**Title:** A study to investigate undergraduate diagnostic radiographer preferences and expectations of clinical role development: quantitative findings.

**Abstract:**

*Introduction:* Whilst United Kingdom (UK) student ambitions for role development have been surveyed previously, no literature has explored their specialisation preferences. This study aimed to explore these ambitions and preferences in final-year diagnostic radiography undergraduates at a Higher-Education Institute (HEI) in the North-West of England.

*Methods:* University ethical approval was granted for a survey-based study. A questionnaire consisting of 4 closed questions and 6 open questions was distributed in paper format after a taught session. Responses were collated and summarised in Excel (descriptive statistics), and transferred into SPSS (inferential statistics).

*Results:* The response rate was 75.6% (n=34/45). Respondents were predominantly female (73.5%), had A-level as their highest qualification (79.4%) and were of ‘school-leaver’ age (76.5%) at the start of the degree. By overall total, preferences were for reporting (n=24/101; 23.8%), computed tomography (CT) (n=20/101; 19.8%) and MRI/ultrasound (both 12/101; 12.5%). CT had more first choices (n=8) than reporting (n=7). 73.5% anticipated specialising in less than 2 years, and 100% within 4 years.

*Conclusion*: Other than a larger percentage having A-level as their highest qualification, the participant demographics were similar to the UK radiography workforce. Reporting, CT, MRI and ultrasound are the specialisation preferences of final year undergraduate diagnostic radiography students. Expectations for the timeline of role development were slightly more ambitious than previously found.

*Implications for practice*: Identification of reporting as the preferred area of specialisation is a novel finding in the context of UK HEIs. Harnessing this ambition will help meet the goals of successive government policy. Ensuring the ambitions of graduate diagnostic radiographers can be satisfied has clear implications for staff retention within the NHS.

**Keywords:** Advanced practice; expectations; role development; student; four pillars.

**Introduction:**

With the creation of the four-tier model and the Assistant Practitioner role, it was envisioned that this role would release radiographers so they could pursue role development opportunities into both Advanced Practitioner and, beyond that, Consultant Practitioner roles[1]. Iterations of government policy[2, 3] have set out the challenges faced by the National Health Service (NHS). With continuing financial pressure and a need to offer operational efficiencies the role of ‘Advanced Clinical Practice’ (ACP) emerged as a solution to maximise non-medical staff added-value, extending their roles further into domains previously occupied by medics. Further elaboration on the role of ACP came from Health Education England (HEE)[4]. Whilst England-centric, HEE identified that health and care professionals working at the level of ACP should have developed the underpinning competencies applicable to the speciality or subject area across the four pillars of advance practice, namely: clinical practice; leadership and management; education; and research. Despite this clear definition, confusion still exists amongst advanced practitioners as to the exact definition of their role. A survey[1] of reporting radiographers elicited 40 different job titles, grouped into 13 categories by the study authors. Whilst 83% of reporting radiographers describe themselves as advanced practitioners, few had evidenced all four pillars of higher level practice.

In the UK diagnostic radiography students typically enter the workforce as Band 5 radiographers[5] with a role focussed on general X-ray, and experience here typically preceding any move into a more specialised role. A number of authors have investigated role development preferences in student populations. A European study[6] established that development of advanced studies in CT and MRI were important for students, whilst in an Australian institution CT, ultrasound and MRI were the top three preferences of the final year cohort[7]. The motivation to pursue role development is latent within undergraduate radiography students in the UK. A 2010 study[8] found three-quarters of the undergraduates surveyed from a single UK institution stated an expectation of realisation of role development opportunities within 2 years of graduation.

Given the lack of recent literature focussed on role development expectations of students in the United Kingdom (UK), and a lack of literature into sub-specialty preferences, the aim of this study was to investigate role development preferences and expectations of final year undergraduate diagnostic radiography students at a single HEI in the UK.

**Methodology:**

*Ethical approval*

Ethical approval was granted from the University ‘Health and Life Sciences Research Ethics Committee’ (HLREC). NHS National Research Ethics Service (RES) approval was not required as no NHS patients, information or resources were accessed.

*Questionnaire design*

The questionnaire for the survey in this study (Table 1) was simple in design, containing closed questions (4 in total; Q2, Q4, Q5 and Q10) and a larger number of open questions (6 in total; Q1, Q3, Q6, Q7, Q8 and Q9), restricted to two sides of A4. A number of the open questions (questions 6 to 9 inclusive) were included to elicit responses to the barriers and facilitators that the students anticipate in pursuing their ambitions to specialise in the sub-specialties they are interested in, as well as the reporting role. Only the responses to the closed questions are considered here; see supplemental material for the full survey.

Closed questions allowed the calculation of statistical significance in the responses, utilising non-parametric statistical analysis[9], and facilitated comparison of responses across the various groupings. A list of options was included for the participants to indicate whether they had experienced each sub-specialty during their clinical placements and their university time.

*Questionnaire dissemination*

The approved invitation e-mail was distributed to the third year undergraduate diagnostic radiography cohort with two attachments, the participant information sheet (PIS) and consent form. At the end of a planned third year lecture (Monday 4th February 2019), a paper copy of the PIS, consent form and questionnaire was distributed amongst the third year diagnostic radiography undergraduate cohort present by the lecturer, one of the study authors, who has a background as a reporting radiographer. The students were informed that their participation was purely voluntary, and all responses were anonymous, which mitigated the power imbalance between student and lecturer. Data collection commenced once any questions raised had been answered, allowing for fully informed consent.

*Participants and sampling frame*

The survey was targeted at the current third year cohort for the BSc (Hons) Diagnostic Radiography programme, which represents a potential pool of 45 participants; the actual number of potential participants would depend on the number of students attending a timetabled taught session. The students were part-way through their final academic teaching block, having just completed their third year dissertation module, and had also undertaken an elective clinical placement at the end of their second year.

*Data analysis*

Data was transferred into Microsoft Excel (Microsoft, 2016), with further statistical data analysis performed for the closed questions using the Statistical Package for the Social Sciences (SPSS, version 24, IBM). Given the collection of nominal (gender) and ordinal (anticipated time) data types, the non-parametric Chi-squared (χ2) test was used to explore any association between these categorical variables[10]. To use the Chi-squared test 80% of cells should have expected values of at least 5; with a 2 x 2 table this rule can be relaxed to allow one cell to have an expected value slightly lower than 5. Where these rules were not satisfied an alternative approach to the Chi-squared test was adopted utilising Fisher’s exact test[10] for 2 x 2 tables. A p-value of less than 0.05 was considered statistically significant at the 5% significance level.

**Results:**

*Response Rate*

All students from the third year university-based cohort who attended the session, totalling 34 out of 45 potential students, participated by consenting to the study and completing questionnaires, representing a response rate of 75.6%.

*Participant demographics and non-participants*

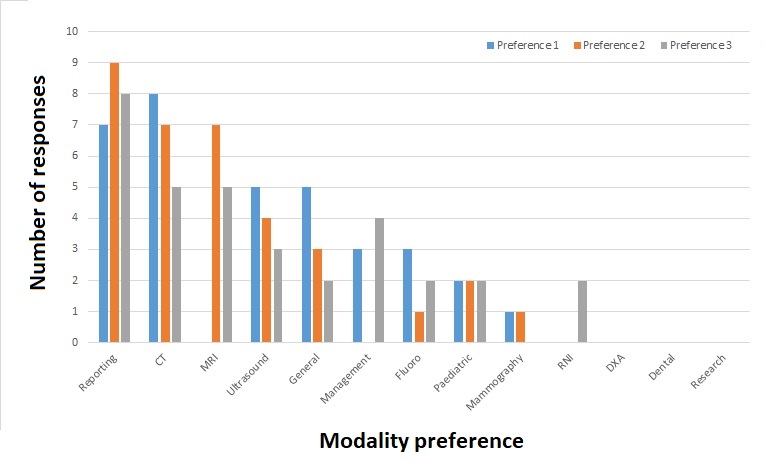
The majority of participants (73.5%) were female and had A-Level as their highest previous qualification (79.4%). A smaller number had undergraduate degree (14.7%), post-graduate degree (2.9%) or leaving certificate (2.9%) as their highest qualification. The majority of participants were classified as a school leaver (76.5%), as opposed to mature student (23.5%), at the point of the commencement of the degree programme in 2016.

*Preferred sub-specialties*

As indicated in Table 1 and Figure 1, reporting (n=24/101; 23.8%) was the number one preferred area of specialisation, when ranked by overall preferences, followed by CT (n=20/101; 19.8%) and then ultrasound and MRI jointly (both n=12/101; 11.9%). By number of first preferences CT (n=8) ranked higher than reporting (n=7), followed by ultrasound and general radiography jointly (n=5). Mammography and nuclear medicine (both n=2; 2.0%) were least preferred in terms of total number of preferences. Dual-energy X-ray Absorptiometry (DXA), dental and research were not ranked in any of the three positions, and subsequently received a total of zero preferences. The total number (n=101) preference rankings is one less than expected as one of the respondents only listed their top two preferences.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sub-specialty** | **Preference 1** | **Preference 2** | **Preference 3** | **Total** | **% of total** |
| Reporting | 7 | 9 | 8 | 24 | 23.8% |
| CT | 8 | 7 | 5 | 20 | 19.8% |
| MRI | 0 | 7 | 5 | 12 | 11.9% |
| Ultrasound | 5 | 4 | 3 | 12 | 11.9% |
| General | 5 | 3 | 2 | 10 | 9.9% |
| Management | 3 | 0 | 4 | 7 | 6.9% |
| Fluoroscopy/interventional | 3 | 1 | 2 | 6 | 5.9% |
| Paediatric | 2 | 2 | 2 | 6 | 5.9% |
| Mammography | 1 | 1 | 0 | 2 | 2.0% |
| RNI | 0 | 0 | 2 | 2 | 2.0% |
| DXA | 0 | 0 | 0 | 0 | 0.0% |
| Dental radiography | 0 | 0 | 0 | 0 | 0.0% |
| Research | 0 | 0 | 0 | 0 | 0.0% |
|  |  |  |  |  |  |
| Total | 34 | 34 | 33 | 101 |  |

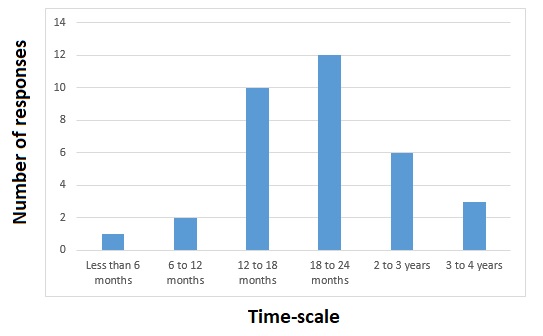
**Table 1.** Participant preferences by sub-specialty, ranked by total overall preference.

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**Figure 1.** Participant modality preferences.

*Anticipated time to achieve specialisation*

Figure 2 highlights only one respondent anticipated specialisation within their preferred area within 6 months of qualification (2.9% overall). Most respondents anticipated achieving specialisation either between 12 to 18 months (29.4%) or 18 to 24 months (35.3%). A small number of respondents (8.8%) anticipated an expected time-frame of over 3 years; no respondents selected a time-scale of 4 years or more.

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**Figure 2.** Anticipated time to specialise in preferred modality.

When the responses were grouped into timescales of less than 2 years, or 2 years or more, the majority of respondents (73.5%) anticipated achieving specialisation in less than 2 years.

*Experience of sub-specialties during degree course*

As illustrated in Table 2, 100% of respondents indicated they had spent time during their clinical placement in CT, fluoroscopy/interventional radiography, general X-ray, nuclear medicine and paediatric radiography. Table 2 also illustrates there were a number of sub-specialties where over half indicated they had not spent time during their clinical placement (DXA, mammography, research and management).

|  |  |  |  |
| --- | --- | --- | --- |
|  | Yes | No | Overall % |
| CT | 34 | 0 | 100% |
| Fluoroscopy/interventional | 34 | 0 | 100% |
| General X-ray | 34 | 0 | 100% |
| Nuclear medicine | 34 | 0 | 100% |
| Paediatric radiography | 34 | 0 | 100% |
| MRI | 33 | 1 | 97% |
| Dental | 32 | 2 | 94% |
| Ultrasound | 32 | 2 | 94% |
| Reporting | 30 | 4 | 88% |
| DXA | 14 | 20 | 41% |
| Mammography | 12 | 22 | 35% |
| Management | 6 | 28 | 18% |
| Research | 6 | 28 | 18% |
| **Table 2.** Participant responses to clinical experience of modalities during degree. | | | | |

As shown in Table 3, the only sub-specialties where 100% of respondents indicated they had experienced the sub-specialties at university were CT and general X-ray.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Yes | No | Overall % |
| CT | 34 | 0 | 100% |
| General X-ray | 34 | 0 | 100% |
| Research | 31 | 3 | 91% |
| MRI | 29 | 5 | 85% |
| Reporting | 25 | 9 | 74% |
| Dental | 24 | 10 | 71% |
| Fluoroscopy/interventional | 24 | 10 | 71% |
| Mammography | 24 | 10 | 71% |
| Nuclear medicine | 24 | 10 | 71% |
| Ultrasound | 24 | 10 | 71% |
| DXA | 22 | 12 | 65% |
| Paediatric radiography | 18 | 16 | 53% |
| Management | 10 | 24 | 29% |
|  |  |  |  |

**Table 3.** Participant responses to university experience of modalities during degree.

*Association between anticipated time to specialise and demographics/preferred sub-specialties*

As demonstrated in Table 4 gender (male/female), age (school-leaver/mature) and highest qualification (A-level or ‘other’) were compared to determine whether there were significant differences in the anticipated time to specialise (less than 2 years or 2 years or more). The only statistically significant result (p=0.039) was for the those students with A-Levels as the previously highest qualification were significantly more likely to anticipate specialising in less than 2 years, compared to those with other qualifications.

|  |  |  |
| --- | --- | --- |
| **Time-scale** | **Female** | **Male** |
| Less than 2 years | 18 | 7 |
| 2 years or more | 7 | 2 |
|  | Chi-squared p-value = 0.736 | |
|  |  |  |
| **Time-scale** | **Mature** | **School leaver** |
| Less than 2 years | 4 | 21 |
| 2 years or more | 4 | 5 |
|  | Chi-squared p-value = 0.085 | |
|  |  |  |
| **Time-scale** | **A-Level** | **Other** |
| Less than 2 years | 22 | 3 |
| 2 years or more | 5 | 4 |
|  | Chi-squared p-value = 0.039 | |

**Table 4.** Comparison of demographics with time to specialise. Statistical significance at the 5% level is seen for p-values <0.05.

**Discussion:**

The response rate of 75.6% compares favourably with other surveys of undergraduate student opinions in relation to role development. Collecting data online achieved response rates of only 16% for students from a UK HEI[6]. A survey of undergraduate students at a single institution (e-mail with online survey) achieved 41%[11]. Two studies[8, 12] achieved a response rate of 100%; however, the method of survey deployment was omitted.

The percentage of female respondents (73.5%) is lower than the 81% across four European HEIs[6], but similar to the 73.3% in a survey of Australian undergraduates[11, 8]. A recent freedom of information request to the HCPC revealed 74.1% of registered diagnostic radiographers are female[13], slightly higher than reported here.

The finding that 76.5% of respondents were of school-leaver age upon commencement of their degree is much higher than the 45% reported in the most recent SCoR survey[14], and the 35.6% of students under 21 in a survey of Australian undergraduates [7, 11]. Whilst the majority of respondents (79.4%) had A-level as their highest previous qualification, no details on the previous highest qualification were reported in a number of studies[6, 7, 8, 11, 12].

Whilst CT was second, and MRI and ultrasound were the joint-third most preferred specialisms in the current study, ultrasound was found to be most preferred in a survey of Australian undergraduate students, with CT second and MRI third[7]. However, in an Australian context the role of reporting radiographer is not an option and there were notable methodological differences. The authors’ presented students with six options which they had to rank. As such, the overall preference for reporting in final year UK undergraduate diagnostic radiography students in the UK represents a novel finding.

As a preferred sub-specialty mammography ranked joint bottom overall supporting the findings from an Australian study[11], where Warren-Forward & Taylor found few students indicated an interest. Research into UK undergraduate mammography provision[15] has highlighted a wide variation in the amount of time devoted to mammography both academically and clinically. Just under half (n=12/25) of the eligible female students identified time spent in mammography clinically in the current study. Recruitment and funding issues have been identified as persistent barriers to the development of advanced practice in breast imaging[16]. Changes to undergraduate placements to incorporate greater exposure to mammography could help introduce the sub-specialty to a wider range of students at an earlier stage in their career.

Nuclear medicine had similar low levels of preference (2.1%), whilst other areas with no students indicating a preference were DXA (0%), dental radiography (0%) and research (0%). Along with audit and service improvement activity, research is considered to be one of the four pillars of advanced practice[4], although reporting radiographers who considered themselves advanced practitioners demonstrate low levels of research activity[1]. A bibliometric review of HCPC registered, research-active contributors consisted of 58 radiographer practitioners, representing <0.19% of the whole workforce[17]. The implications of continuing low levels of research activity will potentially restrict the ability for advanced practitioners to develop into consultant practitioners, given the importance of research activity as one of the four pillars[1]. The low level of interest in specialising in DXA is concerning, given future years will see a growing burden from osteoporotic fractures in the UK[18]. Fracture liaison services provide an outlet for advanced practice DXA radiographers to develop their skill-set but they are not currently offered by all NHS providers[19]. HEI providers are in a position to help promote these areas of practice, through development of a broad academic curriculum supported by relevant clinical practice.

Previous research[8] found 75.7% of third-year undergraduate students indicated they anticipated achieving their specialisation within 2 years of graduation, and 97.3% within 5 years. The students in the current survey may be considered slightly more ambitious; 75.7% expected to realise their ambitions within 2 years, and 100% within 4 years. As demonstrated by previous research[8], if these ambitions are not realised there may be negative implications for workforce motivation and commitment, manifesting as ‘resignation in post’. The Cancer Workforce Plan[19] also identified that 28% of diagnostic radiographers are expected to leave for non-retirement reasons. Ensuring the ambitions of graduate diagnostic radiographers can be satisfied has clear implications for staff retention within the NHS.

One of the limitations of this survey is the terms modality and sub-speciality, included on the questionnaire (Table 1) can be used interchangeably and perhaps do not reflect the prominence of some of the options in the modern NHS. Whilst general X-ray represents the largest number of examinations undertaken in the NHS, the number of CT examinations undertaken in the NHS follows closely behind ultrasound[20] and arguably indicates this is a mainstream specialty, rather than sub-specialty. The same could be considered for ultrasound, with direct-entry options now catering for an increase in attractiveness of this career pathway with novel approaches to matching demand for this course with limited capacity[21]. Furthermore, currently in the UK mammography is not a viable career path for a male radiographer, so nine (26.5%) of the respondents were unable to select this option. In addition the sonographer and, depending on the level of training, mammographer role can include reporting findings, so these options are not mutually exclusive of ‘reporting’ *per se*. Whilst both clinical and university experience of a modality were captured, to allow more in depth analysis of the influence of experience on choice more detailed data on the length of exposure to sub-specialties is required in future studies.

In addition, the distribution of a paper survey after a lecture limited the sample to those present on that particular day. Future surveys could incorporate distribution on social media platforms, for example, to help explore some of the choices in greater detail across a larger population, given the small sample size here. Also, some of the terms used to describe areas of radiographer practice can be open to interpretation. For example ‘paediatrics’ could be working with paediatrics in a dedicated children’s hospital, or as part of a specialised role within a general hospital. Also the term ‘reporting’ itself is somewhat vague, and the authors acknowledge that those participants who chose CT as their preferred area of future work, for example, may also wish to undertake CT head reporting.

**Conclusions:**

Final year undergraduate diagnostic radiography students would like to pursue specialisation opportunities in reporting, CT and MRI/ultrasound after completion of their degree. Further research incorporating the perspectives from multiple HEIs is warranted to see if these trends are generalisable.

The preference for specialising in reporting is a novel and important finding in the context of UK HEIs, with student expectations for the timeline of role development slightly more ambitious than in previous research. Education providers should consider increasing the range of sub-specialties that undergraduate students are exposed to during their clinical experience to help provide exposure to areas that are suffering from recruitment and retention issues.

**Conflict of interest statement:**

The authors can confirm no conflicts of interest exist or are anticipated to exist.

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