

Systematic Review

Research and evidence-based practice in clinical radiography: A systematic review of barriers and recommendations for a new direction



H. Al Balushi ^{a, b}, H. Watts ^{c, d}, T.N. Akudjedu ^{a, *}

^a Institute of Medical Imaging & Visualisation, Department of Medical Science & Public Health, Faculty of Health & Social Sciences, Bournemouth University, UK

^b Department of Diagnostic and Interventional Imaging, Ministry of Health, Sultanate of Oman

^c Radiology, James Cook University Hospital, South Tees NHS Trust, Marton Road, Middlesbrough, TS4 3BW, UK

^d Teesside University, School of Health & Life Sciences, Centuria Building, Tees Valley, Middlesbrough, TS1 3BX, UK

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ABSTRACT

Introduction: Existing literature provides valuable insight into the application of evidence-based practice (EBP) in Radiography; however, it primarily focuses on localised, context-specific scenarios within individual countries or institutions. This review aims to systematically explore the barriers to EBP and research implementation in clinical Radiography practice internationally.

Methodology: A mixed-method systematic review was implemented to obtain data from primary studies of qualitative, quantitative and mixed-methods designs. Articles were searched between June and July 2023 from the following scientific databases: PubMed, Medline, CINAHL, Science Direct and manual search dating from 2003 to July 2023. The reviewed studies were subjected to data extraction and results-based convergent synthesis.

Results: A total of 376 articles were identified through electronic database search and citation screening after the removal of duplicates. Thirty-one studies met the predetermined inclusion criteria and were included for this review. The challenges to EBP implementation in clinical Radiography are broadly themed around professional and personal obligations, motivation and organisational culture, knowledge and skill gaps, resources and opportunities, and institutional governance.

Conclusion: Globally, clinical radiographers perceived a high level of motivation and interest towards research activities. However, numerous barriers were reported such as insufficient time allocation for research, lack of resources, lack of research culture and inadequate research-related skills and knowledge. A transition towards greater evidence-based practice precipitates the quality of clinical Radiography services, augmenting efficiency in the workflow process and enriching patient experience.

Implications for practice: Radiography managers must develop strategies that aim to stimulate radiographers to initiate research projects. Beyond allocation of protected time, managers should inspire staff participation in research activities through implementation of effective departmental level culture and governance for quality service delivery and improved patient care.

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Abbreviations: CT, Computed Tomography; EBP, Evidence-based practice; EFRS, European Federation of Radiographers Societies; ISRRT, International Society of Radiographers and Radiological Technologists; MeSH, Medical Subject Heading; MRI, Magnetic Resonance Imaging; PRISMA, Preferred Reporting Items for Systematic Review and Meta-Analysis; QATSDD, Quality Assessment Tool for Studies with Diverse Designs; RR, Research Radiographer; RT, Radiation Therapist; SCoR, Society and College of Radiographers; UK, United Kingdom; WRETF, World Radiography Education Trust Foundation.

* Corresponding author. Institute of Medical Imaging & Visualization (IMV), Bournemouth University, 114 Gateway Building, St. Paul's Lane, Bournemouth, BH8 8GP, UK.

E-mail address: takudjedu@bournemouth.ac.uk (T.N. Akudjedu).

✉ (T.N. Akudjedu)

Introduction

Evidence-based practice (EBP) combines research evidence, clinical history, professional expertise, and patient preferences in healthcare decision-making.¹ Empanza and colleagues² define EBP as the critical application of relevant evidence to optimise patient outcomes. The neglect of research evidence and its application in clinical practice may lead to suboptimal care and health outcomes.³ The term “evidence-based medicine” was introduced in 1991³ and has emerged in Radiography in relatively recent years as

“Evidence-based Radiography” (EBR) in 2008.⁴ Hafslund and colleagues⁴ defined EBR as “radiography informed and based on the combination of clinical expertise and the best available research-based evidence, patient preferences and available resources”. However, the implementation of EBP in the field of radiography has been inconsistent across settings.⁵ Recent trends highlight a growing focus on research culture in radiography,^{3,6,10–18} aiming to promote EBP, consequently, improving patient care quality and progression of the profession.^{2,15,16,19} However, for successful research integration, an understanding of scientific methods, professional support,^{20–28} and a conducive research environment are necessary.^{21,22} Thus, EBP is often modified to fit the constantly changing clinical environment.²⁹

Klaic and colleagues⁷ found that EBP confidence among allied health practitioners drops within the first five years of practice, especially in tasks such as critically analysing studies. However, practitioners with postgraduate qualifications demonstrate increased confidence irrespective of time qualified, suggesting such qualifications can help maintain proficiency in EBP over time.^{7,8} In a similar context, Middleton and Bolderston⁹ documented that newly graduated radiographers had not engaged in post-graduation research, citing obstacles such as lack of opportunities and insufficient knowledge. Radiography practice differ globally due to multiple factors, including availability of technology and resources, workforce and technical expertise across various demographics.^{14,18,22,27,30} These consequently influence the translation of research into practice, particularly given the complex nature of the healthcare environment generally and across different settings.³¹ These complexities muddle the pathway towards clear and effective EBP implementation.³² The adverse implications of neglecting to incorporate EBP into clinical practice have been highlighted previously.^{19,33–36} Failure to adopt research-based practice can result in the continuation of outdated and unsafe practice, potentially causing detrimental effects on patient care.³³ This is a crucial concern in radiography as the practice is quickly evolving (including artificial intelligence integration) and encompasses numerous risk factors such as radiation, strong magnetic fields and the use of contrast media. Additionally, Salloum and colleagues³⁶ highlighted the economic consequences of ignoring EBP in the national health service.

In recent years, many primary studies independently explored the barriers to EBP and/or research implementation in clinical radiography. These provides valuable insight into the application of EBP in radiography, however, they primarily focus on localised, context-specific scenarios within individual countries or institutions.^{3,7–9,11,14–16,20–28,37–40} The challenges identified within these localised studies span a broad spectrum, including inadequate access to essential research resources, constraints of time, deficiency of critical appraisal skills and resistance among professionals due to ingrained practices or misconceptions about the very nature and utility of EBP.⁴¹ Thus, there is need for a comprehensive study that explores the global perspectives on this subject,⁴² with an aim to understand radiographers' attitudes towards EBP and recognise challenges to be able to devise suitable directed interventions. This study therefore aims to systematically review published literature to explore the barriers to evidence-based diagnostic and therapeutic radiography research implementation across settings. By synthesising and evaluating the available evidence, the findings of this comprehensive review will provide a holistic evidence base on barriers to research and EBR practice in radiography. Additionally, the findings will inform healthcare professionals, policymakers, and educators in developing effective interventions and proposing potential strategies to promote evidence-based radiography and research worldwide.

Methods

Given that the study was approached from a global perspective, a mixed-method systematic review was implemented to obtain data from primary studies of qualitative, quantitative and mixed-methods designs^{43–46} in accordance with the Cochrane Collaboration guide.⁴⁷ The systematic review methodology is deemed as the most appropriate approach to identify, assess and summarise the findings of all pertinent individual studies concerning health-related topics, presenting the evidence in a more concise and approachable format for decision-makers.⁴⁸ This review utilised an adapted version of the new Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) statement.⁴⁹ As part of the adaptation, the protocol was not registered on a public database (e.g., PROSPERO) to avoid the potential challenge of plagiarism of the research idea as highlighted by Tawfik and colleagues.⁷⁷ However, the use of the PRISMA checklist enhanced the quality of reporting and optimised the transparency and efficiency of the review.⁵⁰ This inclusive methodological approach is suitable to extend the conceptualisation and synthesis of existing evidence related to the topic. No ethical approval was required as data was retrieved and synthesised from existing published studies and did not involve human or animal participants.

Search strategy

A systematic search strategy was employed to independently identify relevant studies within each database between June 2023 and July 2023. A further search was conducted on August 10th, 2023, to update the results for any potential interim publications. Furthermore, the Medical Subject Heading (MeSH) was utilised to develop and identify keywords for the literature. The MeSH terms and keywords were used in combination with Boolean operators (OR and AND): [“Evidence-based practice” OR “Evidence-based” OR research OR EBP] AND [radiograph* OR radiotherap* OR “medical imaging” OR “radiologic technologist*” “medical radiation science” OR “diagnostic imaging” OR “therapeutic imaging” OR “radiation therapy”] AND challenge* OR struggle* OR difficult* OR problem* OR barrier* OR limitation* OR deterrent*. This aided in ensuring the inclusion of literature from a global perspective, reflecting all international variations of the job title and speciality for radiographers. In addition, abbreviations and/or truncated syntax and asterisks were used to increase the sensitivity of the search, decrease the risk of missing related articles and expand the search to include all words starting with radiograph* (e.g. radiography, radiographer and radiographers) and radiotherap* (e.g. radiotherapy, radiotherapist and radiotherapists). A combination of reference management software (Mendeley), Microsoft Excel 2019 and Covidence application for systematic review were used to manage the screening and searching process.

Inclusion and exclusion criteria

Considering the emergence of the term ‘Evidence-based Radiography’ in 2008 by Hafslund and colleagues,⁴ full-text primary articles were included if published in English between 2003 and 2023 and explored the barriers hindering the implementation of evidence-based practice and research in the diagnostic radiography or radiotherapy professions across settings. Thus, the participant groups in the included studies are radiographers, irrespective of titles, work status/bands/grades, or place of work. The search covered a 5-year period prior to the formal introduction of the term EBR, to ensure all publications related to the topic that may be in development before 2008 are captured. Thus, the 20-year period

(2003–2023) was considered appropriate to capture all relevant articles. Commentaries, preprints, opinions, reports, supplementary articles, and reviews were excluded as it is not practicable to employ their inclusion through a systematic search as well as to ensure the findings stem from peer-reviewed evidence base sources. Furthermore, primary studies that did not focus on the radiography profession were excluded.

Source of data

The following scientific databases: PubMed, Medline, CINAHL (Cumulative Index of Nursing and Allied Health Literature), Academic Search Ultimate and Science Direct were selected and searched as they reflect the largest and most comprehensive databases for healthcare topics. The electronic database searches were conducted utilising Bournemouth University Library e-resources, through EBSCOhost. Additional sources were identified and searched manually via Google Scholar to ensure all relevant studies were captured. Furthermore, the bibliographies of relevant studies and review articles were also searched for additional relevant publications that fulfil the predetermined eligibility criteria.

Selection strategy and data extraction

A meticulous assessment was conducted in accordance with the predefined search strategy to ascertain the final inclusion and to appraise the rigour of the studies under review following the initial screening of titles, abstracts and full texts. In response to the heterogeneity observed in the study designs and with an aim to preserve methodological consistency in the critical appraisal of the relevant studies, the Quality Assessment Tool for Studies with Diverse Designs (QATSDD) was employed, as suggested by Sirriyeh et al.⁵¹ The QATSDD offers a framework for examining the consistency, transparency and systematic reporting of the research process in health services studies with post-positivistic or positivist methodologies, which informs mixed-method designs.^{51,52} Based on a previous systematic review by Akudjedu and colleagues,⁵³ studies were classified as high quality if they achieved an aggregate score exceeding 70 %, moderate quality for those scoring between 50 % and 70 %, and low quality for scores falling below 50 % (Table 1). Notably, these aggregate quality scores did not factor into the article exclusion criteria. The potential exclusion of studies yielding low aggregate scores could constrain the encompassing global perspective of this review. This is particularly relevant considering the fact, as stated earlier, that specific findings can be inherently associated with distinct geographical areas. In addition, each study included in the review was subjected to a data extraction process. This process entailed the completion of a structured template, designed to capture essential information such as the method employed, the aims and the derived outcomes.

Data analysis and synthesis

A convergent synthesis design grounded in a result-based strategy was implemented to synthesise the results from studies of assorted designs included in this review.^{43–56} This strategy consisted of an independent analysis of each study, and the subsequent demonstration of the findings from all of the included studies in a matrix structure. These findings were then coalesced to formulate overall outcomes via textual narrative synthesis, post the qualitative transformation of the quantitative constituents of the results.^{50,52} Hence, the resulting qualitative data was developed into categories and associated themes, demarcating the key aspects of this review.⁵¹ In addition, an inductive methodology was utilized to synthesize and develop a smaller set of descriptive themes

representing the initial coding and findings of the original studies. Accordingly, the integrated results contribute to a broad-based understanding of the global perspective on the challenges of EBP and research in the radiography profession, aligning seamlessly with the aim of this study. The adoption of this approach was deemed appropriate as it fostered a robust and replicable synthesis of both prevalent and emergent evidence.

Results

A total of 376 articles were identified through the electronic database search and citation screening after the removal of duplicates ($n = 188$) from the following databases: PubMed ($n = 33$), CINAHL ($n = 62$), Medline ($n = 76$), Science Direct ($n = 345$), Academic Search Ultimate ($n = 41$), manual searches through articles' reference list ($n = 7$) (See Fig. 1). After the screening of the articles' titles and abstracts was performed, a total of 318 records were deemed irrelevant to the research topic and thus excluded from further consideration. Following this stage, 58 articles were sought for retrieval and were retained for full-text assessment for eligibility. After reviewing all articles in the full-text screening stage for eligibility, 31 studies were qualified for this review and 27 were excluded as they did not meet the predetermined inclusion criteria (for reasons see Fig. 1).

The literature identified for this review is representative of radiographers and services from a broad spectrum of clinical settings, providing a global perspective that includes both high-income (HIC) and low- and middle-income countries (LMIC) from five different continents (Asia, North America, Africa, Europe and Australia) (see Table 2). This facilitates a more impartial and complete understanding of the current state of EBP in radiography, drawn from diverse geographic and cultural environments around the globe. This review also highlights the perspectives of radiographers working in both diagnostic and therapeutic radiography, from various specialities, and in both private and public healthcare institutions. The geographical distribution, diverse methodological approaches and a summary of key findings of the included studies are outlined in Table 2.

Five broad themes were developed from the literature (Fig. 2); Theme 1: Professional and personal obligations, Theme 2: Motivation and organisational culture, Theme 3: Knowledge and skill gaps, Theme 4: Resources and opportunities, and Theme 5: Institutional governance.

Discussion

The findings of this review confirm pre-existing knowledge, indicating that clinical radiography practice considerably diverges across a multitude of settings and nations.^{3,22–28,37–39} These disparities are frequently associated with the variation in the availability of both expert human resources and physical infrastructures.^{3,5,8,9,12,14–18,20–28,37–40,54,56–58} For instance, a recent survey conducted in England by Yakubu et al.⁸ noted a significant association between the type of healthcare facility and literature search engagement, stating that radiographers working at district general hospitals exhibited a marked propensity towards engaging in literature searches compared to other health facilities. On the contrary, Elshami and colleagues²⁵ discerned that the association between the reported barriers by the radiographers and place of work, age, gender and number of publications was not statistically significant. It was also found that radiographers with postgraduate qualifications or those with reporting or mammography duties reported a significantly higher likelihood of having undergone research training and were more likely to initiate research.⁸ Of note, these findings are

Table 1
Quality Assessment Results using the Quality Assessment Tool for Studies with Diverse Designs (QASTDD).

		Quality Assessment Tool for Studies with Diverse Designs															
		Publications/Studies															
Items		P1 Mix	P2 Mix	P3 Quan	P4 Quan	P5 Mix	P6 Mix	P7 Quan	P8 Mix	P9 Quan	P10 Quan	P11 Mix	P12 Mix	P13 Mix	P14 Mix	P15 Qual	P16 Qual
1	Explicit theoretical framework	2	2	3	3	3	3	1	2	2	2	2	3	3	2	1	2
2	Statement of aims/objectives in main body of report	3	3	3	3	1	3	1	2	3	3	3	3	3	2	1	3
3	Clear description of research setting	2	2	3	2	3	3	1	1	3	3	2	3	2	1	1	3
4	Evidence of sample size considered in terms of analysis	3	1	1	2	2	3	2	2	2	3	2	3	2	2	1	1
	Representative sample of target group of a reasonable size	2	1	1	1	2	3	2	2	3	1	2	2	2	2	1	1
6	Description of procedure for data collection	2	3	2	1	3	2	1	2	2	2	2	3	2	1	2	3
7	Rationale for choice of data collection tool(s)	0	2	2	3	3	2	1	3	2	2	1	2	1	1	1	3
8	Detailed recruitment data	3	2	3	2	3	2	1	3	3	3	1	3	2	1	0	3
9	Statistical assessment of reliability and validity of measurement tool(s) (Quantitative only)	2	3	0	3	2	1	1	3	3	2	0	3	0	0	0	0
	Fit between stated research question and method of data collection (Quantitative only)	2	2	2	3	3	1	1	2	3	3	1	3	1	1	0	0
11	Fit between stated research question and format and content of data collection tool e.g. interview schedule (Qualitative only)	2	2	0	0	0	1	0	2	0	0	2	3	2	2	1	2
	Fit between research question and method of analysis (Quantitative only)	2	2	2	3	3	1	1	2	3	2	1	3	1	2	0	2
13	Good justification for analytic method selected	1	2	2	3	3	2	1	2	3	2	1	2	1	1	1	3
14	Assessment of reliability of analytic process (Qualitative only)	1	1	0	0	0	1	0	2	0	0	0	3	0	0	0	0
15	Evidence of user involvement in design	2	2	2	3	3	1	1	2	3	3	2	2	2	2	1	3
16	Strengths and limitations critically discussed	0	0	1	0	0	2	0	1	2	3	2	3	2	2	2	3
Total Score		29	30	27	32	34	31	15	33	37	34	24	44	26	22	13	32
Percentage/ Quality HIGH MODERATE LOW		60.42	62.50	64.29	76.19	70.83	64.58	35.71	68.75	88.10	80.95	50.00	91.67	54.17	45.83	30.95	66.67

Mix= Mixed method Quan= Quantitative Qual= Qualitative

		Quality Assessment Tool for Studies with Diverse Designs															
		Publications/Studies															
Items		P17 Quan	P18 Quan	P19 Mix	P20 Mix	P21 Mix	P22 Quan	P23 Qual	P24 Qual	P25 Mix	P26 Quan	P27 Qual	P28 Quan	P29 Mix	P30 Mix	P31 Mix	
1	Explicit theoretical framework	2	1	1	2	2	1	2	3	2	2	2	1	3	3	3	
2	Statement of aims/objectives in main body of report	2	2	1	3	3	2	3	3	2	3	3	2	3	3	3	
3	Clear description of research setting	2	2	1	3	2	1	2	3	2	2	2	2	3	3	3	
4	Evidence of sample size considered in terms of analysis	2	2	1	2	3	2	2	2	2	2	2	2	2	2	2	
	Representative sample of target group of a reasonable size	2	1	1	1	2	1	2	2	3	1	2	2	2	2	2	
6	Description of procedure for data collection	1	2	2	3	3	1	2	2	1	2	2	1	3	2	3	
7	Rationale for choice of data collection tool(s)	1	1	1	3	3	1	2	2	1	3	1	1	1	1	3	
8	Detailed recruitment data	2	2	1	3	3	1	3	3	2	2	1	1	2	2	3	
9	Statistical assessment of reliability and validity of measurement tool(s) (Quantitative only)	0	0	0	3	3	0	0	0	0	1	0	0	1	3	3	
	Fit between stated research question and method of data collection (Quantitative only)	2	2	1	3	3	1	0	0	2	2	0	0	1	3	3	
11	Fit between stated research question and format and content of data collection tool e.g. interview schedule (Qualitative only)	0	0	1	3	3	0	2	3	2	2	2	1	2	3	3	
	Fit between research question and method of analysis (Quantitative only)	2	2	1	3	2	1	0	0	2	0	0	0	1	3	3	
13	Good justification for analytic method selected	1	1	1	3	3	1	2	3	1	2	1	1	1	2	2	
14	Assessment of reliability of analytic process (Qualitative only)	0	0	0	3	3	0	0	2	0	0	0	0	1	2	2	
15	Evidence of user involvement in design	2	2	1	3	2	1	2	2	2	2	2	1	3	2	3	
16	Strengths and limitations critically discussed	0	1	0	0	0	1	3	3	0	0	0	0	3	1	3	
Total Score		21	21	14	41	40	15	27	33	24	26	20	15	32	37	44	
Percentage/ Quality HIGH MODERATE LOW		50.00	50.00	29.17	85.42	83.33	35.71	64.29	78.57	50.00	61.90	47.62	35.71	66.67	77.08	91.67	

Mix= Mixed method Quan= Quantitative Qual= Qualitative

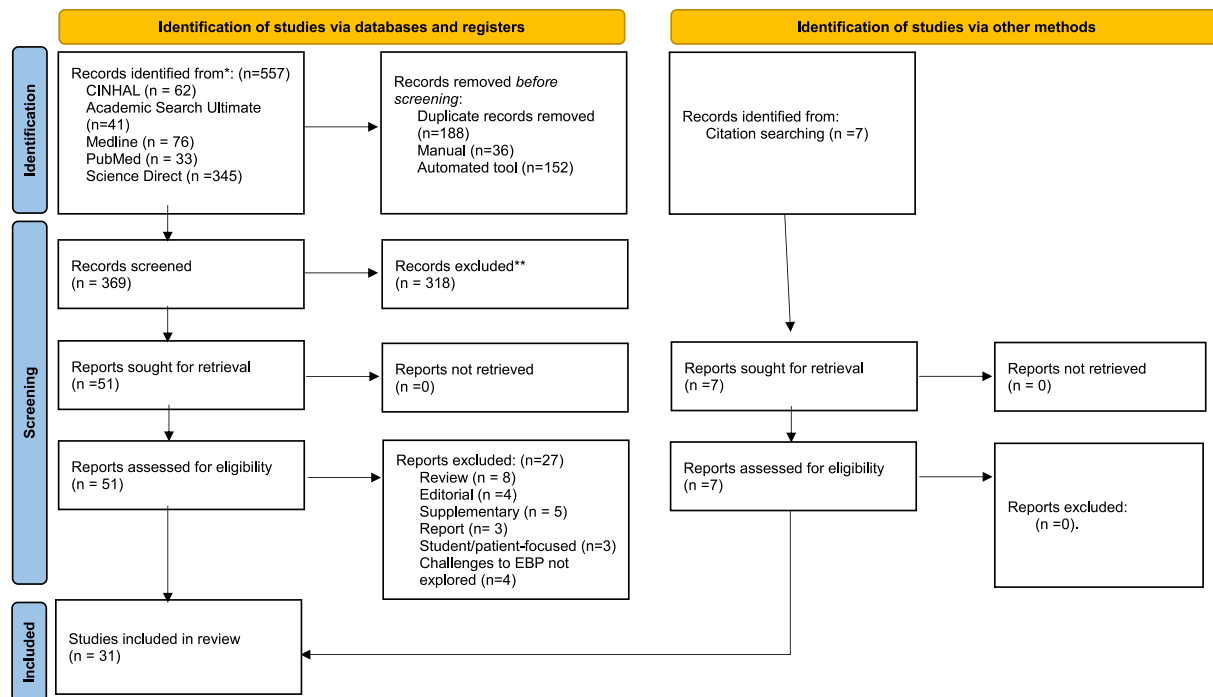


Figure 1. PRISMA flow diagram - search strategy.

potentially context specific and confounded by the status of the type of respondent radiographers in the studies, although the reported trends seem common internationally.

Theme 1: professional and personal obligations

Integrating evidence-based practice (EBP) in clinical radiography faces challenges, especially personal and professional commitments.^{16,25–27,38,58,61} Key among these are significant time constraints due to heavy workload, clinical responsibilities, and understaffing,^{3,9,16,18,20–28,38–40,54,46,58–60} further compounded by family commitments.^{25,59}

Many studies highlighted time as a major barrier to radiographers' research involvement.^{9,12,16,18,20–23,38–40,54,56,58–65} Agustin and colleagues⁵⁴ reported that 87 % of participants cited time as the primary obstacle, with 65 % struggling to develop new ideas during working hours. Similarly, a Singaporean study revealed two-thirds of radiographers viewed time and workload as significant research challenges.³⁹ Likewise, data from radiographers in Arab countries supported these findings, with 62.3 % of participants noting non-research-related tasks and 56.6 % identifying time shortages as primary deterrents to research.²⁵ This was evident in Iweka and Hyde's recent study¹⁶ which indicated irregular attendance at research sessions, attributing this to the lack of dedicated research time and increased workloads.

This time-related barrier is consistent across various radiographer subgroups.^{8,24,25,64} For example, Elliott and colleagues²⁴ documented that 62.9 % of sonographers identified time as their main research hindrance. Likewise, research radiographers, especially those in clinical trials, sought dedicated research time with some being requested to cover clinical services instead of performing their research duties.^{16,18}

In the same context, Elshami and colleagues²⁵ found that radiographers solely in clinical roles faced more research barriers compared to those in academia or dual roles. Similarly, Ramazan

and colleagues⁶³ reiterated that clinical duties take precedence, forcing some radiographers to carve out personal time for research, which was unfavourably received.

Theme 2: motivation and organisational culture

Interest and motivation

Globally, there has been a reported perceived lack of interest and motivation from radiographers in their clinical institutions towards research and EBP.^{9,16,20,21,23,28,33,58,59,62,63,65} In a recent study, Vils Pedersen⁵⁸ found that while 77 % of radiographers were interested in conducting in research, 69 % of respondents were not interested in leaving their clinical duties to conduct research, with 21 % of the respondents considered less contact with patients as a demotivating factor. A recent Australian study demonstrated that 35.8 % of radiographers continue to report an absence of interest and motivation in EBP engagement.³³

Relatedly, Challen and colleagues¹² found that nearly 23 % of the respondents indicated that lack of motivation is one of the deterrents to be considered when undertaking research as individuals or as a part of a team. However, Chau and colleagues²³ noted that radiographers were moderately or very interested in research with no difference noted between radiography specialities. Other recent studies from 2023^{8,40,58} found a widespread enthusiasm and positive attitude from radiographers towards EBP and research, yet low actual engagement in practice. These discrepancies in interest and motivation rates among radiographers could be interpreted and correlated to many factors indicated throughout this review.

Support from management and colleagues

The social context of the work environment in clinical radiography, where radiographers often work in teams or pairs,

Table 2
Summary of the relevant studies.

Paper No.	Study Reference & Journal	Methods		Study Design & Analysis approach	Study period and duration or operational details of centres	Study Aim (s)	Study Outcomes		Study Quality Grading ^a
		Country/Continent of study	Sample/Study Site Characteristics				Key findings	Key Conclusions	
P1	Agustin et al., 2008 Journal of Medical Imaging and Radiation Oncology	Australia, Australia	Radiation Therapist = (n = 78)	Online survey Cross-sectional Mixed methods data analysis approach	Not stated	To investigate the perceived challenges impeding the conduct of clinical trial research among Radiation Therapists in Australia	About 79 % of the respondents conveyed that their managers attribute a high degree of importance to research. The same percentage of RT reported that initiating and conducting research is considered important in their workplace. 87 % agreed that time is the overwhelming barrier that stops them from conducting research, while 65 participants experienced difficulty developing new ideas during working hours. 46 % stated that they did not have sufficient research skills during their undergraduate studies. In addition, the library resources were limited (35 %), and there were no active research or academic activities in their workplace (33 %)	Based on the outcomes, the following strategies would enhance the role of clinical trials. 1. Time allocation. 2. Conduct research skills-related activities. 3. Improve communication channels between the MDT research team. 4. Mentorship by research-skilled RT. 5. Promote the value of research.	Moderate
P2	Ahonen and Liikainen 2010 BJR Open	Finland, Europe	Radiographers = 170	Online survey Mixed methods data analysis approach	October 2008 Survey Opened for two weeks.	To assess the radiographers' preconditions for EBR in Finland and	Of the respondents, 54 % (n = 168) reported a lack of support from work colleagues and management, while 45 % and 46 % of the respondents stated a lack of knowledge, motivation and funding, respectively. In addition, most respondents agreed that the lack of time is the main factor hindering their participation in research activities (85 %).	In addition to adequate resources, the adoption of research and evidence-based radiography (EBR) heavily relies on the radiographers' research knowledge, the valuation of research activities, and the support system. Factors including engagement with scientific literature, research, higher academic degrees and senior roles significantly boost EBP and research utilisation.	Moderate
P3	Alakhras et al., 2023 Radiography	Jordan/Asia	Radiographers = 203	Paper-based survey Cross-sectional (one time-point) Quantitative data analysis approach	Not stated	To assess Jordanian diagnostic radiographers' attitudes toward the use of EBP, investigate education, knowledge, and skills related to EBP and identify specific terms associated with EBP	The most common barriers to the implementation of EBR were insufficient time (63.5 %, n = 129), lack of collective support among colleagues (35 %, n = 71), lack of research skills (29.1 %, n = 59) and lack of interest were indicated by 25.6 % of the participants. Less than 25 % of the participants perceived poor	This study reveals that despite their positive attitude towards EBP and resource availability, radiographers require increased confidence for active engagement and implantation of EBP. The study results could be utilised to redesign radiography education	Moderate

(continued on next page)

Table 2 (continued)

Paper No.	Study Reference & Journal	Methods				Study Aim (s)	Study Outcomes		Study Quality Grading ^a
		Country/Continent of study	Sample/Study Site Characteristics	Study Design & Analysis approach	Study period and duration or operational details of centres		Key findings	Key Conclusions	
P4	Bolejko et al., 2022 Radiography	Nordic countries/ Europe	Radiographers = 507	Online survey Cross-sectional Quantitative methods data analysis approach	Not stated	The study focused on clinical radiographers' perceptions of facilitators for and barriers to participation in research in public healthcare.	ability to appraise the literature (24.6 %, n = 50) critically, lack of information resources and understanding of statistical analysis (22.7 %, n = 46) and language of the article (18.7 %, n = 38). The results demonstrate that a lack of knowledge about scientific methods is a barrier, along with limited knowledge about potential research projects and the absence of a radiography research culture in the workplace. Lack of knowledge of how to conduct research (57 %, n = 204) and about potential research projects in which to participate (51 %, n = 183) was identified as barriers to radiographers' participation in research (OR 2.48 and 2.00, respectively). Lack of a radiography research culture at the workplace (37 %, n = 130) was also associated with non-participation in research (OR 1.75)	programs and other interventions needed to promote EBP in clinical radiography in Jordan. This study revealed factors influencing clinical radiographers' participation in research across four Nordic countries: support from colleagues and other professionals, the importance of self-esteem in their capability for performing research and the presence of a radiography research culture at the workplace.	High
P5	Abuzaid et al., 2023 Healthcare	Arab countries/ Asia	Radiographers = 250	Online survey Cross-sectional Quantitative methods data analysis approach	1st May 2023 to 31st July 2023	To comprehensively understand the motivations driving radiographers in five Arab countries to engage in research.	Most participants believed research positively impacts their professional development (34.8 %) and patient care and outcomes (40 %). The participants perceived professional development (36.4 %) as a key motivator for research engagement. A significant majority (81.6 %) expressed motivation to start research in clinical practice. A total of 66.8 % found research opportunities available during clinical practice. Barriers included time constraints (56 %), limited resources (47.2 %), and lack of support and skills (33.2 % and 32 %, respectively).	This study emphasises the need for targeted strategies to enhance research engagement among radiographers in the Arab region. Addressing barriers, such as time constraints and resource limitations, while leveraging intrinsic motivators, such as professional development, is crucial for fostering a culture of research-driven excellence in radiography.	High
P6	Chau et al., 2022 Journal of Medical	Australia/ Australia	Diagnostic Radiographers = 323	Online survey Cross-sectional (one		The study aimed to delineate the current	Multiple barriers to research were selected from the	This study found that there are still challenges that	Moderate

	Imaging and Radiation Sciences		Therapeutic radiographers = 82 Nuclear medicine = 2 Sonographers = 2 (n = 409)	time-point) Mixed methods data analysis approach	Open from 4th November to 13th December 2020	research demographic of Australian Medical Radiation Practitioners (MRPs) and to discern the preserved or actual challenges inhibiting their participation in research activities.	predetermined list. Among the respondents who expressed no intention of undertaking future postgraduate research, lack of interest or motivation (35.8 %) and insufficient time allocation (24 %) were identified as the most prevalent inhibiting factors. Other deterrents, such as the absence of a clearly defined pathway (11.4 %) and insufficient support (9.2 %), were also pinpointed as contributory factors. In contrast, for those respondents who expressed intent to engage in future postgraduate research (67.8 %), lack of time, financial constraints (33.9 %) and workplace support (32.2 %) were cited as primary barriers. These factors also align with the total responses of the population. (47 %) time limitations, lack of interest (33 %), cost constraints (24.2 %) and lack of workplace support are the major impediments to their engagement in research. Seventy-four of the respondents showed interest towards EBP. However, 68 % of the respondents do not utilise research-based evidence due to insufficient knowledge evaluating the quality and reliability of the research findings (72 %) or due to institutional/ organisational factors (75 %).	need to be addressed. A targeted support strategy could be implemented to overcome these barriers and increase the research capacity in the radiography profession.	
P7	Chuukwuani et al., 2017 Biomedical Statistics and Informatics	Nigeria, Africa	Radiographers = 40	Questionnaire Quantitative data analysis approach	Not stated	To obtain a better understanding of the attitude and perceptions of radiographers towards EBP.	EBP challenges must be addressed to ensure the effective implementation of EBP in clinical radiography. Training programs need to be designed so that radiographers achieve the skills and knowledge required to apply EBP and research in their clinical. In addition, policies and regulations need to be formulated to encourage research and EBP implementation in medical imaging services.	Low	
P8	Elliott et al., 2009 Radiography	United Kingdom, Europe	Sonographers = 218	Online questionnaire Mixed methods data analysis approach	Not stated	The study addresses perceived barriers to research utilisation in sonography practice in the UK.	Time constraints attributed to heavy workloads and staff shortages were identified as the primary barriers to research involvement by (63 %) of the respondents. Lack of support was reported as the second most frequent barrier, and the majority of	The effective transformation of the findings into actionable research strategies necessitates the presence of robust, well-coordinated organisational structures to foster a conducive environment for research	Moderate

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Table 2 (continued)

Paper No.	Study Reference & Journal	Methods				Study Aim (s)	Study Outcomes		Study Quality Grading ^a
		Country/Continent of study	Sample/Study Site Characteristics	Study Design & Analysis approach	Study period and duration or operational details of centres		Key findings	Key Conclusions	
P9	Elshami et al., 2021 Radiography	Arab countries, Asia	Radiographers who hold or are studying for Ph.D. 53	Online survey Quantitative data analysis approach	April 2018 The survey remained open for five weeks.	To identify barriers hindering the research publication activity by radiographers holding PhDs.	the comments referred to the impact of the line manager on both the individual and the department. Almost half agreed they lacked the authority to implement research findings in their department. In the free text comments, the study participants raised requirements for time allocation for research, heavy workload and understaffing. These findings were significantly associated with part-time sonographers and those qualified between 1992 and 1995. The most common barrier stated by 75.5 % of the respondents was lack of funding for research and publication (n = 40). In addition, the data gleaned from the 62.3 % (n = 33) responses indicated that non-research-related workloads prevented them from conducting research. Other barriers reflected by respondents were lack of institutional support and Lack of time 56.6 % (n = 30) and 54.7 % (n = 29), respectively. Interestingly, the response from both academic and clinical personnel conveyed that radiographers who are solely engaged in clinical duties experience a higher degree of hindrances to research participation than their counterparts in academia or those who have both academic and clinical roles.	productivity by ensuring adequate time allocation and cultivating a supportive philosophy for scholarly pursuits. Moreover, the study has emphasised the importance of support from colleagues and other health professionals. The study stressed the necessity of support and guidance from governmental bodies and professional organisations. The coordinated approach ensures the research alignments with national priorities and professional standards, which can establish a solid foundation for Ph.D. research development.	High
P10	Garlock-Heuer and Clark, 2020 Radiologic technology	United States of America, North America	Radiographers = 390	Online survey Quantitative data analysis approach	The survey remained open for eight weeks.	To evaluate medical imaging and radiation therapy professionals' perceptions of conducting research.	The most common barriers stated by the participants were lack of knowledge (32.3 % n = 126), and 43.6 % (n = 170) of the radiographers had no or little exposure to the research	The study showed a lack of knowledge and confidence in conducting research among most participants. However, various ways could be implemented to boost research proficiency	High

P11	Grose 2016 Journal of Medical Imaging and Radiation Sciences	Canada, North America	Radiation Therapists = 35	Case study (Point-of-Care) tool Online survey Mixed-method data analysis approach	Not stated	To examine the potential usefulness of a P-O-C tool for radiation therapists to identify the existing barriers causing radiotherapists to resist keeping up with research needs and to determine what is needed in practice to support practitioners with research initiatives.	process during the entry-level diagnostic or therapeutic radiography programs. Among the 302 respondents who have not been involved in research projects, two principal reasons were identified for their non-participation in research: 63 % (n = 193) reported that research is required for their position and 23.8 % (n = 72) due to lack of time. Lack of knowledge and resources was reported by almost 21 of the participants. The participants outlined the following barriers. Lack of dedicated quiet space and protected research time. Lack of support from management to act on evidence-based findings, workload exhaustion, lack of organisational funding and opportunities for front-line practitioner research initiatives. Limitations of personal research capabilities, evaluation of research and. Limited access to databases and full-text journal articles and limited computer access. There is no additional time to use workplace technology for research initiatives. Limited involvement in creating departmental vision, goals, and research directions. Limited funding for educational opportunities and conferences. Departmental research is not valued by management.	were suggested, such as integrating research education into academic programs, encouraging research publications and sharing, increasing research-focused continuing education programs and promoting employer support for research activities funding and mentorships. Respondents outlined several barriers to their ability to do so, including access to evidence-based data, differing organisational research philosophies and practices, and lack of resources to promote discipline-specific practitioner research. Developing a clinical decision support tool narrows the gap between the separate worlds of academia and real-life practice, fostering evidence-based decisions.	Moderate
P12	Halkett et al., 2017 Journal of Medical Radiation Science	Australia, Australia	Radiation Therapist (RT) = 206	Online survey Mixed-method data analysis approach	30th September 2013 to 2nd May 2014	To identify benefits and barriers to research participation in medical imaging.	The majority of the participants (73.8 n = 152) reported "Time and workload" as the main barrier to research implementation, followed by "Support", which was cited by 14 % (n = 29) of the respondents. Both lack of "Funding" and "Education, expertise and confidence" were selected by 11.7 % (n = 24) of the participants, indicating financial	The findings suggest that sustained engagement in research and participation opportunities can potentially improve job satisfaction among radiologic technologists. Furthermore, it is more likely that RTs' research activities could be expanded by allocating additional time, support and resources.	High

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Table 2 (continued)

Paper No.	Study Reference & Journal	Methods				Study Aim (s)	Study Outcomes		Study Quality Grading ^a
		Country/Continent of study	Sample/Study Site Characteristics	Study Design & Analysis approach	Study period and duration or operational details of centres		Key findings	Key Conclusions	
P13	Hancock et al., 2023 Radiography	United Kingdom, Europe	Therapeutic Radiography Departments = 32	Online survey Cross-sectional Mixed-method data analysis approach	The survey was open for one month.	To identify the barriers and facilitators to undertaking research and clinical trials in the radiotherapy departments in the UK.	constraints and gaps of knowledge and confidence as significant hurdles to conducting research. Additional obstacles to research engagement, lack of “motivation, incentive and interest” were reported by 9.7 % (n = 20). In contrast, issues relating to career structure, recognition and remuneration for conducting research were cited by 8.3 % (n = 17) of the participants. Additionally, 4.4 % (n = 9) of the respondents identified family commitment and lack of opportunities as barriers. The majority of the radiotherapy departments (64 %) felt that radiotherapy quality assurance (RTQA) capacity was ‘never’ or ‘rarely’ a barrier to opening clinical trials. However, 20 %, 12 % and 4 % of the participating departments felt that RTQA was ‘Often’, ‘Sometimes’ or ‘Always’ a barrier to clinical trials, respectively. Resource limitations were perceived as barriers by 34 % of the departments, and in addition, the time required for trials to be published or reported accounted for 25 %, while clinical preference accounted for 19 %. Radiotherapy delivery readiness was indicated by only 3 % of departments. Furthermore, the lack of therapeutic radiographers’ (TR) involvement in trial protocol development was perceived as a barrier to clinical trial implementation.	The study suggested that embedding radiotherapy clinical trials into departmental and NHS-Trust strategies is crucial to guarantee that the necessary processes and resources for clinical trial implementation are not only established but also acknowledged as vital and significant for cancer patients receiving radiotherapy treatment.	Moderate
P14	Harris and Paterson, 2016 Radiography	United Kingdom, Europe	Consultant radiographers = 20	Online survey Mixed-method data analysis approach	Not stated	It aims to identify the facilitators or barriers to research activity by consultant radiographers in clinical practice.	The survey responses showed the main barriers to the research involvement by consultant radiographers as the following: Thirty-three of the respondents (80 %) cited a lack of allocated time as the	The study’s findings underscore the need for heightened research preparedness and acceptance across all disciplines, with a particular emphasis on the	Moderate

P15	Hurt and McLoughlin 2023 Journal of the Medical Library Association	UK, Europe	Radiographers = 11	Case report Questionnaire Qualitative data analysis approach	Not stated	To identify what prevented the participants from attending the literacy workshop sessions.	The study demonstrated inconsistent attendance in literacy workshops due to a lack of research-dedicated time and a high workload for participants. Some participants stated that it is hard to understand and get their head around the research topics in general."	subset of breast imaging speciality. These discrepancies warrant further examination to aid in integrating research into all consultant radiographer's roles, thereby addressing the inherent challenges. According to the participants' feedback, there are plans to deliver the program to other groups, ensuring senior management buy-in is present to enable maximum engagement and participation. Delivering profession-specific training meant that content could be tailored effectively to the participants.	Low
P16	Iweka and Hyde 2023 Radiography	UK, Europe	Radiographer = 16	Autoethnographic Qualitative	February 2022 to 10 months.	The study aims to explore the experiences of a research radiographer in promoting a research culture through the facilitation of Journal Club (JC) activities within a UK NHS Foundation Trust.	The study demonstrated a lack of research-dedicated time for participants and research radiographers. High workload and lack of dedicated research team, non-uniformity of acceptance of the Journal Club value and inconsistent attendance.	The potential of the JC in promoting research activities can be harnessed fully by providing protected time and resources for participants to explore gaps identified during the critical appraisal of research articles.	Moderate
P17	Kyei et al., 2015 OMICS Journal of Radiology	Ghana, Africa	Radiographers = 216 (91 % n = 256)	Questionnaire Quantitative approach	Not stated	The aim was to assess the perceptions and practices of radiographers about evidence-based practice in Ghana as well as the perceptions of the barriers to EBP.	Sixty (30.1 %) respondents cited insufficient time as the most critical barrier. 52 (26.1 %) indicated a lack of information resources as the second most important barrier. The absence of the generalisability of research findings to their specific patient population (13 %) and the inability to apply research findings to individual patients with unique characteristics were also shown to be important barriers (13 %). 26 (13.1 %) respondents cited a lack of collective support among colleagues as a significant barrier.	Radiographers in Ghana generally have positive attitudes and beliefs about evidence-based practice (EBP). However, there is an identified lack of knowledge and skills necessary for the practice of EBP.	Moderate
P18	Metcalfe et al., 2010 Radiologic Technology	United States of America, North America	Radiographers = 163	Survey Quantitative data analysis approach	Not stated	To indicate the barriers to conducting research by radiographers with doctorates.	About 78 % of the respondents cited lack of time to write as the significant challenge and lack of funding, which was reported by 43 % (n = 64). Major distractions (travel, competing work demands,	The findings suggest that, despite the strong interest in research activities, many radiologic technologists holding doctoral degrees have minimal involvement in research and publications. Thus,	Moderate

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Table 2 (continued)

Paper No.	Study Reference & Journal	Methods				Study Aim (s)	Study Outcomes		Study Quality Grading ^a
		Country/Continent of study	Sample/Study Site Characteristics	Study Design & Analysis approach	Study period and duration or operational details of centres		Key findings	Key Conclusions	
P19	Middleton and Bolderston 2023 Journal of Medical Imaging and Radiation Sciences	Canada, North America	Radiation Therapist = 8	Online survey Mixed methods data analysis approach	The survey remained open for 4 weeks.	To identify the engagement of University of Alberta's Radiation Therapy Program (RADTH) alumni in research activities and the barriers to conducting research post-graduation	etc.) were reported by 70 % (n = 104) of the participants and staff shortage at work was stated by 57 % (n = 76) of the radiographers. Most respondents (83 %) reported that they do not face pressure from their employer to publish research, while 53 % (n = 78) stated that research is not required or prioritised in their clinical post. The study reported the following findings: limited local opportunities, lack of time, lack of research knowledge, and lack of interest in research.	fundamental changes in radiography science education and training are required if this trend is to be reversed. The study concluded that despite the effective spread of undergraduate research, challenges to further involvement may reflect those reported in broader academic literature.	Low
P20	Moran and Davis, 2020 Journal of Medical Imaging and Radiation Sciences	Canada, North America	Radiological Technologist = 249 Nuclear Medicine Technologists = 51 MR Technologists = 30 Radiation Therapists = 114 (Total = 444)	Online survey Mixed methods data analysis approach	Not stated	To identify the enablers and barriers to Canadian radiographers' involvement in research and EBP	Barriers were most frequently clustered under resource-related factors, including lack of protected time/clinical obligations, heavy workload/ understaffing, lack of funding, and lack of tools and resources. Most respondents (51 %) disagreed/strongly disagreed that they received sufficient training to develop a successful research project during their academic education, while 44 % of the respondents indicated their current level of knowledge in developing a research project as low. Barriers to non-participation in EBP and research were identified and further organised based on resources, workplace culture, opportunities, and personal-related factors.	The continued growth of EBP in medical radiation technology and (MRT) requires regular monitoring of the research trends, fostering of supportive work environments and individual motivation. The synergy between academic institutions, professional bodies, organisations and individual MRT practitioners is essential to overcome barriers and enhance the search output.	High
P21	Ooi et al., 2012 Radiography	Singapore, Asia	Radiographers = 114	Survey Mixed methods data analysis approach	One month	To explore radiographers' involvement in research activities and	About two-thirds (n = 75) of the participants graded time as a significant challenge in conducting research. This was	The findings suggest that more training is needed for radiographers in research protocol and biostatistics.	High

P22	Piro et al., 2020 Technical Innovations & Patient Support in Radiation Oncology	Italy, Europe	Radiation Therapists (RT) = 135	Questionnaire Quantitative data analysis approach	October 1st, 2018 to January 31st, 2019.	The study aims to explore the RTTs' opinions and involvement in radiation oncology research in Italy.	to identify their perceived attitudes and barriers to research involvement. followed by a heavy workload and a lack of resources.	In addition, organisational support is required to overcome barriers such as lack of time and resources to encourage research culture. The lack of trust towards other professionals involved in multidisciplinary research may derive from a shortage of appropriate interest and insufficient training. Thus, Specific training programs and RTs integration into research projects and activities are required to increase the RTs' involvement in research.	Low
P23	Ramzan et al., 2022 Radiography	United Kingdom, Europe	Diagnostic radiographers = 13	In-depth semi-structured interviews Qualitative data analysis approach	April and May 2021	The study aims to identify the radiographers' attitudes, perceptions, and experience towards using evidence-based optimisation strategies and potential barriers to implementing these strategies.	Participants stated that they experienced resistance from radiologists and other medical practitioners, Lack of support from colleagues, lack of resources, difficulties accessing literature and information, and fear of change. Furthermore, clinical work is the highest priority and time allocation for research is not guaranteed. Thus, it requires radiographers to take time out of their personal lives, which participants did not receive positively. In addition, the participants felt that it is challenging to implement new practices due to the department's protocols and organisational structures, as most of the decisions are made by radiologists and medical physicists. Altogether, the radiographers lost interest and unwillingness to engage in research activities.	The study findings suggest that research optimisation strategies need to be developed to overcome the barriers to EBP implementation.	Moderate
P24	Rawle et al., 2023 Journal of Medical Radiation Sciences	Australia, Australia	Diagnostic radiographers = 12	Semi-structured interviews Focus group Qualitative	Not stated	The study examines the factors motivating and influencing the radiographers'	Five themes were identified. There is a lack of autonomy over the selection of radiographic projections as radiology staff influence	Research promotion is needed to increase the willingness and capacity of radiographers to	High

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Table 2 (continued)

Paper No.	Study Reference & Journal	Methods		Study Design & Analysis approach	Study period and duration or operational details of centres	Study Aim (s)	Study Outcomes		Study Quality Grading ^a	
		Country/Continent of study	Sample/Study Site Characteristics				Key findings	Key Conclusions		
						decisions on research-based evidence.	radiographic practice. Participants reported that time was a limiting factor in searching and appraising new techniques, as this often occurred during the examination. Radiographers explained their reliance on experience, their own or that of a colleague, when making decisions to modify imaging techniques rather than research-based evidence. Due to the technical nature of their role, they presumed evidence had already been used to demonstrate that the prescribed radiographic techniques produced the highest quality images for assessing relevant pathology. The following findings were documented: Lack of: Time = 33 Funding = 14 Support/communication = 13 Contacts/knowledge of what others are doing = 10 Resource, Vision/research and Training = 7 Twenty-six percent of participants were asked to cover routine service instead of carrying out their duties.	implement evidence-based practice.		
552	P25	Russell et al., 2007 The British Journal of Radiology	United Kingdom, Europe	Research Radiographer (RR) (Therapy) = 70	Online survey Mixed methods data analysis approach	One month 2006	To identify perceived training needs and make recommendations for the planning of the RR community in 2007 and 2008	The following findings were documented: Lack of: Time = 33 Funding = 14 Support/communication = 13 Contacts/knowledge of what others are doing = 10 Resource, Vision/research and Training = 7 Twenty-six percent of participants were asked to cover routine service instead of carrying out their duties.	Dedicated research time, stable funding, training and support are required.	moderate
	P26	Sauti and Yamin, 2020 Health Scope Journal	Malaysia, Asia	CT radiographers = 30	Cross-sectional questionnaire Quantitative data analysis approach	Not stated	The study aims to identify the level of knowledge, attitude, and practices toward evidence-based practice (EBP) in computed tomography (CT) among radiographers and the factors that influence the use of EBP in CT among radiographers.	The results show that the three highest mean values are 3.60 for the inability to appraise literature, 3.47 for insufficient time critically and 3.40 for the lack of information resources.	Most radiographers had a high level of knowledge, attitude, and practices toward evidence-based practice in CT and understood most of the specific terms related to EBP.	Moderate
	P27	Turner et al., 2012 Journal of Radiotherapy in Practice	Australia, Australia	Radiation therapist = 19	Focus group Qualitative data analysis approach	July to August 2009	To identify the challenges and opportunities that prevent Radiation Therapists (RT) led the research.	Several departmental barriers that discouraged or prevented RTs from participating in research activities were identified. These included culture, time,	RTs identified challenges to research. The information has given a greater understanding of the culture of our department and the attitudes to	Low

P28	Ugwu et al., 2009 European Journal of Radiography	Nigeria, Africa	Radiographers = 50	Cross-sectional survey Quantitative data analysis approach	Not reported	To assess the attitudes of radiographers/ imaging scientists towards EBMI in Nigeria.	The majority (80 %) of radiographers indicated that they would evaluate evidence if it contraindicated with clinical judgment (36 %) of radiographers reported that there was no access to resources and a threat to clinical freedom (18 %)	research activities. Thus, a framework of support to facilitate increased initiatives will be the next step. This study has shown that many clinical radiographers practising in south-eastern Nigeria have poor knowledge and attitude towards EBP radiography but will be willing to participate if individual and organisational barriers are removed.	Low
P29	Vils Pedersen 2022 Radiography	Denmark, Europe	Radiographers = 39 Radiography managers = 5	survey Focus group interviews a mixed method data analysis approach	Not reported	To explore the interest of clinical radiographers in three radiology departments in Southern Denmark towards research projects, their enthusiasm for research in clinical practice and obstacles hindering such undertakings.	The majority of the radiographers, 77 % (n = 30), stated they were interested in conducting research. However, 89 % (n = 27) of them experienced difficulties allocating research time during their clinical working days. The top motivation factor, as reported by 44 % of the participants (n = 17), was the involvement in research projects with other colleagues, followed by the opportunity to attend local and international conferences and courses, as reported by 41 % of the respondents (n = 16) while salary supplement was chosen by 33 % of the participants (n = 13). On the other hand, 69 % (n = 27) showed no interest in leaving their clinical duties to conduct research, while 25 radiographers expressed no respect or motivation from colleagues. Four thematic points were drawn from both the survey and the focus group discussion: a) Provision of educational and training support. b) Research should be relevant to clinical practice. c) Research should be incorporated into the department's strategy. d) Time allocation for research within the clinical hours is vital for developing a research culture.	This study underlines that implementing research in clinical environments is surrounded by numerous challenges. Nevertheless, clinical radiographers exhibit a high level of motivation and interest in research. Radiography managers find it advantageous to develop strategies that aim to stimulate radiographers to initiate research projects. However, they may experience that a conflicting value framework can influence their ability to foster the development of the research culture within these clinical settings.	Moderate

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Table 2 (continued)

Paper No.	Study Reference & Journal	Methods				Study Aim (s)	Study Outcomes		Study Quality Grading ^a
		Country/Continent of study	Sample/Study Site Characteristics	Study Design & Analysis approach	Study period and duration or operational details of centres		Key findings	Key Conclusions	
P30	Watts and Snaith, 2023 Radiography	United Kingdom, Europe	Diagnostic Radiographers = 77	Retrospective review Cross-sectional Online survey Mixed methods data analysis approach	From 2018 to 2020 The survey was open for 4 weeks.	To evaluate radiographers' engagement in EBP in the UK, compare it with documented standards, understand the radiographers' attitudes towards EBP, and identify the barriers and strategies for improving the radiographer's participation.	The respondents demonstrated a positive outlook towards EBP and research. However, they express some concerns about barriers hindering their active involvement. Lack of time (n = 71/77; 92.2 %) and heavy workload (n = 69/77; 89.6 %) were identified as the most significant barriers to RASE. Other identified barriers were a lack of leadership or management support (n = 47/77; 61 %) and a lack of authority to make changes (n = 45/77; 58.4 %)	Although there is widespread enthusiasm and a positive mindset among radiographers to get involved in research, the level of active involvement does not reflect this sentiment.	High
P31	Yakubu et al., 2023 Radiography	United Kingdom, Europe	Radiographers = 100	Cross-sectional Online survey Mixed methods data analysis approach	The survey was open for 6 weeks.	To explore radiographers' level of engagement in audit and research processes and factors that affect their involvement	The study noted a significant association between the type of healthcare facility and literature search engagement, stating that radiographers working at district general hospitals exhibited a marked propensity towards engaging in literature searches compared to other health facilities. Similarly, radiographers with postgraduate qualifications or those with reporting or mammography duties reported a significantly higher likelihood of having undergone research training and were more likely to initiate research. The study also revealed that more radiographers with postgraduate qualifications have initiated (61.5 %) and previously been involved in research (80.8 %) than those with a diploma or degree (29.0 %) and (50.5 %), respectively.	This study critically analyses radiographers' understanding of and engagement with research and audits. Although radiographers in England exhibit a positive attitude towards these areas, active participation remains low, highlighting a disconnect between philosophy and action. Furthermore, the study advocates appointing research and audit leads in radiology departments and linking promotions to active research and audit engagement to encourage participation.	High

^a Quality assessment based on QATSDD.⁵¹.

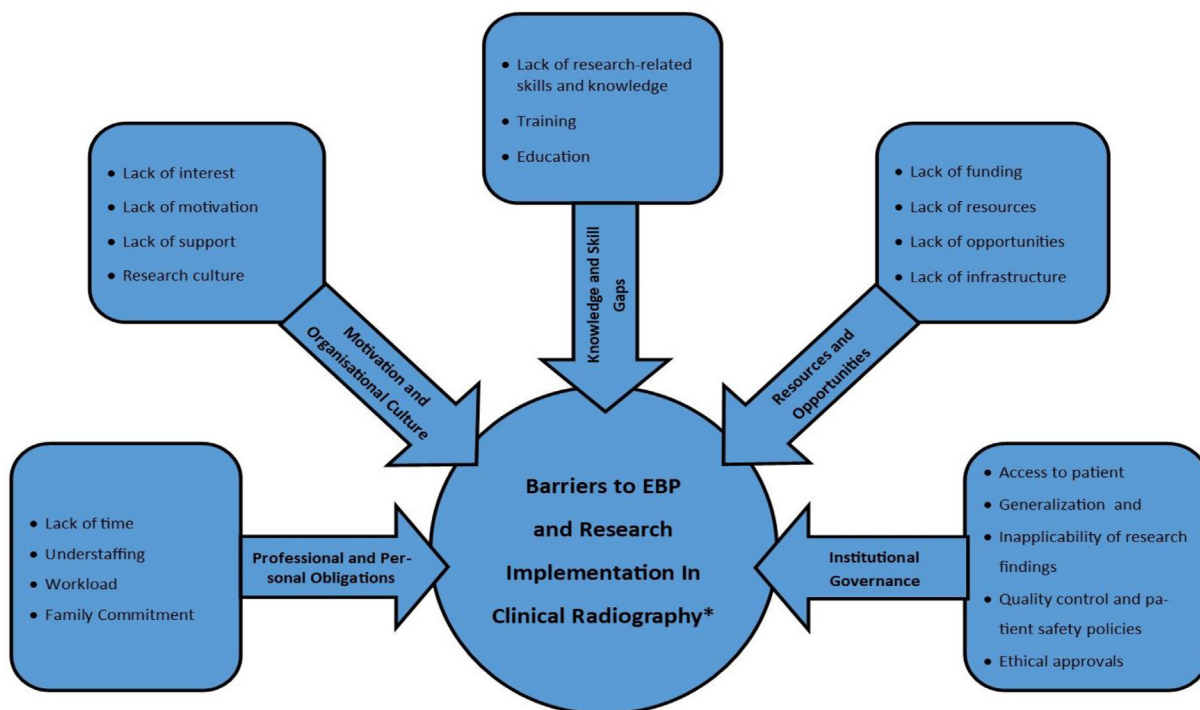


Figure 2. Themes for common barriers to EBP implementation in clinical radiography.

appears to play a significant role in facilitating their participation in research.²² Increased engagement has been demonstrated to correlate with support from managers and colleagues.^{18,20–28,39,40,54,56,58,59,62,63,65} The acceptance and acknowledgement of research participation and project conduction by professional colleagues is crucial. In Finland, Ahonen and Liikanen²⁰ documented that more than half of radiographers reported a lack of support for research activities from work colleagues and management. Equally, Ramzan and colleagues⁶³ reported that radiographers experience some resistance from radiologists and physicians. Thus, support from senior colleagues and other professionals, the importance of self-esteem in individuals' capability for performing research and the presence of a radiography research culture in the workplace are important to promote EBP.²²

The role of the radiography manager significantly impacts both the individual and the department, particularly in facilitating and promoting research culture.^{20,24,39,40,54} Elliott and colleagues²⁴ reported the lack of support from managers as the second most frequently reported barrier. The same authors emphasise that managers have the responsibility not just to allocate time for research but also to inspire staff participation in research activities.

Agustin and colleagues⁵⁴ reported that 79 % of their respondents indicated that their managers attribute a high degree of importance to research. Accordingly, the same percentage of participants reported that initiating and conducting research is considered important in their workplace. Professional support is instrumental in creating an environment conducive to research and fostering a positive attitude towards its utilisation within the organisation.^{15,25,28,39,40} Radiography managers have found it advantageous to develop strategies that aim to stimulate radiographers to initiate research projects.⁵⁸

Research culture

Several studies have demonstrated that the establishment of a research-oriented culture within the radiography community has not yet been universally embraced.^{16,22,26,28,38–40,58,61,65} For instance, non-uniformity of acceptance of the research activities such as journal club and inconsistent attendance was observed among radiographers⁴⁰ and the absence of a clearly defined pathway was identified as a prevalent inhibiting factor.²³ Bolejko and colleagues²² reported that research culture in the workplace was also associated with non-participation in research as indicated by 37 % of the participants.

However, the utilisation of research seems to be integrated to some degree into clinical care.^{8,24} Elliott and colleagues²⁴ reported that 72.9 % of participating sonographers use literature search findings to modify their practice, and 42.2 % of them have altered their practice following their personal involvement in projects. This is consistent with the recent English study findings that showed 63 % of respondents' departments have made changes to services following an audit.⁸

Notably, a number of studies revealed that the research component was not considered a mandatory requirement within radiographers' roles and responsibilities. Radiographers did not see the requirement to engage in the conduct or application of research projects.^{26,38,56,61} For instance, Metcalf and colleagues³⁸ indicated that most of their respondents (83 %) reported an absence of pressure from their employer to conduct research, while 53 % stated that research is not a requirement or priority in their clinical posts. These findings are parallel to Garlock-Heuer and Clark's findings²⁶ that among their radiotherapist participants who had not been involved in research projects, 63 % of them stated that research is not required for their position, and it was one of the principal reasons identified for their non-participation. Similarly,

UK findings indicated that research involvement was not included in consultant radiographers' roles. These discrepancies warrant further examination to aid in integrating research into radiographers' roles, thereby addressing the inherent challenges.⁶¹

Theme 3: knowledge and skill gaps

Several studies indicated that lack of knowledge pertaining to research-oriented skills, education and training strongly attenuates the achievement of EBP within the radiographer community.^{8,9,18–22,26–28,39,54,59,61,65,68,78} Alakhras and colleagues²¹ noted a struggle among radiographers with a lack of information resources towards understanding statistical analysis. Likewise, Bolejko and colleagues²² reported that this knowledge deficiency about scientific methods created a significant barrier towards research culture within a work environment.

In Nigeria, Chuukwuani et al.⁵⁵ and Ugwu et al.⁶⁶ documented that clinical radiographers had poor knowledge and research-related skills. The former study claimed that 68 % of respondents did not utilise research-based evidence due to insufficient knowledge to evaluate the quality and reliability of the research findings.⁵⁵ Similarly, a Canadian study reported that more than 50 % of respondents disagreed or strongly disagreed that they received sufficient training to develop a successful research project during their academic education; a total of 44 % of respondents described their current level of knowledge in developing a research project as low.²⁸

Halkett and colleagues⁵⁹ stressed that a lack of education and expertise pertaining to research methodologies inevitably leads to a lack of confidence. While Agustin et al.⁵⁴ and Garlock-Heuer and Clark²⁶ interlink the lack of knowledge with the lack of training and poor exposure to research during undergraduate studies. This correlates with Yakubu and colleagues,⁸ who found that radiographers with post-graduate level qualifications are more likely to initiate research due to prior exposure. In addition, this may correlate with a lack of potential contacts within the scientific community, resulting in the absence of information within the field of research.¹⁸

Theme 4: resources and opportunities

Globally, a lack of resources has been reported as one of the prominent deterrents inhibiting EBP and research implementation in radiography.^{16,20,21,26–28,39,54,56,60,63,64,66} For instance, in a Malaysian study,⁶⁴ lack of information resources was a major barrier to considering an in-depth analysis of relevant topics.⁶⁴ Similarly, Agustin et al.⁵⁴ and Grose et al.⁵⁶ documented limited library resources including access to databases, full-text journal articles and computers. In the latter of the two studies, 94 % of respondents agreed that the ease of accessibility to research evidence resources positively impacts their clinical decision-making.^{56,78}

Radiographers have pointed out a lack of opportunities in their workplace.^{9,26,28,54,56,59} Agustin and colleagues⁵⁴ noted only 33 % had access to academic activities at work, indicating a lack of support for research, while Halkett et al.⁵⁹ and Middleton and Bolderston⁹ discussed limited opportunities for collaboration and professional development. On a similar topic, engagement in research projects and attending conferences were identified as motivators for radiographers,⁵⁸ suggesting such engagements improve job satisfaction.⁵⁹

Financial constraints further exacerbated obstacles to implementing EBP and research in radiography as indicated by reports from varied settings.^{18–20,23,25,26,28,38,56,59} For example, Challen and

colleagues¹² reported that financial implications were the second most prominent deterrent expressed by radiographers. In addition, limited funding emerged as a barrier for radiographers in the context of postgraduate research and publication.^{18,25}

Theme 5: institutional governance

The findings of this review highlight barriers experienced by some radiography departments related to research regulations and patient participation.^{24,27,55,60,68} For example, in Nigeria, radiographers often underestimate patient involvement in decision-making.⁶⁶ Similarly, in Ghana, 13 % of radiographers claimed research findings lacked generalisability and applicability for specific patient groups.²⁷ Other barriers include inflexible imaging protocols, inadequate support⁵⁵ and complex ethical approval processes,²⁴ limiting the radiographers' capacity to integrate evidence-based guidelines into their patient care pathway.

In the radiation therapy context, 36 % of the participating radiotherapy departments in a UK study identified quality assurance systems as a clinical trial barrier.⁶⁰ Other challenges include the time for trial reports and clinician preference influencing the translation of research into practice.⁶⁰ Furthermore, the exclusion of therapeutic radiographers in trial protocol development hinders implementation. Other challenges in non-radiotherapy clinical trials include patient recruitment difficulties due to study protocol interactions, health practitioner influence and patient-related inclusion issues.⁶⁰ Thus, policymakers need to recognise the potential of therapeutic radiographers and integrate them into decision-making, clinical trials, research development and effective patient recruitment strategies.

Strengths and limitations

This review's findings provide a broad landscape of clinical radiography areas, inclusive of diagnostic and therapeutic radiography, and multiple specialities such as general radiography, computed tomography, magnetic resonance imaging and sonography. Additionally, the population of the included study participants represent different career stages throughout radiography, ranging from novice to consultant level. Equally, this review encompasses studies from a range of clinical settings and countries across the world. This diverse participant pool and wide range of study settings enhance the representativeness and generalisability of the study findings.

The potential limitations of the study stem from its eligibility criteria of primary research published in English, thereby potentially neglecting valuable insights offered by grey literature and reviews articulated in other languages. However, the diversity of the reports incorporated in this review depicts a broad spectrum of settings spanning from low and intermediate to high, offering a comprehensive view despite the potential language and source material limitations.

Another limitation is that the quality rating of the studies evaluated ranged from low to high, with the most frequent rating being moderate. Therefore, the synthesis of the research findings should be cautiously regarded. In addition, given the low response rate reported in some studies, it is plausible to postulate that individuals possessing a more favourable inclination towards research may have been more predisposed to participate in these studies.⁶⁷ However, findings may still accurately represent the attitudes of the population,⁶⁸ as achieving a high response rate does not necessarily equate to a significant reduction in nonresponse bias and can paradoxically induce other measurement issues by extending the fielding period.⁶⁹

Conclusion

This review demonstrates that implementing evidence-based practice and research in clinical radiography environments is surrounded by numerous challenges such as insufficient time allocation for research, lack of resources and inadequate research-related skills and knowledge. Nevertheless, globally, clinical radiographers were perceived to have a high level of motivation and interest towards research activities. Evidence suggests that some radiography managers have found it advantageous to develop strategies that aim to stimulate radiographers to initiate research projects. However, they may experience that a conflicting value framework can influence their ability to foster the development of the research culture within these clinical settings. A profession-wide transition towards evidence-based practice precipitates a heightened consciousness, acknowledging that research constitutes the indispensable foundation for not only elevating the quality of radiography services but also augmenting efficiency in the workflow process and enriching patient experience.

Recommendations

Successful and sustainable integration of evidence-based practice and research into clinical radiography and promoting radiographers' engagement requires multi-polar collaboration. The study findings suggest several recommendations including.

Promoting research culture

Strengthening the research culture in radiography necessitates cultivating an environment valuing interdisciplinary collaboration and innovation. Management initiatives, such as professional development programmes, journal clubs, and training workshops, are crucial for this enhancement.^{15,16,38–40} In addition, mentorship programs significantly nurture the research skills of novice practitioners, facilitating knowledge exchange and skills development.^{26,54,78}

Securing resources, allocating time for research, and recognising achievements foster a positive research attitude. One key guidance document is the 2021–26 research strategy by the UK's Society and College of Radiographers (ScoR), aiming to integrate research across radiography practice, emphasising patient care, service delivery, and developing research-active professionals.¹³ Implementing strategies such as this will enhance the dynamism of the radiography profession, creating a research-engaged community and raise the standards of care.

Radiography education

Incorporating research knowledge and skills into pre-registration radiography education programs is highly recommended.^{30,53,78} This is due to the significant impact such training can have on learners' involvement in evidence-based practice and research.⁷⁰ By integrating research-related competencies into the curriculum from the outset, students can develop an understanding and appreciation for research, fostering their engagement in these activities from the early stages of their professional journey. Furthermore, cultivating research skills can equip clinical radiographers to effectively interpret and apply research findings in their practice, thereby improving patient care and outcomes. Consequently, a well-structured pre-registration education program that highly emphasises research can be instrumental in promoting a robust culture of research and evidence-based practice within radiography.

International and local societies' collaboration

Prominent international societies like the ISRR, EFRS, and WRETF, alongside governments across the world, play a crucial role in enhancing research capacity in LMICs. They can elevate quality research by partnering strategically with national societies, fostering research knowledge and competencies, and providing vital resources. Approaches include sponsorships, expert opinions, educational workshops, training courses, conferences, and online sessions. For instance, the British government offers scholarships for commonwealth citizens to study in the UK, encompassing radiography programmes.^{71,72} Such collective efforts can greatly elevate the quality of radiography research from LMICs, fostering development and cooperation, and adding to the global knowledge base in the field.

Research governance

Research has transitioned from an independent pursuit to a structured, scrutinised endeavour.⁷³ Regulating policies ensure patient access to relevant research while balancing accessibility and privacy protection. In addition, quality control and ethical approval processes enhances credibility, ensures participants safety, and protects patient rights.⁷³ Lean management can streamline the ethical approval process and organisations prioritising ethical values may find this approach beneficial.⁷⁴

Furthermore, the research ethics system and radiographers' awareness of this requires evaluation. For example, the Radiography Research Ethics Standards for Europe survey suggests regulatory frameworks need modifications to include all research participants and guidelines for various low-risk research undertakings.^{75,76}

Conflict of interest statement

All authors have no conflicts of interests to declare. Of note, TNA is a member of the editorial board but was blinded to the decision-making process.

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