and continuing professional development	4
Computerization	4
I am not sure	3
More rigorous reporting guidelines	3

some responses falling into multiple thematic categories. The primary improvements proposed through this exercise were to: (1) *simplify and streamline the research ethics committee application and approval processes, particularly for multi-site studies (*e.g. *centralised approval) and low-risk research projects (*e.g. *retrospective studies)* (n = 38), (2) *speed up the approval process (*e.g. *via more frequent research ethics committee meetings, increased collaboration, computerisation etc.)*, (n = 31), and (3) *provide greater clarity around the application process with in-depth guidance/instructions and worked examples* (n = 25). Efforts to *standardise the ethics application and approval processes* were also a notable focus area across responses, a total count of 18 responses falling within this category.

Discussion

It is evident through the survey findings that there may be an association between education and ethical research, given that formally trained researchers reported significantly higher confidence levels in the items required for an ethics application and placed greater importance on ethics review and approval processes compared to their untrained counterparts. This link has previously been described by the EFRS who highlighted research skills and ethical conduct as core competencies, which should be incorporated into radiography curricula and asserted that *"the development of research and audit skills are essential to ensure the constant improvement of service quality for the benefit of service users"* in their 2019 *Statement on Radiography Education.*[8,9,10] The positive impact of integrating ethical research practices and training is further evidenced by the work of Higgins and colleagues. They demonstrated educational programmes that combined research and teaching led to improved student learning and the successful development of research skills in radiography.[2]

Concerningly, 43% of survey respondents noted they had not received formal research training, despite active involvement in research projects, with well over half of respondents indicating a lack of formal training in safeguarding vulnerable patients, diversity and inclusivity, and research with healthy volunteers. Similar findings were observed for the availability of formal research training throughout respondents' organisations/countries. Taken together with the existing body of knowledge around radiography research and training, the current survey emphasises the need for further research-led and research-oriented teaching, and draws attention to the importance of educating, conducting, and implementing radiography research through an ethical lens. Additionally, the identified association between research experience and formal training within the current survey indicates a need to increase research-centric training initiatives and introduce research-oriented teaching earlier in the educational framework, as these results suggest most radiographers aren't undergoing formal research training until later on in their careers. The value of radiography students' early exposure to research is supported by the work of Jenkins and Healy[27] who argued that research should be a key element across all higher education programmes, as well as the work by Higgins et al.[28–31] which shone a spotlight on the value of incorporating research into the undergraduate radiography curricula. Ethical practice is a complex area of professional competence requiring knowledge, skills, and the ability to formulate professional judgements. Furthermore, as identified above, the training gaps will need to be addressed in customised training which will ensure clearer ethics processes, which safeguard participants, researchers, and the reputation of their educational or research institutions. It is recommended that future efforts to address education and training needs leverage the current EQF Level 6 and Level 7 education models, and work to increase the availability of postgraduate training given the association of these with both completion and availability of formal research ethics training in the current study. That being said, it is understood that not all teaching and learning will occur within structured courses or formal training programmes; it is important to mention that workplace-based learning, involving mentoring and coaching, may also provide an effective route for education and training that must continue to be fostered.

Moreover, it is necessary to look beyond training to the regulatory framework and best practice standards informing curricular content. While education and training form the foundation of a sustainable and healthy research culture, the day to day conduct of radiography research is bound by the governing regulations, legislations, and international guidelines which set the standard of research quality, ethical behaviour, and in turn the underlying education for the profession.[8] Further to research ethics rules and regulations, there are also unwritten rules of what makes a good and valuable research project, in terms of research integrity and morality; this is better learned through practical application and by role-modelling other researchers. Thus, theoretical research ethics training should be paired up with training in practice with opportunities for mentoring, observation, or shadowing other experienced researchers. The College of Radiographers (UK) have piloted a research mentoring scheme to increase the quality and quantity of radiographers' research.[32] Research ethics forms part of this training both in theory and in practice.[32]

To successfully develop and uphold a thriving research culture, the ethical frameworks that inform evidence-based practice must be ensured. Curriculum development must also facilitate the highest standard of research and adherence to well-established ethical principles. Unfortunately, the radiography profession and associated research ethics frameworks are not uniform; the responsibilities of a radiographer and requirements for when and how ethics approval must be obtained vary from country to country.[8,33–35] These inconsistencies in professional governance and clinical practice are likely contributing to the non-uniformity of radiography education and training across Europe as previously reported by McNulty and colleagues[11,26] and now again by the regional sub-analysis of the current survey. When left unaddressed, this variability has resulted in gaps and misinterpretation in implementing the research ethics frameworks. It ultimately can lead to inconsistent, unethical practices and distrust in the

radiography professionals.[16,33,35] Implementation and adherence to a centralised research ethics framework at the European level, and in turn, the implementation of a harmonised education and training infrastructure which has regard for said framework, is thus critical to assure equitable high-quality evidenced-based practice, while maintaining a clear focus on patient care.[36] These frameworks should allow flexibility to accommodate national idiosyncrasies for ethical concerns and align with local/institutional rules and national regulations.

Lastly, it is essential that efforts to improve and harmonise the radiography profession have regard for the critical barriers to ethical research and incorporate strategies and systems that overcome such hurdles. To this end, the current survey asked respondents to report on what they consider the biggest challenges for research ethics in their country through an open-ended response. This exercise and subsequent content analysis identified the onerous and lengthy approval process as the primary challenge for research ethics followed by the complexity and variability of ethics applications and processes. This translated into respondents expressing a need for simplified and streamlined ethics approval processes and faster approval timeframes to allow for a productive research environment while still maintaining the necessary checks and balances. Further studies are necessary toaddress potential confounding factors, such as respondents' own research motives and level of training: nevertheless, the challenges identified in the current study are supported by multiple reports throughout the literature. For example, the multinational, observational study of very old critically ill patients (the VIP1-study) in which de Lange and colleagues[33] report that 8 out of 16 study sites had to apply to more than one research ethics committee to gain approval and experienced an average time-to-approval of 87 days, the longest reported approval time as long as 300 days. Additionally, the variability in ethics systems and processes reported across the 16 sites and the consequences this lack of uniformity had on study conduct (one site not even being able to participate) further supports the need for harmonisation and streamlining of research ethics frameworks. Moreover, Jonker and colleagues report the time necessary to get a project approved and inconsistent approval processes as researchers' primary frustrations with the research ethics system in the United Kingdom.[37] A centralised research ethics process for multisite studies, expedited approvals for low-risk research, and more frequent research ethics committee meetings were proposed by respondents as just a few strategies to streamline and hasten the approval process. Investment in proportionate resourcing for research ethics staff and training would help ensure our research continues to uphold the highest standards for patient safety, clinical relevance, research integrity and facilitates optimal service delivery for the benefit of the patients.

Limitations

The study's sample size, self-selection design, and the time constraints imposed by the cross-sectional approach taken for data collection present limitations to the current research. The notable number of respondent's with no formal research training must also be mentioned as a potential confounding factor. The sample size is, however, representative of the diversity of European radiography researchers and the cross-sectional approach serves well the aim of benchmarking radiography research ethics practices and perceptions. Additionally, content analysis required a degree of interpretation when assessing the content of open-ended responses. Still this induction is innate to the qualitative nature of the open-ended questions and adds depth and richness of understanding to the outcomes and recommendations derived from this project. Furthermore, efforts were made to define all terms within the survey form, including what constitutes formal research training; nevertheless, it is possible that there were slightly varying interpretations of what constitutes formal research training given the diversity of training programmes and course structures that exist across Europe. Lastly, this exploratory study did not incorporate an analysis of covariance, thus further studies are recommended which may control for and analyse confounding factors.

Conclusion

This survey has reported professionally important findings which will help to inform future efforts to address research ethics and associated education and training needs. The survey positively contributes to a growing body of knowledge surrounding the importance of education and training for assuring a high standard of research ethics in Radiography. Furthermore, findings support the need for early and universal integration of research-oriented teaching within the radiography education framework, both theoretical and practical. Additionally, the study has highlighted the variability that exists in research training across Europe and has identified that time-to-ethics-approval and the complexity of ethics applications are key challenges for research ethics. Additional European-wide studies are recommended to further develop our understanding of the facilitators and barriers of research ethics, identify the associated education and training needs, and improve adherence to high ethical standards throughout Europe for genuinely high-quality radiography research and optimal radiography practice. Re-administration of the current survey, or similar benchmark studies, at regular intervals is proposed to monitor research ethics across Europe and track progress in addressing identified deficiencies within research ethics frameworks.

Authors contribution

Authors JMcN, PB, AE, RK, MMcE, NM, HP, LR, VS, CB, and CM hold, or have held, voluntary roles linked to research activity within the European Federation of Radiographer Societies. All authors hold, or have held, research roles within their organisation. Authors JMcN, PB, AE, DF, RK, MMcE, NM, HP, AS, VS, CB, RH, TOR, and CM hold, or have held, roles within their national professional societies. JMcN (Editor in Chief, *Radiography*), AE (Associate Editor, *Radiography*), and MMcE (Deputy Editor, *Journal of Medical Imaging and Radiation Sciences*) hold editorial roles within the identified professional journals. NM, HP, LR, and CM hold journal advisory roles.

Conflicts of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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