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Integrating AI into medical imaging curricula: Insights from UK HEIs

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ABSTRACT

Introduction: With artificial intelligence (AI) becoming increasingly integrated into medical imaging, the Health and Care Professions Council (HCPC) updated its Standards of Proficiency for Radiographers in Autumn 2023. These changes require clinicians to be both competent and confident in operating AI and related technologies within their role. Responsibility for meeting these standards extends beyond individual clinicians to higher education institutions (HEIs), which play a crucial role in preparing future professionals. This study examines the current and planned provision of AI education for medical imaging students and staff, identifying potential challenges in its implementation.
Methods: An electronic survey was developed and hosted on the Joint Information Systems Committee (JISC) platform. It was disseminated in April 2023 by the Society of Radiographers to UK HEIs offering medical imaging programmes.
Results: 24 HEIs responded, with representation from all four UK nations. Of these, 71 % ($n = 17$) had already integrated AI into their curriculum. Reported challenges included timetabling constraints and the need to upskill staff. 21 % (n = 5) indicated that AI would be incorporated following course revalidation in the 2024/25 academic year, while the remaining two HEIs were unaware of planned changes.
Conclusion: Most UK HEIs have begun integrating AI education into medical imaging programmes. However, significant disparities exist in the depth and scope of AI content across institutions. Further efforts are needed to develop a comprehensive and standardised AI curriculum for medical imaging in the UK.
Implications for practice: This study highlights key areas for improvement in AI education within medical imaging programmes. Further research into content and delivery methods is essential to ensure radiography professionals adequately equipped to navigate the evolving clinical environment.

Introduction

The integration of artificial intelligence (AI) into healthcare is transforming clinical practices, including radiography and radiology.[1] Whilst AI has had a presence in medical imaging for many years, technological advances in recent years have allowed its role in the field to grow.[2] As AI evolves, UK higher education institutes (HEIs) offering medical imaging degrees face pressure to update their curricula to prepare graduates for an AI-enabled healthcare environment. While government and professional bodies have published frameworks and recommendations to align with these technological advancements,[3–5] a gap remains in the availability of AI-focused education.[6] In Autumn 2023 the Health and Care Professions Council (HCPC) updated their Standards of Proficiency for Radiographers,[7] now requiring clinicians to demonstrate competence in AI technologies, emphasising the need for HEIs to ensure their graduates are equipped for this shift.

To address this, the College of Radiographers Industry Partnership Scheme (CoRIPS) funded Radiographer Education and Learning in Artificial Intelligence (REAL-AI) project aims to explore the AI education landscape in undergraduate diagnostic and therapeutic radiography through 1) determining current understanding of AI amongst the medical imaging community; 2) ascertaining current and planned offerings from HEIs; 3) curating, delivering

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and evaluating educational interventions. The results of the first aim have been published in Radiography.[8] This paper presents the second aim which addresses the findings of a survey of current/planned practice of UK HEIs offering medical imaging programmes.

Methods

Ethical approval from XXXX University's Research Filter Committee was gained prior to distribution (XXXX).

An original survey was co-designed by the study team, consisting of healthcare and human-computer systems researchers and academics. The survey aimed to gather information directly from HEI's on the integration of AI into their undergraduate curriculum. Piloting with a group of 20 key stakeholders and laypersons ensured validity. A mixed methods approach was employed, combining data from closed-ended and open-ended questions. Qualitative responses provided deeper context and elaboration on the closed-ended responses, allowing for a more comprehensive understanding of how AI has been added to the curriculum, as well as the challenges and opportunities related to the effort. The target population was UK HEI's which deliver undergraduate diagnostic and therapeutic radiography programmes.

The survey instrument was concise to encourage participation and consisted of three main questions (Fig. 1).

Dissemination

The survey was designed and hosted online using the JISC Platform. This allowed for ease of dissemination and submission of responses. The survey link was shared with a contact within the Society of Radiographers, who distributed it to the academic leads for each of the 36 target universities in April 2023.

Ethical considerations

Participation was voluntary and informed consent was attained using an embedded participant information sheet (PIS) and digital consent form. Data were collected and stored anonymously on the JISC platform until the survey closed in July 2023. Upon survey completion, data were exported from the platform to Microsoft Excel for analysis. The study adhered to General Data Protection Regulation (GDPR) 2018 regulations[9] and participant confidentiality was assured via JISC's 'anonymise responses' option, which strips identifiable information. An e-version of the PIS was included at the beginning of the survey, explaining participation was voluntary and the survey adhered to the Checklist for Reporting Results of Internet E-Surveys (CHERRIES).[10]

Data analysis

Data were exported directly from JISC to Microsoft Excel. Data were checked and cleaned before thematic analysis of responses. Thematic analysis of free-text responses was conducted following Braun and Clarke's[11] six-phase framework, a widely accepted analysis method in qualitative research which offers flexibility and depth of insight. This involved: 1) familiarising with the data, 2) generating initial codes, 3) searching for themes, 4) reviewing themes, 5) defining and naming themes, and 6) producing the report. The analysis was inductive, with themes identified directly from the data, ensuring that the coding and themes remained grounded in participants' responses.

Results

Responses were received from 24 HEIs out of a possible 36 giving a response rate of 67 %. Most responses came from England (88 % or $n = 21$), with one each from Northern Ireland, Scotland, and

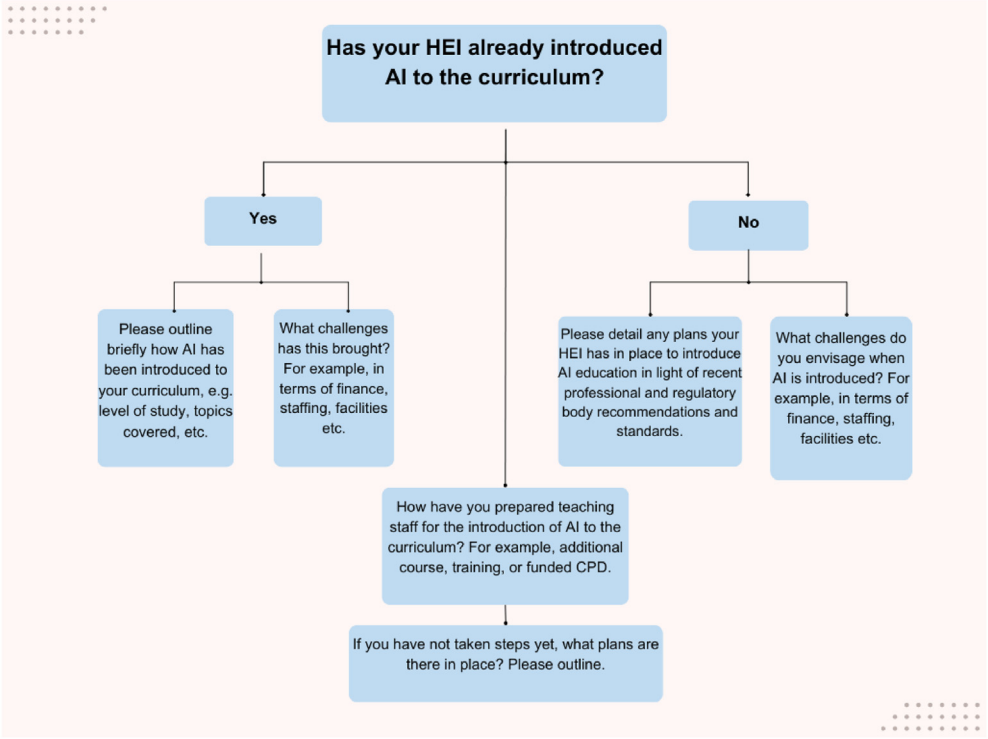

Figure 1. Flowchart demonstrating question routing.

Wales. 77 % ($n = 18$) of respondents stated AI has already been added to their curriculum, with a further 21 % ($n = 5$) stating that AI would be included as the 2024/25 academic year through course revalidation. Of the remaining two, one indicated they were unsure of plans and the other stated there were *'none as far as I am aware'*. Table 1 summarises details provided by respondents pertaining to their HEIs current provision of AI on the curriculum.

Challenges

Of the 17 HEIs who had added AI to their curriculum, 14 identified a range of barriers they had to overcome during the process. The thematic analysis identified four primary themes regarding the challenges faced by HEIs (Fig. 2) and eleven sub-themes (Table 2).

1 Upskilling staff
Many institutions reported significant concern regarding the need for staff to acquire the appropriate knowledge to deliver AI education. This challenge underscores the need for ongoing professional development and training opportunities to equip faculty with the requisite skills.
2 Lack of resources
Financial burden was raised as in issue by several institutions, noting a lack of facilities, workforce, and tools to enable them to offer AI content. This highlights the need for substantial investment in infrastructure and resources to support AI education.
3 Temporal constraint
Time was cited by a few organisations directly, and indirectly by others, as a barrier to incorporating AI concepts into the curriculum. Institutions indicated that fitting AI education into already packed curricula posed significant scheduling challenges.
4 Uncertainty
Some institutions voiced apprehensions about resistance from both staff and students. This was identified along with fears around ability to deliver education that would take abstract concepts of AI and make them translatable to the real world. This uncertainty reflects broader concerns about the readiness and acceptance of AI integration within both educational and clinical communities, and the longevity of the technologies in clinical practice.

Three HEIs (3,17,22) stated they faced no challenges in integrating AI into their curriculum.

Staff preparation

Of the 24 responses, 24 % ($n = 6$) had not yet made any preparations to assist staff in gaining the competency to deliver AI education, nor did they intend to. From the qualitative thematic analysis of the remaining responses, a prominent theme emerged of self-directed upskilling. Some HEIs conveyed that faculty members would need to take the initiative to research and engage in self-directed continuing professional development (CPD) to acquire the requisite knowledge in AI to enable them to deliver AI content on the curricula. Four respondents mentioned specific staff members with an interest in or conducting research on AI, suggesting that reliance on personal motivation and initiative is a common approach.

Limited resources surfaced as a sub-theme in the analysis of these responses. Time, financial and faculty constraints were raised by four HEIs in response to plans for training staff on AI in medical imaging.

> *"Members of the teaching team have undergone their own research efforts into AI in reporting … No courses or training have been provided …"*
>
> Participant 2

> *"There is no funding within the university available for additional courses."*
>
> Participant 8

> *"Staff preparation is an area in which investment and training is still outstanding."*
>
> Participant 10

Table 1
Current AI curricula in responding HEIs.

HEI	Level of Study	Topics Covered	Nature of Content (Theory/Practical)	Comments
3	2nd year	Imaging science/technology modules	Theory	Single lecture
7	Levels 5 and 6	Uses and future developments	Theory	Broad but vague
8	All stages	Theory of AI, applications	Theory	Covers theory and applications
9	Level 4 (plans for level 5)	Physics, anatomy modules	Theory	Early-stage introduction
10	Science, image commenting modules	CAD, machine learning (lung and breast cancer)	Practical	Structured with investigative elements
11	Stage 1 and Stage 2	Image acquisition, technology, ethics, VR	Theory and practical	Comprehensive and diverse
12	Level 5	Principles, applications, ethics of AI	Theory	Planned for future implementation
13	Level 6, radiography top-up	Radiographic applications, AI legislation	Theory	Focused on radiographic applications
14	Levels 4-6	Radiation physics, image interpretation, research	Theory	Broad integration
15	Levels 4-6	Intro to digital skills in line with Digital Skills Framework (L4), applied imaging (L5), AI principles (L5&6)	Theory	No space for new module, so elements of AI embedded in existing course. Further development planned
17	Level 6	Clinical practice modules & talks from industry/ research point of view	Theory & practical	Offered by industry partners
18	Levels 4-6	Current uses, future development, ethics & risks	Theory	Comprehensive & diverse
19	Not specified	AI simulated practice & VR	Practical	Practice focus
22	Not specified	Discussion on uses of AI in imaging & interpretation	Theory	Limited & vague
23	Level 4 and 5	Specific topic in L4, within modalities L5	Theory	Limited & vague
24	Level 1 and 4	Brief introduction L1, 2 h lecture L4	Theory	General principles, history and future potential

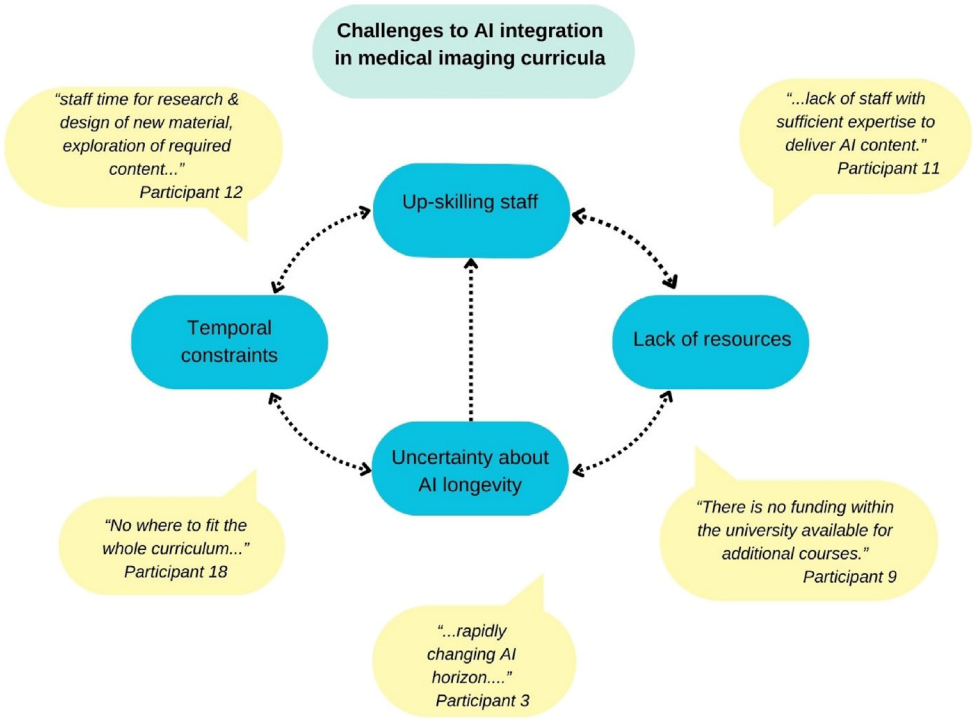

Figure 2. Thematic map.

Table 2
Current AI curricula in responding HEIs.

Main Theme	Sub-Themes
1. Upskilling staff	1. Self-directed learning and CPD
	2. Personal interest/research in AI
	3. Lack of structured training/support
2. Lack of resources	4. Financial constraints
	5. Insufficient facilities/tools
	6. Limited workforce availability
3. Uncertainty about AI longevity	7. Resistance to AI integration
	8. Abstract AI concepts practicality
	9. Long-term relevance doubts
4. Temporal constraints	10. Overloaded curricula
	11. Scheduling challenges

> *"A depleted staff body making attempts to invigorate the [c]urriculum. Requires massive investment …"*
>
> Participant 23

Discussion

The findings of this study provide some insight into the landscape for HEIs as AI education is introduced. Several themes for discussion emerged from the data.

Current and planned addition of AI to curriculum

77 % of responding HEIs ($n = 18$) state that AI has been added to their undergraduate radiography curricula. However, the detail provided on these additions demonstrates inconsistency, vagueness, and a lacklustre approach by some. The range of examples given on content and method of delivery in Table 1 shows a lack of commonality in providing comprehensive education on AI. This could ultimately lead to poor learning experiences for students. This highlights a need for definitive guidance on the appropriate topics, level of instruction, and competencies required to practice as a radiographer so that HEIs can design the necessary educational interventions. The current authors previous research of HEI educators *(currently under review)* indicated that 75 % ($n = 25$) of UK medical imaging educator respondents worked in a HEI that had already added AI to the curricula, which is in keeping with the findings of this study. Existing courses on AI education which formed the subject of a 2024 scoping review[6] were also found to vary in their approach; on the topics offered, method of teaching and outcomes measured.

Challenges

The 4 themes identified in the data: 1) upskilling staff, 2) lack of resource, 3) temporal constraints, and 4) uncertainty. A thread that ties the first two is finance. To overcome these barriers, a commitment from the top levels of the HEI is essential. Investment must be made to equip future graduates and existing staff with the requisite knowledge to safely and effectively work with AI technologies. It is evident from the investment by the government and the NHS that AI is here to stay.[3,12] It follows, therefore, that staff will need to work alongside it. Failure to prepare those staff could result in serious implications for patients, staff, the profession, and health boards and trusts.

The theme of uncertainty encompasses a different set of challenges faced by HEIs when considering the addition of AI to their curricula. Uncertainty relates to issues with AI acceptance and readiness, two factors which have been much discussed in the literature, which stem from the 'black box' nature of AI algorithms and what that can mean for liability and trust.[13–15] Despite an apparent lack of acceptance and need to improve AI readiness, it is evident that the NHS is investing in these technologies,[12] and they continue to be implemented in imaging departments across the UK.

This theme of uncertainty in the data may reflect HEIs hesitation to fully revise their curricula until there is greater confidence in the projected impact of the technology. A case in point is the rise and fall of computer-aided detection (CAD) in mammography in the 1960s, which was expected to change radiographic practice forever, but ultimately issues with low-specificity and high-sensitivity meant that it did not have a lasting impact.[16] These fears are not unwarranted; however, AI technology has advanced exponentially in the time since those initial systems failed and AI is now commonplace in everyday life. Coupled with the data capacity of modern systems, the capabilities of today's AIs much exceed that of previous iterations, and this should be acknowledged by HEIs as they consider the revalidation of their courses. There is increased urgency to prepare staff with draft consultations underway by the National Institute for Health and Care Excellence (NICE) for AI for fracture detection.[17]

The theme of time is a more difficult challenge to overcome. Staff and students have voiced concerns about overcrowded timetabling[18,19] and the impact this has on teaching and learning outcomes. A balance needs to be found in terms of including a relevant and sufficient level of knowledge on AI to adequately carry out the functions of medical imaging roles, without detracting from existing course content. This would require a definitive AI curriculum and set learning outcomes. Potential risks of not doing so could be sacrificing core imaging teaching content to allow for AI content. The ramifications of this could be dire, with graduates emerging to the workforce with subpar core skills. This could result in any number of poor outcomes – be that for patients, employing boards/trusts, or individual staff.

A small number of HEIs reported experiencing no challenges in the introduction of AI to their curriculum. Upon closer examination of their responses, it becomes apparent that this lack of challenges may be attributed to the limited scope of their AI educational offerings. These institutions reported minimal AI content integration, such as a single lecture or in-class discussions. This finding raises important questions about the depth and breadth of AI integration in medical imaging curricula. Whilst the absence of challenges might initially seem positive; it may indicate a superficial approach to AI education that fails to adequately prepare students for the increasing role of AI in medical imaging practice. The contrast between these institutions and those reporting challenges suggests that more comprehensive AI integration efforts are likely to encounter obstacles but may ultimately provide a more robust educational experience. This could also be indicative of a need for greater advisory measures from governing bodies to assist in the development of a medical imaging curricula that encompasses AI. This finding underscores the need for critical evaluation of what constitutes meaningful AI education in medical imaging programmes and highlights the potential gap between cursory exposure to AI concepts and in-depth, practical training. Participants in an earlier REAL-AI survey[8] indicated a preference for AI concepts to be taught at undergraduate level, with practical applications, AI terminology and key concepts amongst the most desired topics.

Staff preparation

The theme of time also relates to the time necessary for faculty to be upskilled to a sufficient level to deliver AI content. In a thematic analysis of the responses, the emergent theme was self-directed upskilling. This was reinforced by responses to our previous survey of medical imaging educators *(currently under review)*, where respondents indicated they have been expected to source their own training and CPD, at their own cost (financial and time). If they are expected to learn these concepts as part of their role as faculty, HEIs as employers should be responsible for ensuring this is budgeted for within their working schedule. Failure to do so could mean that those without the means to conduct this essential learning on their own time or purse, neglect to do so. This could lead to disparity in the rigour of teaching both between colleagues but also between HEIs. Staff could be supported by colleagues in computer science, or with access to MSc courses or online CPD, to achieve proficiency and ensure preparedness. In addition to radiography educators, the broader multidisciplinary team – including radiologists – has a crucial role to play in preparing students for the realities of AI integration in clinical practice. Radiologists often work at the forefront of AI adoption, particularly in diagnostic interpretation and workflow optimisation, and their involvement in education could offer valuable clinical insight and reinforce interprofessional learning. There is scope for HEIs to foster collaborative teaching approaches, where educators from radiography, computer science, and clinical domains co-deliver AI content.[20] This not only enhances the authenticity of the learning experience but also prepares students to work within AI-enabled multidisciplinary environments. Recognising AI as a shared domain across disciplines may help reduce the burden placed solely on radiography staff and promote a more cohesive educational model. If the quality of education begins to fall, impact will eventually be felt by the HEI in terms of student feedback and rankings, not to mention the potential impact suffered by graduates and patients. This trend raises concerns about the potential for disparities in the quality of AI education delivered across institutions. When the responsibility for upskilling falls solely on teaching staff, they may face challenges in identifying what knowledge is essential, locating reliable sources, and assessing the quality of the information they acquire. This situation could lead to a fragmented educational experience for students, with varying levels of expertise among faculty members.

Implications for practice and policy

The findings of this study have key implications for practice and policy and several recommendations can be proposed. Firstly, a disconnect exists between HEIs and their teaching staff in relation to the planning and preparation required for integrating AI into medical imaging curricula. HEIs should consider consulting with both teaching staff and AI experts to ensure that faculty aligns with the needs of educators and the evolving demands of clinical practice.

Secondly, it would be beneficial to facilitate the co-design of learning materials and assessment strategies promote consistency and ensure an appropriate level of AI knowledge among all graduating imaging professionals. Such knowledge is essential, not only for clinical practice but for broader responsibilities such as procurement decisions and quality assurance. Graduates equipped with AI competencies may contribute to overcoming one of the main barriers to implementation – resistance to AI – by supporting cultural change and greater acceptance within the workforce.

Whilst this study focused on undergraduate provision, it is equally important that AI education is also tailored at the postgraduate level to ensure inclusivity of learners at different stages of professional development, including those already established in clinical roles. Further research is warranted to determine the specific competencies and depth of content appropriate for postgraduate curricula.

Limitations

It is possible that this survey could have been completed by a member of staff without sufficient knowledge of the curriculum

plans. Steps were taken to minimise this by distributing the link via the SoR to course directors or equivalent, who would be expected to have the necessary insight to answer the questions.

Conclusion

This study highlights the varied approaches taken by UK HEIs in integrating AI into undergraduate diagnostic and therapeutic radiography curricula, with significant disparities in content depth and delivery. While 77 % of institutions reported incorporating AI, the lack of standardisation presents challenges in ensuring all students receive adequate preparation for an AI-integrated clinical environment. It is imperative that HEIs begin to meaningfully augment curricula to align with HCPC, government, and professional body policies.[3–5]

Four primary challenges were identified in AI integration: staff upskilling, resource constraints, time limitations, and uncertainty regarding AI's long-term role in clinical practice. Many institutions rely on faculty engaging in self-directed learning, often without institutional support, raising concerns about inconsistencies in teaching quality. Without structured faculty training, disparities in AI education across HEIs may emerge, potentially impacting student preparedness for practice.

These findings emphasise the need for HEIs to provide structured professional development opportunities for educators to collaborate with AI experts to ensure the curriculum aligns with industry advancements. Establishing standardised learning outcomes and co-designed educational materials could improve consistency across institutions, ensuring graduates are adequately equipped with AI competencies. Given the increasing presence of AI in medical imaging, strategic planning at the institutional level is essential to overcoming barriers and fostering a sustainable approach to AI education in radiography.

Informed consent

Informed consent for patient information to be published in this article was not obtained because no patient identifiable information was gathered.

Informed consent to participate was obtained and recorded via electronic consent form at the outset of the data collection process.

Ethical approval

Ethical approval for this study was obtained from Ulster University Filter Committee (FCNUR-23-006).

Availability of data

Data required for this study will be available at https://pure.ulster.ac.uk/.

Author contributions

GD: Conceptualisation, methodology, formal analysis, investigation, writing – original draft, visualisation.

CH; LMcL; JMcC:; SMcF: Conceptualisation, methodology, validation, writing – reviewing & editing, supervision, funding acquisition.

RB: Conceptualisation, methodology, writing – reviewing & editing, supervision, funding acquisition.

LMcL: Conceptualisation, methodology, validation, writing – reviewing & editing, supervision, funding acquisition.

JMcC: Conceptualisation, methodology, validation, writing – reviewing & editing, supervision, funding acquisition.

SMcF: Conceptualisation, methodology, validation, writing – reviewing & editing, supervision, funding acquisition.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author(s) used Perplexity.ai in order to reformat the reference list. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

Conflicts of interest statement

The author(s) declare(s) that there are no conflicts of interest.

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