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A scottish survey exploring diagnostic radiography students' attitudes towards a career in nuclear medicine

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ABSTRACT

Introduction: The career aspirations of undergraduate radiography students have previously been surveyed but there is little in the literature exploring nuclear medicine as a career specialism. This study aimed to explore the relationship between clinical placement and career choice within third and fourth year diagnostic radiography undergraduates in Scotland.
Methods: University ethical approval was obtained; gatekeepers were appointed from each university and distributed the survey. The online survey was conducted consisting of 22 questions including 4 open ended. Descriptive results were summarised using tables and graphs, whilst inferential statistics were collated using R.
Results: The survey response rate was 30.3 % (n = 64/211). Students were predominantly female (89 %). The preferred modality for specialising was general radiography (weighted average = 98.99) whilst nuclear medicine was the least favored career choice (weighted average = 18.69). Clinical placement was the most influential factor in career planning for radiography students, and students expressed a desire to learn more about nuclear medicine. There was a statistical difference in length of time spent in nuclear medicine between the three universities (p = .021).
Conclusion: The study helped to establish the link between career planning and clinical placement. Students were more likely to choose a modality based on a positive clinical experience. Notably students spent the least amount of clinical time within NM and also favour this modality the least for their future career.
Implications for practice: Students have demonstrated a need to learn more about the modality and experience it within a clinical placement setting. It is recommended that the radiography curriculum is modified to incorporate learning objectives with a minimum of one week within NM.

Introduction

Nuclear medicine (NM) is a specialist imaging modality within Radiology,[1–3] used for its functional imaging acquisitions.[4,5] The multidisciplinary workforce consists of radiographers and nuclear medicine technologists (NMT's) in varying ratios dependent on the hospital service model.[6] While radiographers are eligible to work in NM post-qualification, NMT's generally undertake a two-year work based training programme delivered by the Institute of Physics and Engineering in Medicine (IPEM), designed to equip them with the necessary specialist knowledge and skills.[6]

Working collaboratively in the delivery of a patient-centred service, the titles "radiographer" and "NMT" are frequently used interchangeably.[7] However, a key distinction lies in the professional regulation of radiographers. Defined as experts in NM and medical imaging by the European Federation of Radiographer Societies (EFRS),[8] radiographers are governed by the Health and Care Professionals Council (HCPC) and must adhere to its standards of proficiency, which includes NM as outlined in standard 13.38.[9]

NM workforce shortages are a global issue, exacerbated by staffing limitations and financial constraints. These challenges have reduced the number of NMTs being trained, prompting an

Abbreviations: NM, Nuclear Medicine; MRI, Magnetic Resonance Imaging; CT, Computed Tomography; PET/CT, Position Emission Tomography/Computed Tomography; SPECT/CT, Single-photon Emission Computed tomography/Computed Tomography.

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urgent call for radiographers to fill vacancies,[6] and highlighting the necessity of promoting workforce growth for sustainability[10–12] For instance, the Scottish diagnostic workforce plan forecasts a 6 % yearly increase in demand for NM imaging services, further straining a workforce already experiencing an estimated 20 % vacancy rate.[6,13–15]

Despite the eligibility of radiographers to enter NM post qualification, data indicates that NM vacancies are more frequently filled by NMTs in a 3:1 ratio.[6] It is therefore imperative to understand the barriers preventing greater radiographer engagement in NM specialisation. Radiography courses are practice based and require students to spend substantial time on clinical placement.[16] According to the literature, clinical placement plays a pivotal role in influencing students' career planning decisions.[17–20] Clinical placements are an invaluable experience enabling students to consolidate classroom teaching into real life scenarios[21–25] while simultaneously shaping their professional aspirations[18,19,26]

It is not uncommon for students to want a career outside of the contemporary route straight after graduation. With new technologies and developments constantly evolving, students are relying on their clinical placement to form a realistic image of their future.[17] It is imperative that students gain clinical experience across the spectrum of radiography modalities in order to be adequately informed of the strengths and weakness of each modality to guide their future career trajectories.[17,27] In a study by McKenna, McCall and Wray,[18] undergraduate students from various healthcare professions, including radiography, reported that clinical placements often altered their initial perceptions of particular modalities. As such, undergraduate curricula should be responsive to the evolving landscape of medical imaging and the corresponding needs of the diagnostic workforce.

The scarcity of NM taught on UK diagnostic radiography courses[26] could indicate why NM is often reported as the least preferred career choice, alongside mammography.[17,20,28–30] A literature search identified only one study[28] that included NM as a possible career choice, even though there have been numerous studies evaluating radiography careers.[27,29–31]

Even though NM is one of the smallest modalities with a workforce that is 15 times smaller than general radiography,[32] there are 22 NM departments available to students throughout Scotland.[33] This study seeks to assess diagnostic radiography students' exposure to NM throughout their undergraduate training and explore relationships between clinical placement and modality preference, with a view to inform future curriculum development and workforce planning strategies.

Objectives

- To understand what influences a student in career planning.
- To identify student attitudes and barriers to a career in nuclear medicine
- To understand the importance of clinical placement in career planning.
- To compare if nuclear medicine experience differs between the three Scottish universities

Methodology

Survey design

A survey was selected as the most cost effective data collection tool capable of adequately addressing the study's aims and objectives. The literature review identified a study[17] with similar methodology and it was determined that the survey could be modified for this study by incorporating additional questions specific to NM.

The online survey was created using Microsoft Forms. To maintain anonymity; no identifying demographics were collected besides age, gender, university and year of study. The survey consisted of four sections (see Fig. 1): Introduction collected demographics; Methodology explored career preferences; Data analysis focussed on clinical placement; and Results collected information directly related to NM. The questionnaire consisted of attitudinal and information gathering questions (n = 18), supplemented by four open-ended questions to allow participants the opportunity to provide more in-depth comments.

The survey introduction contained essential study information, encompassing data protection and confidentiality considerations. Participant consent was obtained before moving into the first section of the survey. The study was reported using the Checklist for Reporting of Survey Studies (CROSS).[34]

Survey pre test

The survey was pre-tested with a sample comprising four newly qualified diagnostic radiographers, and one ultrasonographer with research experience. Newly qualified radiographers may share similar thoughts to students, and therefore are similar to the intended participants and can help to ensure readability.[35] Feedback from the pre-test resulted in minor survey amendments to improve question comprehension, and correct wording errors.

Ethical considerations

Ethical approval was granted by the institution's Health and Social Science Ethics Committee prior to data collection. As the author had no direct access to participants, gatekeepers were appointed at each participating university to facilitate recruitment.

Sample

All Scottish universities offering an undergraduate Diagnostic Radiography programme were included in the study. Since NM is routinely taught within year 2, students in years 3 and 4 were identified as the target population. Each university (n = 3) provided cohort data to ascertain the total population size. Given the limited number of eligible students (n = 211) that met the inclusion criteria and the nature of the survey methodology, randomisation was not feasible, therefore non-probability purposive sampling of the total population was conducted.

Each participating university appointed a gatekeeper responsible for distributing the survey via email and the university's virtual learning environment. An email invitation was sent along with the participant information sheet to the students meeting the following criteria:

- 3rd or 4th year undergraduate Diagnostic Radiography student
- Enrolled at a Scottish university

The survey remained open for 6 weeks, and was redistributed at week 4.

Data analysis

All anonymised survey data was exported to Microsoft Excel for descriptive analysis, and inferential analysis was conducted using R Studio (v 4.4.1).[36] A p-value $\leq$.05 was considered to be statistically significant.

Fisher's exact tests were employed to determine relationships between the universities and year groups. Inter-quartile range was obtained for questions with skewed distribution. The reliability of

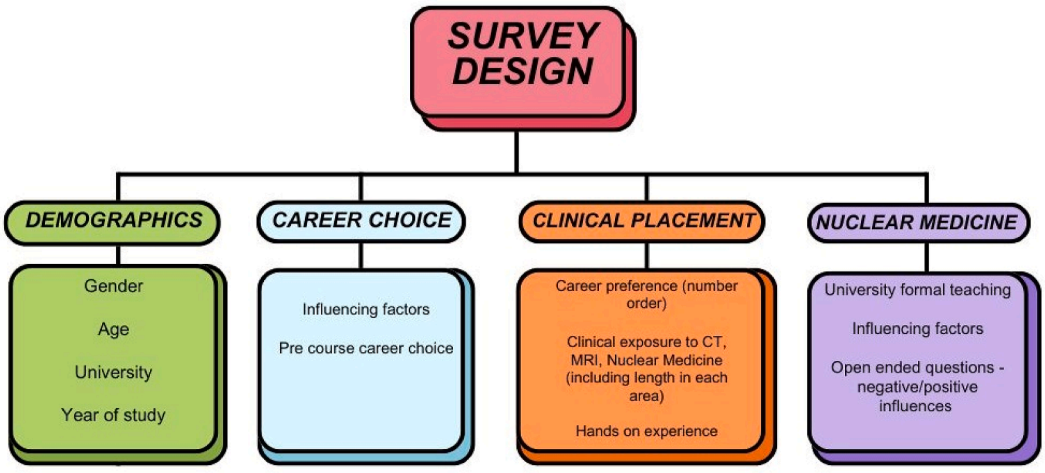


Figure 1. Survey topics.

the qualitative analysis was supported through the use of inductive coding.[37] All free text responses were initially reviewed and coded by FO (co-author). An iterative process was employed to refine and consolidate the codes, ensuring they were thematically consistent and aligned to answer the research question.[38] This systematic approach enhanced the trustworthiness and coherence of the findings. Additionally, the iterative refinement helped to minimise researcher bias and improve the clarity and interpretability of the coded data.

Results

Demographics

64 responses were received, providing a response rate of 30.3 % (Table 1). Non-response analysis using a Fisher's exact test of early (n = 45) and late (n = 19) responses to the question about the number of NM clinical hours found no statistical difference (p = 0.367). A Fisher's exact test analysis of the demographics (Table 1) found no statistical differences between the year of study or university.

The survey was completed by a higher number of females (n = 57/64, 89 %) than males, with two respondents not specifying a gender. The students were aged between 18 and 44, with 73 % (n = 47/64) within the 18–24 age bracket.

Career preference

73 % of respondents (n = 47/64) did not have a preferred modality prior to studying. One respondent specified a career aspiration to work in forensic radiography and organised a two-week clinical placement within post-mortem CT.

General radiography was the preferred modality (weighted average = 98.99), followed by CT (weighted average = 35.02) (Table 2). Not accounting 'other' the least preferred modality for specialisation was NM (weighted average = 18.69). Twelve students expressed additional career preferences: forensic radiography (n = 2), lithotripsy (n = 2), paediatrics (n = 4), PET/CT (n = 1), DXA (n = 2), obstetric ultrasound (n = 1), and dental (n = 1). Three of which were chosen as the student's first choice.

15 students had no experience to some of the modalities listed in Q10, as shown in Table 3. All male students (n = 7) had experienced all modalities surveyed including mammography, and only students from HE2 had experienced all modalities.

*1 student was removed from this question as they stated they had no experience in MRI or NM but contraindicated themselves by stating they had experienced a 5 week placement in MRI and one week in NM.

Fig. 2 summarises the influencing factors towards career planning whereas Fig. 3 examines the same factors in relation to a career in NM. Comparing the results from Figs. 2 and 3, the factor impacting students' the most in career planning is clinical placement. Fig. 2 indicates an overall positive trend with most answers either agree or strongly agree whereas Fig. 3 displays more uncertainty and negative selections.

Table 1
Response rate by university and year group.

Demographic	Eligible Student	Responded (no.)	Response Rate	p value
Total number	211	64	30.3	
Year of study				
3rd year	100	33	33	p = 0.129
4th year	113	31	27.4	
University				
HEI1	51	6	11.7	p = 0.065
HEI2	98	32	32.6	
HEI3	62	26	41.9	

Clinical placement

Students were asked how much time they spent in CT, MRI and NM. The median and inter-quartile range findings are shown in Table 4. Fisher's exact test of 3rd and 4th year found the difference in hours spent in NM was statistically significant (p = 0.021). 90 % of students had experienced hands-on experience in CT compared to only 26.5 % in NM (n = 58/64, 12/64 respectively). NM had the highest number of students who had either no hands-on experience (n = 37/64) or no clinical experience.

Nuclear medicine specific questions

Among respondents, 26 students (n = 40.6 %) expressed interest in specialising in NM. A total of 38 written responses answered "unsure" and "no" were provided by 20 third year

Table 2
Weighted averages of modality preference. The higher weighted average represents the most preferred choice. Each preference was weighted in reverse order, i.e. first choice weighted 8 and eighth choice weighted 1.

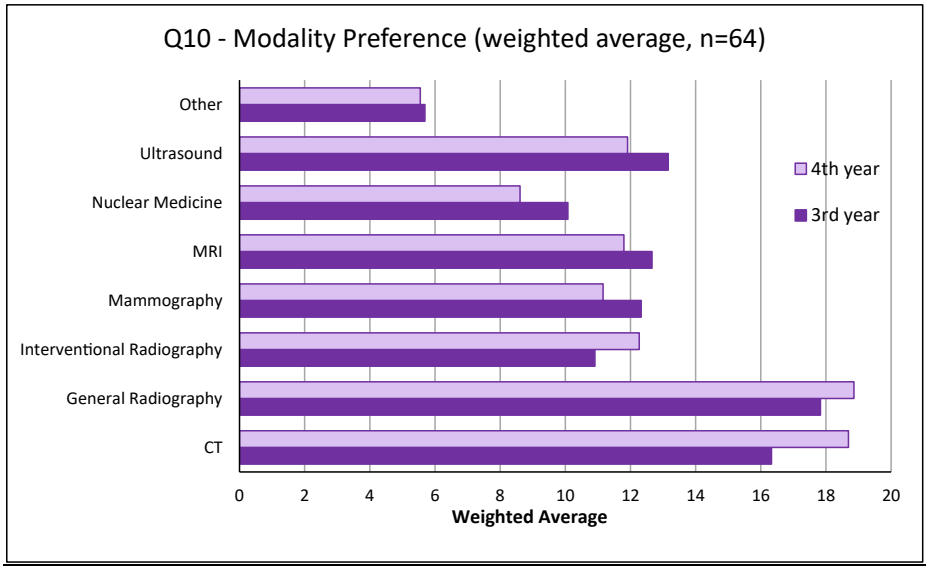
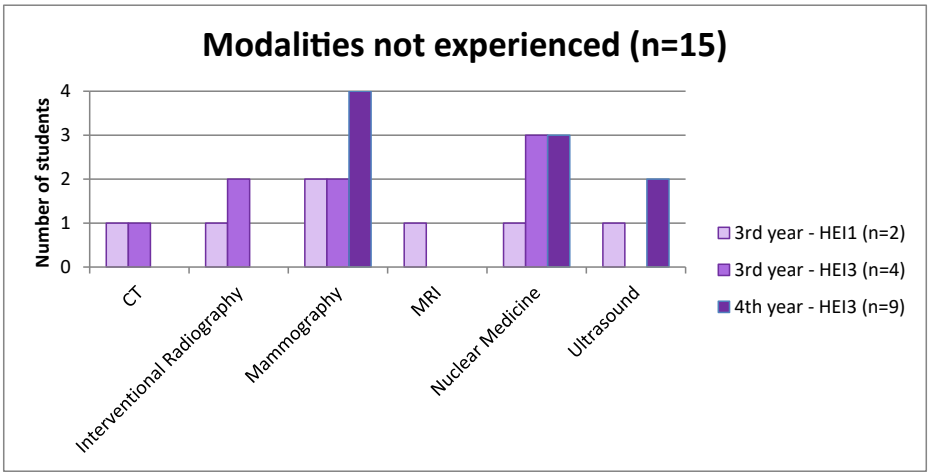


Table 3
Bar chart of modalities not yet experienced on clinical placement.



students and 18 in fourth year. Responses to open ended questions are displayed in Fig. 4.

Several students expressed an interest in NM but were stalled by the lack of clinical experience *"I have no experience to make a decision" (Year 3, HEI3), "I haven't been to a nuclear medicine department yet but I would like to at some point." (Year 3, HEI3),* and "I *used to be interested in it, but not having the chance to spend time on placement … I am unsure if I will like." (Year 4, HEI3).* Students that had been on clinical placement in NM said *"the staff were knowledgeable and sparked an interest in me*" and the equipment was "fascinating" and "*easy to learn*".

Regarding formal NM teaching, all respondents reported receiving teaching either through PowerPoint lectures (n = 7; 10.9 %), lecturers and tutorials (n = 32; 50 %) or formal lectures delivered by a NM specialist (n = 25; 39 %). Nevertheless, students perceived NM teaching as less comprehensive compared to other modalities, with one student stating: *"I haven't had as much exposure and teaching around this specialty as I have with other modalities." (*Year 4, HEI3).

Discussion

This research is novel in its approach to understand the barriers facing students considering NM as a career. In particular, several themes were highlighted for discussion: insufficient clinical experience, clinical placement, a lack of knowledge and radiographer attitudes.

Insufficient clinical experience

Radiography courses require students to complete a minimum of 50 % of their training in clinical practice.[16,39,40] Wilkinson[41] reported that UK higher education institutes (HEIs) schedule an average of 1538.2 clinical hours within their diagnostic

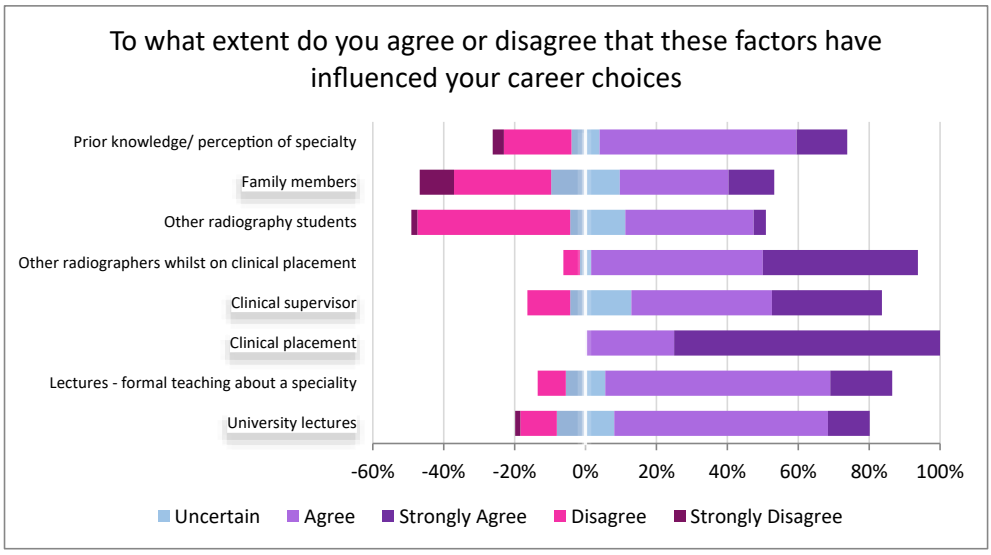


Figure 2. Factors influencing career choice.

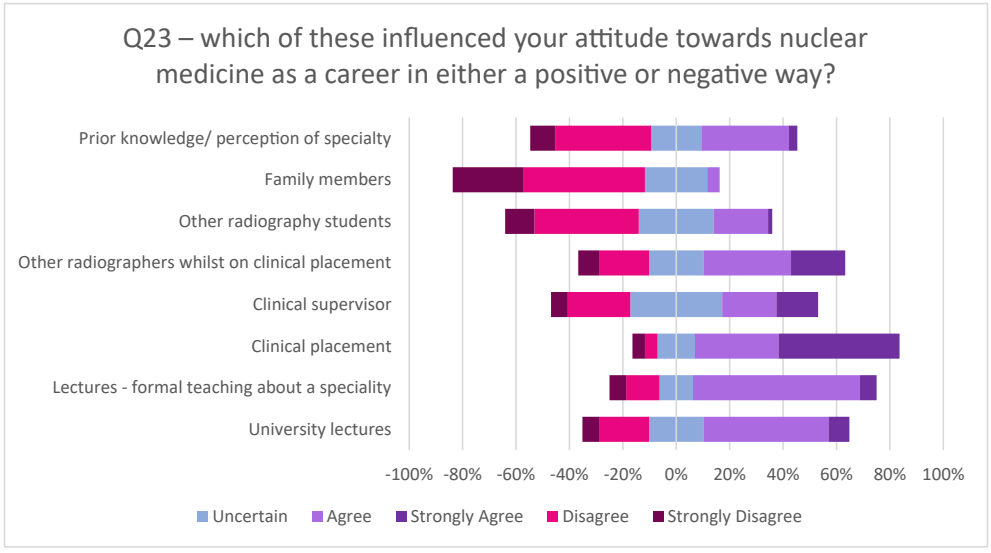


Figure 3. Influencing factors towards a career in NM.

Table 4
A break-down of hours spent in CT, MRI and NM.

	Approximate Clinical time spent in CT (hours)	Approximate Clinical time spent in MRI (hours)	Approximate Clinical time spent in NM (hours)
	Median (IQR)	Median (IQR)	Median (IQR)
3rd year students	23.00 (14.00–56.00)	24.0 (14.0–37.0)	7.000 (7.000–7.000)
HEI1 (n = 4)	21.00 (3.75–64.75)	28.50 (6.00–73.75)	8.50 (2.25–15.00)
HEI2 (n = 20)	21.0 (14.0–39.0)	14.00 (14.00–25.25)	7.00 (7.00–7.00)
HEI3 (n = 8)	111.0 (69.5–148.0)	55.50 (37.00–92.50)	0.000 (0.000–6.500)
4th year students	140.0 (99.0–203.5)	40.00 (37.00–72.00)	7.00 (4.50–37.00)
HEI1 (n = 1)	120 (120–120)	80 (80–80)	40 (40–40)
HEI2 (n = 12)	98.0 (70.0–142.5)	48.50 (34.75–59.50)	7.000 (7.000–7.000)
HEI3 (n = 18)	182.5 (125.0–265.5)	37.00 (37.00–66.75)	22.00 (0.00–37.00)

radiography curricula. Since students must demonstrate competency in to gain HCPC registration,[9,42,43] it is understandable that more clinical time is devoted to CT compared to MRI and NM. However, this is likely to change following the HCPC[9] standards of proficiency update to include a MRI competency.[44] Currently, no NM specific competency exists, and although students are encouraged to witness the modality, this study found that most students have limited time within NM. This limited exposure may contribute to NM's low appeal as a career choice, particularly as 85.9 % of students felt clinical placement enhanced their

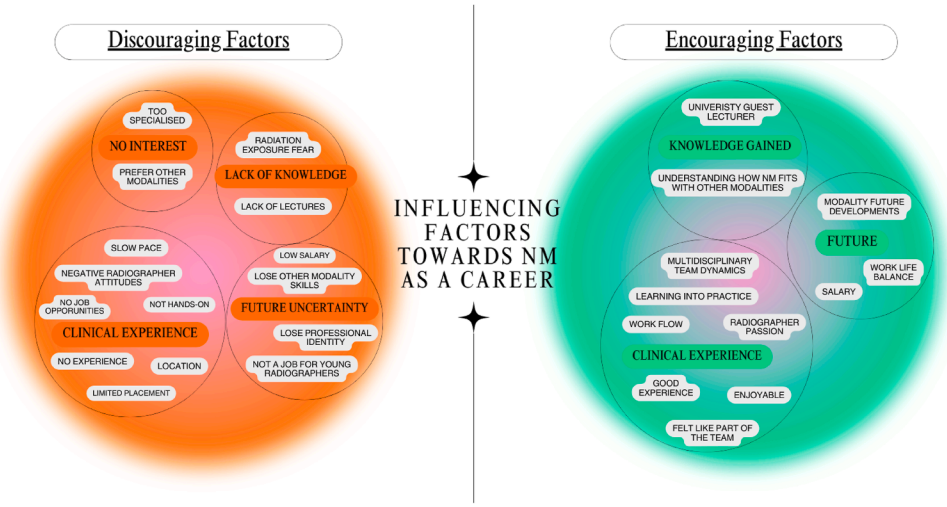


Figure 4. Themes arising from open ended questions.

understanding of a modality more and thus increased their motivation to pursue it, similar to published studies.[17,20,29]

Clinical placement

Clinical placement offers opportunity for students to gain hands-on experience and apply theoretical knowledge into real-world practice;[45] "*it was totally different in real life than what I was taught on campus*" (Year 4, HEI3). While numerous studies,[45–49] have evaluated student perceptions of clinical placements, this study provided a novel insight into how clinical placement can impact both positively and negatively on a student's career plan; *"I did not enjoy the experience in nuclear medicine therefore it has put me off exploring this*" (Year 3, HEI1) versus "*Seeing the difference of how it is taught on campus in comparison to what it is actually like … I thoroughly enjoyed my time"* (Year 4, HEI1).

Student radiographers are keen for hands on experience, as it helps to develop technique and problem-solving skills.[16,45,50,51] Consistent with existing literature,[29,44] CT was rated highest for hands on experience compared to MRI and NM. One study[45] described a lack of hands on experience may result from inexperienced clinical supervisors, and student overcrowding. NM placements can feel restrictive to students because they are not permitted to handle radioisotopes; "*not very encouraging or welcoming to students, for example not allowing the students to do anything for safety reasons*" (Year 4, HEI3). However feeling prohibited from getting involved is not limited to NM; similar barriers exist in CT, particularly during contrast administration.[44] Being less hands-on may explain students' concerns about the slower pace of NM; "*I didn't enjoy how long a scan takes*" reflecting similar student feedback to placements in MRI.[50] Both NM and MRI have long scan lengths (average 37.6 min/45 min respectively)[40] which reduces hands-on learning opportunities.[50] Despite these similarities MRI is often ranked higher in preference than NM[17,28] warranting further research to understand this phenomenon.

Lack of knowledge

University curriculums play a pivotal role in exposing students to the different imaging modalities available to them. Historically, general radiography has naturally been the first job sought, and largely because it constitutes the main focus of undergraduate degrees.[30] Manning–Stanley and Kirby[28] argue that HEIs are uniquely positioned to promote all modalities across the radiography spectrum. Although all participants reported receiving formal NM training, many expressed a need for deeper understanding to cultivate genuine interest. NM accounts for a small percentage of the curriculum, with many HEIs relying on guest lecturers. Guest lecturers are perceived as a useful resource for students to gain expert real-world knowledge and they provide a perspective of the modality that can influence students; "*their passion for NM shone through in the teaching*" (Year 4,HEI3). Similar findings were illustrated in a study where 71 % of students were positively impacted by a mammography specialist lecturer,[22] and likewise another study[52] found 40 % of students (n = 10/25) valued the expert knowledge offered by external lecturers.

Radiographer attitudes

During clinical placements, students interact with radiographers perhaps for the first time; as a result, qualified radiographers can substantially impact students' career decisions - either positively or negatively.[48] Several studies have documented that a negative environment undermines student learning and confidence.[45,48,49] In particular, unsupportive clinical supervisors have been found to leave students feeling unwanted,[48,49] consistent with findings from this study: "*the department was unprepared for a student, didn't seem to care I was there" (Year 3,* HEI1) and "*I didn't really have the best experience as I wasn't involved and nothing was explained to me.*" (Year 3, HEI2). The literature suggests that such negative clinical environments can be discouraging students from pursuing certain modalities.[47,53] Conversely, a positive, supportive, and nurturing environment, coupled with competent and non-judgemental supervision, fosters autonomy and can inspire a lasting passion for the modality.[13,20,45,46,54,55]

Negative staff attitudes have been recognised by the SoR as a form of bullying.[56] Several studies,[48,49,57,58] identify that staff negativity often stems from inadequate training and unpreparedness to be involved in student supervision. Whilst this could be the same throughout radiography, further research to understand the attitudes of NM staff specifically would be beneficial to enhance the clinical experience for students.

Recommendations

It is recommended that the radiography curriculum is modified to incorporate learning objectives with a minimum of one week within NM. This change will enable students to gain a comprehensive understanding of the NM environment, thereby providing more informed guidance for career planning and challenging existing misconceptions. Additionally, targeted support and training to develop staff in all modalities, but especially NM, is needed to create a better learning experience for all students.

Study limitation

The study was limited by the low response rate (30.3 %). Although all Scottish universities offering undergraduate diagnostic radiography programmes participated, the responses were notably lower from one university (HEI1), despite frequent communication with the designated gatekeeper. Nevertheless, non-response analysis indicated no statistical significance between the respondents and non-respondents. In hindsight including a question on the amount of time spent in general radiography would have provided valuable insight into how HEIs allocate clinical practice hours across modalities.

Conclusion

This study offers valuable insights into the relationship between clinical placement and career preference among diagnostic radiography students in Scotland. The findings establish clinical placement is the most influential factor in career planning. Notably students reported spending the least amount of time within NM and expressed the least preference for it as a career option. The study also highlighted that positive clinical experiences within a modality are strongly associated with students' likelihood of pursuing a career in that field. It is hoped that these findings will influence NM departments to provide a more beneficial experience, thereby fostering greater interest and development within this modality.

Ethics approval and consent to participate

Ethical approval for this study was obtained from the University of the West of England, Bristol.

Written informed consent was obtained for anonymised patient information to be published in this article.

Availability of data

Data required for this study may be made available by the author(s) upon reasonable request.

Author contributions

FO: Conceptualisation, Methodology, Formal Analysis, Investigation, Data Curation, Writing – Original Draft, Visualisation, Project Administration.

AS: Supervision, Writing – Review and Editing.

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

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Conflict of interest statement

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