**Introduction**

Abnormality detection systems in trauma radiography have been established in the National Health Service (NHS) for a number of years1 and participation in these is now considered a fundamental aspect of the radiographer’s role. The evolution of the classic “red dot” system has led to the inception of the preliminary clinical evaluation (PCE) system, which through provision of a comment specifying the abnormality is thought to improve the communication of abnormal findings2. Inherent in this, newly qualified radiographers will invariably be expected to participate in an abnormality detection system upon commencing their first post. The idea of radiographers providing a written comment to supplement the abnormality detection system has been encouraged for a number of years2, though for this to become established as normal practice a number of issues need to be appreciated.

While the Society and College of Radiographers (SCoR) propose that all trauma radiographs should receive an immediate PCE2, acknowledgment must be given to the confidence and education issues3 that may hinder widespread implementation of this policy, specifically those relative to newly qualified radiographers. It is important to recognise that the self-perceived confidence of a graduate radiographer, or lack thereof, may not necessarily correlate to an individual’s actual abnormality detection ability. Recent work has shown that the abilities of graduate radiographers to recognise and describe abnormalities upon commencing their first post can be improved with focused training during the preceptorship period4. In view of this, it is not unreasonable to expect undergraduate training to instil the necessary skills and knowledge to allow radiographers to contribute effectively in an abnormality detection system.

The theory and academic training of PCE skills within the university setting is traditionally consolidated by clinical practice-based experiences. Seventy-six percent (n = 19/24) of the Higher Education Institutions (HEIs) that provide radiography education have indicated that their curriculum includes teaching concerning image interpretation5. However, the extent of university education that is dedicated to image interpretation is likely to vary due to variations of course design and content within each HEI. The views of radiology managers suggest that graduates seek career pathways away from general radiography, implying that the educational desires of students are shifting with a need for flexible teaching pathways6. Restructuring curricula to reflect this shift may lead to reduced opportunities for image interpretation training at undergraduate level and illustrates the potential of clinical experiences in supplementing theoretical teaching

Recent research has indicated that 18.7% (n = 61/325) of NHS hospitals utilise a commenting system to communicate abnormal findings with 57.4% (n = 35) limited to musculoskeletal (MSK) examinations, 18% (n = 11) to MSK and chest examinations, and 21.3% (n = 13) commenting on all radiographic examinations.7 The wide variations of practice and lack of local guidance regarding implementation are seen as potentially causing confusion and error.7 This is perhaps the leading factor preventing widespread implementation. Ultimately, the lack of uptake of the PCE system within students’ placement hospitals prevents the opportunity to further develop these skills in the clinical setting.

The combination of training at university and on placement is a key aspect of developing autonomous practitioners, as such a balance should be sought between theoretical input and experiential learning.8 The purpose of teaching is to develop students with the necessary skills and abilities to fulfil the requirements set out by the statutory body.9 Professional body guidance10 outlines an educational framework with clear values for developing individuals in a personal and professional manner in order to meet the workforce requirements. Although undergraduate programmes do provide image interpretation education, it is uncertain whether the amount of image interpretation experience accrued by students on placement can be satisfactory to support their learning.

The suggested level of training and experience required to partake in a PCE system omits newly qualified radiographers from participating. SCoR guidance states that the knowledge, skills and responsibilities associated with participation in a PCE are consistent with Agenda for Change pay band six or equivalent.2 It could be construed that undergraduate education is not considered to adequately train students for immediate participation in PCE. Strict adherence to this guidance may prove problematic. According to workforce census data gathered by the SCoR11 pay band six provides on average 27.8 whole time equivalent (WTE) radiographers per department, band seven provides 16.9 WTE radiographers, while band five provides only 13.6 WTE radiographers. However, band 6 radiographers are likely based across other modalities not just general radiography, and band 7 radiographers are reported as only spending 50% of their time undertaking clinical duties11, whereas band 5 radiographers will be predominantly based in general radiography. Consequently, large proportions of examinations will be undertaken by band five radiographers and would not receive an immediate comment.

Irrespective of the pay band recommendation, SCoR guidance reiterates that participation in PCE is a core competence for all radiographers.2 The ability of radiographers to provide descriptive comments of traumatic abnormalities has previously been reported as being better than emergency practitioners12, subsequently the inclusion of commenting skill as a core competency may not be of concern. However, the issue of whether undergraduate education provides the requisite level of training for radiographers to be accurate in describing abnormalities is prevalent. The study by Neep et al13 reports that radiographers have difficulties in converting their observations into words, with a belief that additional education is required to be able to provide a descriptive comment. A point verified by earlier work which indicated that interpretive accuracy is reduced when tasked with describing traumatic abnormalities.14 An observer study utilising 18 radiographers has previously indicated that image interpretation ability improves following additional training with increases in sensitivity (+9% to 69%) and specificity (+10% to 83%).15 Subsequently, support is strong for the notion of additional training being a necessity. A number of studies13,14,16,17 advise further training as the method of providing inexperienced radiographers with the skills and knowledge required to competently participate in abnormality detection systems.

Without assessing if graduates can demonstrate adequate skills, it remains unclear whether the abilities developed within the academic and clinical environments sufficiently support competent contribution in a PCE system. A single HEI interpretive phenomenological analysis of eight graduates’ opinions proposed that upon qualifying they were suitably prepared for the clinical environment.7 Yet a recent longitudinal image interpretation study at one HEI discovered that only 52% of final year students could attain 80% accuracy18; which has earlier been suggested as a minimum standard.16 Another single HEI study concluded that students’ abilities to recognise and communicate fracture findings were strong aspects of their development.20 This supports the view that undergraduate training can sufficiently prepare students for PCE participation. However, it is likely that there will be a variable range of PCE competences amongst new graduates. Consequently, some may be more prepared than others to participate in a PCE system in a confident manner.

This study aimed to specifically assess the confidence of newly qualified radiographers with regards to their ability to recognise (red dot) and describe (PCE) traumatic radiographic abnormalities, as well as how they perceived their undergraduate training in these areas. Exploration of the perceptions of newly qualified radiographers will provide valuable insight into any issues that may prohibit the SCoR’s vision becoming a reality.

**Method**

This single cohort, cross-sectional, online survey-based study was undertaken with participants sought from 24 NHS adult major trauma centres (MTCs) across England. Research Indemnity and Insurance Committee (RIIC) and Ethics committee approval were obtained from the Faculty of Health, Education and Life Sciences (HELS) academic ethics committee at Birmingham City University. NHS approval was obtained using the Integrated Research Application System (IRAS).

The sample frame in this study was defined as being radiographers who had been qualified less than two years. Radiographers were contacted via an invitation email following confirmation of approval to approach by local Research and Development departments and the principal Radiographers in the selected MTCs. The invitation included the participant information sheet outlining the scope of the project. All participants provided consent to participate in the study.

This study utilised a quantitative approach using a survey with attitudinal statements in closed-questions with single-choice and 5-point Likert scales. Some questions allowed a short free text response. Simple demographic questions were also included to allow identification of any trends in responses that may have been present (appendix 1). Cross-tabulation and correlational statistical analyses of results were undertaken using Statistical Package for the Social Sciences (SPSS).21

A small, departmental pilot study, consisting of five newly qualified radiographer colleagues was carried out. Participants were asked for feedback to determine survey and participant information sheet suitability. Minor amendments were made to the survey by reducing question complexity to improve clarity and understanding. The wording of both documents was considered to be consistent with participants’ anticipated understanding.22

The survey method was used as it allows a representative sample to be obtained from the population identified. The self-report method provides a direct technique of finding out what people think, feel or believe.22 An online survey was chosen as it allowed the study to reach the target sample in the most cost-effective manner, providing a quick way of obtaining data.23

**Results**

In order to ascertain the population size, freedom of information (FOI) requests were sent to each of the selected MTCs requesting disclosure of the number of radiographers currently employed who fulfilled the inclusion criteria. Three sites did not keep a record of this information. Given the FOI responses received, the population size was estimated to be 340. With a known population size of 340, a power analysis was undertaken with power (1 - β) set at 0.80 and α = 05. In order to achieve an estimated effect size of .30, 174 respondents were required.22

Approval to approach radiographers was granted in 17/24 MTCs. Consequently, this reduced the accessible sample size to 272. Of these 272 potential participants there were 85 respondents, providing an adjusted response rate of 31.3%. Gender and age range distribution of participants are shown in figure 1. No participants were above 50 years of age. The majority of participants qualified during 2016 (n = 42, 49.4%), 31 participants (36.5%) qualified in 2015 and 12 (14.1%) qualified in 2014. Figure 2 illustrates the geographical distribution of the universities that participants attended for their undergraduate training, and Figure 3 illustrates the regional distribution of the 17 active survey sites across England.

Figure 1: Distribution of male and female participants in each age range

Figure 2: Geographical distribution of participants' university for undergraduate training.

Figure 3: Regional distribution of the 17 active survey sites.

*Confidence in recognising and describing abnormalities*

The large majority of participants agreed that they feel confident in their red dot abilities (n = 66, 77.6%). Positive responses remained high (n = 59, 69.4%) when participants were asked if they feel confident in their ability to provide a descriptive comment of an abnormality.

It was evident that of the 66 participants who feel confident in their red dot abilities, 49 (74%) feel confident in their PCE abilities as well. Interestingly, 21 (42.9%) of those 49 participants who feel confident in their abilities to recognise and describe abnormalities had undertaken additional education. Seventeen (26 %) of the 66 participants who feel confident in their red dot ability are not confident with their ability to provide a descriptive comment of an abnormality. Within the whole sample, nine participants (10.6 %) do not feel confident in either their ability to recognise or their ability to describe an abnormality.

All participants who are confident in their red dot abilities and have a red dot system in their workplace do participate in the system (n = 60). Thirty-two participants (38%) indicated that a PCE system was in place at their workplace, but only 22 of these respondents stated they are confident in their commenting abilities, X2(3, N = 85) =4.23, p = .238). Only 18 of these 22 participants indicate that they do participate in a PCE system. Overall, only 30% of respondents (18/59) who stated they are confident with their commenting abilities are actively participating in a PCE system. Four participants indicated that despite not feeling confident in their commenting abilities they do opt to partake in a PCE system.

*Perceptions of Training*

With regards to participants’ feelings concerning their abnormality detection training received at university, 73 participants (85.9%) agreed that they had received suitable red dot training at university. A weak but statistically significant correlation exists between red dot confidence and training at university (r = .382, p = .001). A moderate, statistically significant correlation exists between red dot confidence and training on placement (r = .487, p = .001). Generally, those who believe they had suitable red dot training at university also believe their PCE training at university was suitable (r = .704, p = .001).

Sixty participants (70.6%) agreed that PCE training at university was suitable. A statistically significant, moderately positive correlation (r = .424, p = .001) exists between confidence in commenting ability and the commenting training received at university. However, 25 participants (29.4%) did not believe commenting training at university was suitable. A majority of 47 participants (55.3%) do not believe that their commenting training on placement was suitable.

**Discussion**

It is clear that participants’ perceptions of their abnormality detection abilities are generally positive, and the majority of participants feel confident in their red dot abilities as well as their PCE abilities, which supports the argument of Mackay et al20 proposing that graduates may be suitably prepared to detect and communicate abnormal findings. HEIs are noted as including image interpretation in their curricula5, and the findings of this study suggest it is sufficient to educate the basics of red dot to a level that participants feel confident with. In this study, the majority acknowledge PCE training as being suitable at university with a significant positive correlation with PCE confidence, underlining the positive effect of training at university. Although, 29% of participants did not perceive PCE training at university as positively affecting their confidence. This finding provides an interesting adjunct to previous work5, which concluded that HEIs are able to meet the SOR’s PCE aspirations. The discovery that some participants feel less confident with their commenting abilities supports the work of Buissink et al24, which determined that radiographers may perform better at localisation tasks, like red dot abnormality detection, than they do at description tasks such as providing an accurate comment of an abnormality.

The shortage of implemented PCE systems across England1 denies practice and training opportunities in placement hospitals. This offers plausible reasoning for the poor perceptions of PCE training when on placement. Given the finding of positive correlations between confidence levels and training, sustained efforts should be made to improve PCE training to benefit those who are less confident in their ability to describe abnormalities. This will help to ensure graduates are adequately aligned to the professional and service needs. The capability of undergraduate PCE training in aligning graduates’ confidence levels, and subsequently ability, with the needs of the profession as set out by the regulatory body could be viewed as an opportunity for improvement.

Active participation in a PCE system at time of responding to this survey may have had a positive influence on participants’ perceptions of their confidence. Additionally, the impact of experiential learning and peer influences must also be considered as contributory to this effect. Overall, 30.6% specified that they do not feel confident in their PCE ability, and 10.7% indicated that they do not feel confident in their ability to recognise or describe an abnormality. If the SCoR’s vision is to become a reality then the provision of additional support to build the confidence of those individuals who may not have fully grasped the concept of describing abnormalities must be considered. An argument strengthened by the finding that 21 participants who feel confident in their ability to recognise and describe abnormalities had undertaken additional education. This is also in line with the work by Hardy & Culpan14 that implies additional training is required if newly qualified radiographers are expected to produce accurate comments. Provision of training sessions covering the basic concepts of forming a comment using a structured framework such as the *What, Where, How* model25 might be beneficial. Furthermore, discussions should be held to highlight the wider issues of participation without sufficient skills and knowledge, including the potential impact on patient management and resources.

The adjusted sample size yielded a response rate from almost a third of the pool of potential participants. This represents a small proportion of newly qualified radiographers employed within the selected major trauma centres and is less representative of the newly qualified radiographer population as a whole. A post hoc power analysis of the study indicated that owing to the low response rate the estimated effect was reduced and was between .40 and .50.22 Due to the presence of non-response bias, extrapolation of any generalisations should be made cautiously. It must be acknowledged that whilst offering useful insight a self-reported survey has limitations and cannot be considered a true measurement of skill or ability.

The anonymous nature of the study permitted any radiographer to potentially respond to the survey and provide false information that would skew the findings in an inaccurate way. Additionally, due to the self-selecting nature of the sample, participants may only have had motivation to respond if the topic was of interest to them and this should also be recognised as potentially skewing the results. Given that almost 10% of respondents trained outside of England or overseas, it should be acknowledged that the curricula employed during their training may not have included image interpretation teaching to the level in which UK HEIs do. It is important to appreciate the potential negative impact of this on the results. Consequently, it is difficult to appreciate the readiness of newly qualified radiographers to participate in a PCE system based on self-perceived confidence alone. The most appropriate approach for assessing image interpretation abilities might be for participants to undertake an observer performance assessment following graduation, prior to starting any employment. Therefore, the next stage for this area of research would be to carry out an image interpretation study with a larger sample size over a longer period of time. This will help to generate a more accurate portrayal of the abnormality description abilities of newly qualified radiographers and to determine the presence and extent of any educational issues that may exist.

**Conclusion**

The data gathered from this study suggest that participants generally feel confident with their red dot abilities. It transpired that red dot training at university and on placement was considered suitable. PCE training was also considered to be suitable at university with significant positive correlation with confidence. Almost a third of participants perceived little positive impact on confidence levels, which suggests opportunity for improvement. Consequently, undergraduate PCE training is recognised as an area for development, predominantly in clinical environments.

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