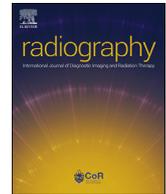




Contents lists available at ScienceDirect

Radiography

journal homepage: www.elsevier.com/locate/radi

Radiographers reporting chest X-ray images: Identifying the service enablers and challenges in England, UK

B.J. Stevens^{*}, L. Skermer, J. Davies

Radiology, Manor Hospital, Walsall Healthcare NHS Trust, Moat Road, Walsall West Midlands, WS2 9PS, UK

ARTICLE INFO

Article history:

Received 5 January 2021
Received in revised form
18 March 2021
Accepted 21 March 2021
Available online xxx

Keywords:

Chest reporting
Barriers
Drivers
Service development

ABSTRACT

Introduction: The chest x-ray (CXR) is the most commonly performed x-ray examination in England, UK. Reporting radiographers provide a cost-effective and safe solution for managing CXR backlogs, but not all Trusts support this service development. This study aimed to establish the service enablers and challenges associated with training and employing radiographers to report CXR images in acute hospital sites in England, UK.

Methods: Approval for this electronic survey was granted in 84 of 146 (58%) Trusts approached. The survey was open for 10 weeks during August to October 2020, comprising of qualitative and quantitative questions. Data was exported in to an Excel spreadsheet where manual thematic analysis was performed. Descriptive statistics were also generated.

Results: Sample size was 75 (89% response rate). Thirty-three departments (44%) had at least one trainee. Most departments (n = 53, 71%) employ at least one CXR reporting radiographer. A total of 121/160 (76%) radiographers report CXRs. Number of reporting sessions shows progression. Factors enabling training and employment arise from service improvements, financial pressures, and developing the workforce. The main challenges relate to staffing issues with a number of associated sub-themes. A small faction indicated lack of radiographer interest to report CXRs due to litigation worries; possibly uncovering a new and emerging issue.

Conclusion: Enablers and challenges associated with radiographers reporting CXRs are similar to previous studies. The growth of CXR reporting radiographers and reporting sessions indicates a continuing reliance on radiographers to contributing to managing CXR backlogs.

Implications for practice: It is recommended that potential trainees are explicitly informed of the legal protection that will be provided, to prevent accountability concerns impacting on the continuing progression in this area of advanced practice.

Crown Copyright © 2021 Published by Elsevier Ltd on behalf of The College of Radiographers. All rights reserved.

Introduction

The chest x-ray (CXR) is the most commonly performed x-ray examination with 8.3 million requests in England, United Kingdom (UK) in 2019–20, a 0.8% increase since 2018–19¹, yet the urgency for reporting these images often does not take priority. It is known that in National Health Service (NHS) hospitals in England, UK, many CXRs can remain unreported for many weeks.² Increased demand and reduced reporting capacity can lead to lengthy report

turnaround times, potentially impacting upon timely patient management. Lengthier report turnaround times will also increase the likelihood of local key performance indicators (KPI) being breached. Consequently, radiology departments may implement a number of different mitigation strategies to ensure patient safety is maintained.

Common strategies include insourcing, outsourcing and auto-reporting, although these come with increased cost and clinical risk. However, this can practicably be solved by reporting radiographers. Utilising radiographers as reporting resources provides a more cost-effective and safer alternative for managing CXR backlogs.² Previous research has shown increasing numbers of chest reporting radiographer regionally.³ A more recent study illustrated the efficacy of radiographer reporting CXRs,⁴ and earlier work has

^{*} Corresponding author.

E-mail address: barry.stevens@walsallhealthcare.nhs.uk (B.J. Stevens).

 (B.J. Stevens)

also asserted comparable accuracy to expert thoracic radiologists.⁵ Despite these positives, many challenges can hinder the progress of advanced practice developments.

It is likely that many radiology departments will have encountered an obstacle when attempting to develop a reporting radiographer service. The systematic review by Culpan et al.⁶ outlined a number of the potential barriers to the progression of advanced practice, broadly categorised as lack of funding, radiographer staffing issues and lack of radiologist support. Likewise, a number of factors can facilitate the development of advanced practice, such as service redesign and improvements, responding to demand,⁶ responding to service needs, radiographer career development, and radiologist shortages.⁷ Despite numerous studies evaluating the accuracy of reporting radiographers,^{4,5,8–11} none have specifically investigated why the reporting of CXRs by radiographers may be progressing at some Trusts but resisted at others.

This study aims to establish the service enablers and challenges associated with training and employing radiographers to report CXR images in acute hospital sites in England, UK. Secondary aims include calculating the number of sessions allocated to reporting radiographers for CXR reporting, and evaluating any restrictions on reporters' scope of practice (SoP)

Method

An online survey method was used for this study. The authors' local Research and Development (R&D) department approved the study. An Integrated Research Application System (IRAS) form was submitted and the project was given Health Research Authority (HRA) approval without the need for ethical approval.

The Research and Development (R&D) departments in 146 National Health Service (NHS) Trusts (non-specialist and specialist) in England were approached seeking authority to approach their respective radiology departments. Once approval was granted an email invitation with a hyperlink to access the online survey was sent to a senior member of the radiology department. The survey was open for 10 weeks during August to October 2020, accessible via an online host (Online Surveys, Jisc, Bristol, UK). Reminder emails were sent after three and six weeks. A notification was also posted on Twitter seeking participants in the Trusts with R&D approval. A pilot of the survey was undertaken with the local R&D manager resulting in minor amendments to question lay-out and wording.

The survey comprised of a mixture of qualitative and quantitative questions designed to generate an overview of participating

departments' stance regarding radiographers reporting CXRs. Participants could not progress to the survey without agreeing to the consent statement on the first page of the survey. The survey asked for the Trusts' name and position held by the person completing the survey to monitor responses and to recognise duplicate responses. It was clearly stated that this information would not be disclosed publicly. Each completed survey was assigned a unique reference number (URN) to identify different responses. Data was exported in to an Excel spreadsheet where manual thematic analysis was performed. An inductive approach to thematic analysis was used by the team. The answers for each question were read through by the authors, which then determined the themes. Pertinent answers were then recorded under each theme as potential evidence to use in text. Descriptive statistics were also generated.

Findings and discussion

Demographics

R&D approval was granted in 84 of the 146 (58%) Trusts that were approached; 18 Trusts (12%) declined to participate, and the survey was unable to be arranged in 44 other Trusts (30%). Seventy-six responses were received with one duplicate entry, providing a final sample size of 75 (89% response rate). The survey was completed by a variety of senior roles with wide ranging nomenclature (Chart 1). There was a good regional distribution of responses across England (Chart 2). The regional borders used are shown in Fig. 1.

It was apparent that issues relating to staff were the commonest barrier to not training or employing CXR reporting radiographers. The themes that emerged relating to the drivers for training and employing CXR reporting radiographers included; capacity and demand, finances, workforce development and service improvement.

Challenges to overcome for training and employing CXR reporting radiographers

Reporting radiographers' roles already fulfilled

It is encouraging that the commonest reason for not having any CXR reporting trainees is that they are not needed due to already having a cohort of reporters with fulfilment of current roles and no requirement to expand capacity ($n = 13/41$, 31.7%), underlining widespread service development;

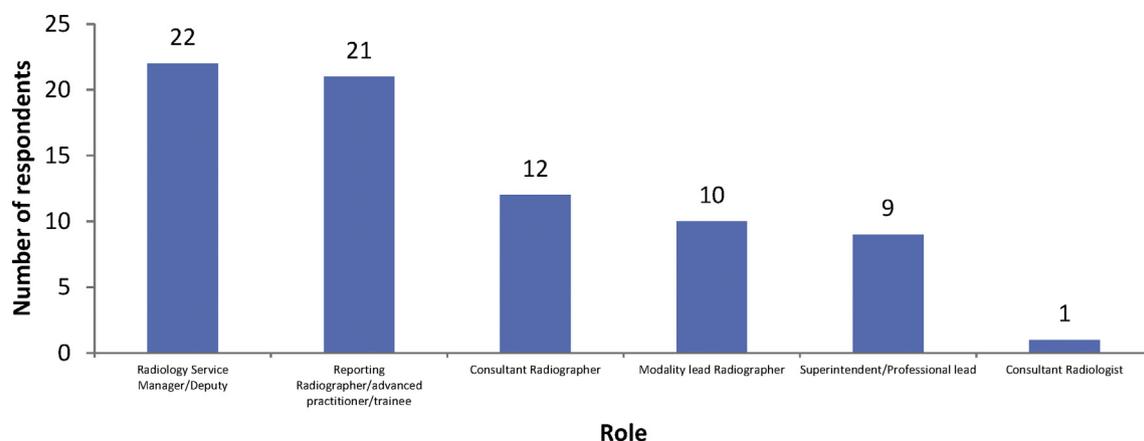


Chart 1. Number of respondents and roles of those who completed the survey.

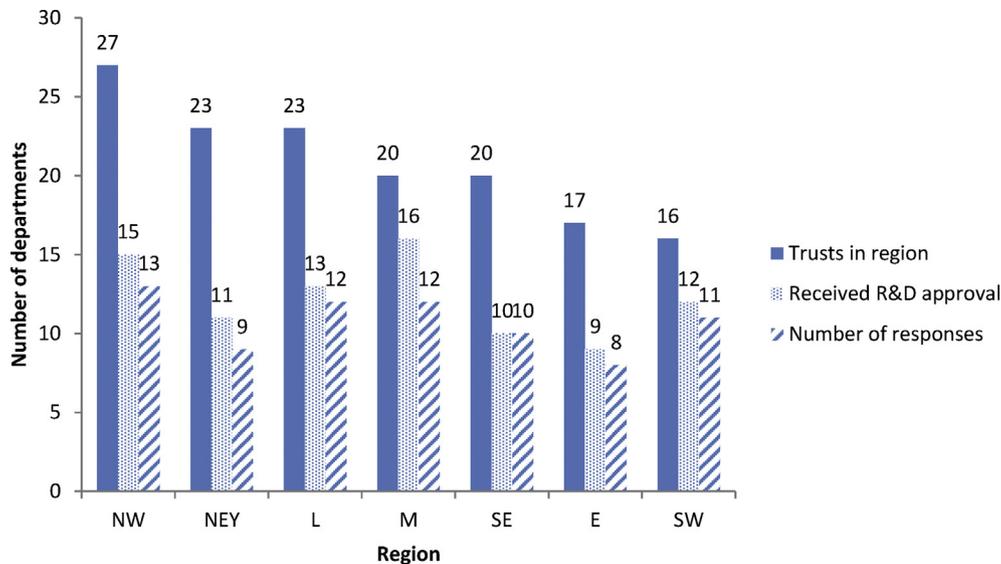


Chart 2. Regional distribution of the departments that responded to the survey. (Key: NW = North West, NEY = North East & Yorkshire, L = London, M = Midlands, SE = South East, E = East, SW = South West).

“Currently 3 reporting radiographers qualified in Chest reporting ... re-evaluation as to whether further reporting radiographers are required.” URN078

“We already have 4 trained AP’s in chest reporting. No more required at present.” URN503

Interestingly, the recent Recovery and Renewal Review for Diagnostics¹³ suggested that although hospital attendances and demand fell dramatically in the early phases of the COVID-19 pandemic, it is expected to return to normal levels and will require greater staffing numbers in the future. The review indicated that an additional 500 advanced practitioner radiographer will be required across all modalities. This raises an interesting issue and implies the notion that forward-planning must be at the forefront of CXR reporting service developments.

Radiologist staffing issues

Another common sub-theme of staffing issues preventing the training of reporting radiographers was the lack of radiologist support ($n = 7/41$, 17.1%), and this was also a stated reason for not employing reporting radiographer ($n = 4/22$, 18.2%). These occurrences were spread out across all regions, except the North East and Yorkshire, though the reasons for this have not been explored here. The lack of radiologist support possibly stems from the time constraints associated with increased cross-sectional and hybrid imaging scans¹ requiring longer reporting times, and the persistent radiologist vacancies.^{2,14} It has previously been acknowledged that many underlying cultural barriers exist, born out of professional protectionism, which transpires to hinder the development of advanced practice.⁶ Radiologists are the key stakeholders regarding the CXR reporting service and provide the greatest challenge to further progression. The lack of support is a major barrier, and can have devastating effects on the confidence of reporting radiographers when qualified;

“... a severe lack of support from radiologists ... found it increasingly difficult to approach with problems we have had with regards to a report or advice.” URN112

“... not a good experience when it came to mentorship, has affected their progress and confidence to perform the role autonomously.” URN934

It would be wrong to convey the only radiologist response in this study as the voice for all radiologists, and it is likely that many contrasting opinions exist. However, insight is provided as to why some radiologists may be opposed to radiographer reporting CXRs;

“I do not see the rationale for a reporting radiographer to report a CXR that a radiologist is available to do ... the lack of the 6–8 years medical training that a radiologist has undertaken puts the radiographer at a significant disadvantage in interpreting and conveying the findings of a CXR” URN350

The influence of radiologists on advanced practice progression cannot be overlooked. These viewpoints hold power with regards to allocating CXR reporting duties to radiographers and the support of local radiologists is paramount in developing a successful reporting radiographer CXR service, and to ensure amicable team working. Recently, the Royal College of radiologists (RCR) expressed reservations about non-radiologist reporting of anything but basic minor trauma images.¹⁴ It is possible that this perspective is still influencing some radiologists, leading to reduced support for this type of advanced practice. Previous research has illustrated the potential impact^{6,7} and our findings show how radiologists can affect the provision of initial opportunity and ongoing support, to the detriment of radiographers.

Radiographer staffing issues

Even without any opposition from radiologists, it was disclosed by some participants that there was no desire amongst radiographers to take on the role ($n = 5/75$, 6.6%). A lack of interest from radiographers was a surprising reason for not having any reporters in post. One participant described the lack of interest in CXR reporting owing to the increased accountability and responsibility;

“No appetite to take on CXR reporting as they feel there is too much potential litigation involved in this area of Advanced Practice.” URN031

The unwillingness to want to progress or develop through a fear of failure is a surprising finding. There is no published literature proposing a reluctance of radiographers to undertake advanced

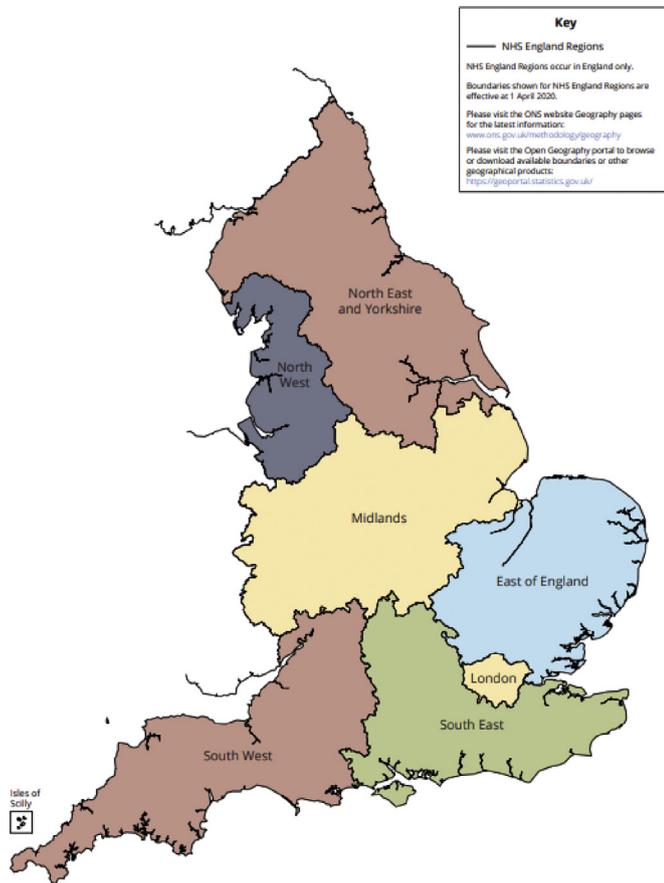


Figure 1. NHS England regions.¹²

practice. These infrequent occurrences were confined to the South East (three occurrences) and the South West (two occurrences), and although occurring with low frequency may be a new, emerging phenomenon. One participant described previous reluctance from radiographers to engage with CXR reporting but with senior departmental, a change in culture and ethos has followed;

“... resistance originally for radiographer to perform CXR reporting ... clinical director has supported this role ... changed the whole departmental rota to achieve a reporting rota. Prior to this it was ad hoc” URN338

The lack of desire to engage could stem from the fear of missing a major pathology. However, an appropriately trained radiographer reporting within their capabilities with clearly-defined protocols can be assured that they will be covered by Trusts' vicarious liability insurance, and as a SCoR member will also benefit from personal professional indemnity cover.¹⁵ This should be made explicit to any potential trainees. The fear of litigation may also arise from a lack of confidence or the perception that inadequate radiologist support may prevent them from attaining the required competency; although this has not been explored in this study it does raise an interesting topic for further investigation. Possible solutions to this challenge include regionalised clinical education centres led and supported by consultant and advanced practitioner radiographer, such as an academy-type set-up¹⁶ or a “hub and spoke” model.¹⁷ These approaches to reporting education provide a logical

approach to overcoming issues associated with lack of support and could help to allay any litigation fears.

The 2018 workforce survey from the Society of Radiographers (SOR)¹⁸ reported the issue of staffing levels being under pressure affecting training places, and in our study inadequate radiographer establishment was cited ($n = 4/41, 9.75\%$) as being causative for not having any current trainees;

“Lack of backfill for training, department severely understaffed and no capacity to allow radiographer the time to train and go to university.” URN546

“No radiographers currently at the required level to complete the course.” URN626

The SOR report showed recruitment difficulties in other modalities too, with an overall vacancy rate in England of 10%,¹⁸ which may impact on the availability of higher grade staff to undertake training. This remains an area for action if the recently published recommendations regarding reporting radiographers are to be upheld.^{13,19}

Service enablers for training and employing CXR reporting radiographer

Thirty-three departments (44%) had at least one (mean 1.6, SD 0.9, min 1, range 4) radiographer studying on a CXR reporting module, further breakdown is shown in Chart 3. Of these 33 departments, only one department did not currently employ any radiographer reporting CXRs.

Most departments ($n = 53/75, 71\%$) indicated that they currently employ at least one (mean 3, SD 0.34, min 1, range 12) CXR reporting radiographer, further breakdown is shown in Chart 4. More than half of these departments ($n = 28/53, 53\%$), with radiographer reporting CXRs, had at least one current trainee.

Capacity and demand issues

The reasons for training and employing radiographers are similar, and are often multi-factorial, rarely singular, but do substantiate the previously described drivers for developing advanced practice.^{6,7} The main driver specific to training radiographers to report CXRs was the desire to enhance existing departmental provisions, illustrated by a desire to improve on the current service inefficiencies specifically that of report turn-around-time (TAT) ($n = 15/28, 54\%$);

“Capacity for reporting is insufficient to meet demand. Aim to move towards chest hot reporting in the future” URN557

“Improve turnaround time for CXR reports” URN626

The employment of CXR reporting radiographers was commonly driven by the aim of improving reporting capacity to deal with demand and maintain backlog ($n = 21/53, 40\%$), along with perceived improvements to the reporting service ($n = 20/53, 38\%$). Being able to release radiologists for other reporting duties ($n = 8/53, 15\%$) was another indication for employing CXR reporting radiographers, and a small number of departments indicated that it was a response to radiologist shortages ($n = 4/53, 8\%$). The perception of being unable to meet current demand is supported by recent data published on NHS Model Hospital²⁰ that shows the national median for x-ray activity up to March 2020 was 136,290 examinations and the number of reports, including outsourcing,

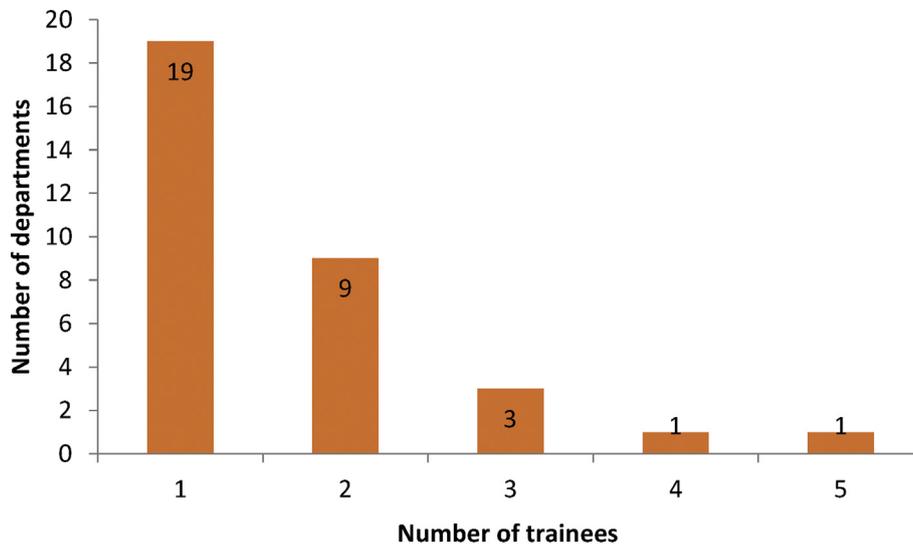


Chart 3. The number of departmental trainees across the sample.

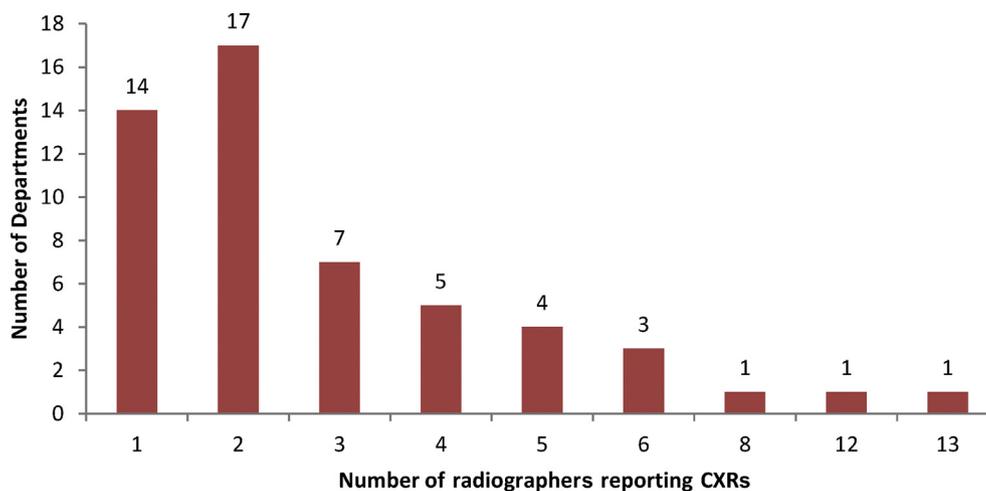


Chart 4. The number of radiographers reporting CXRs across the sample.

was 123,660 providing a shortfall of 12,630 unreported examinations. This illustrates that current radiographic reporting provisions are not sufficient. Consequently, some departments may have no option but to outsource reporting to negate any clinical risks, but this does come with increased costs.

Finances

A small number of responses indicated that the training of radiographers ($n = 4/28$, 14%), and the employment of CXR reporting radiographers ($n = 7/53$, 13%), was seen as a way to address the associated pressures and financial inefficiencies by reducing outsourcing;

"... had to out-source chest reporting services with substantial cost. It is assumed that the reporting radiographers will drive the reporting service forward at a minimal cost" URN763

"On-going need to outsource plain film reporting" URN552

The desire of departments to move away from the burden of outsourcing by preferring to train and develop their own radiographers is consistent with previous recommendations.² This could be interpreted as a more prudent use of restricted funds but also demonstrates an appreciation of, and willingness to develop, the radiographers available. The availability of Government funds²¹ to train radiographers was also considered to be contributory in some departments ($n = 4/33$, 12%), two in the North West and in the South East, respectively;

"HEE funding as part of cancer plan." URN120

"... tackling our outsourcing expenditure on reporting, this combined with the extra funding given" URN016

Conversely, three responses (4%) implied that lack of funding was a compounding factor for not having any current trainees; a factor identified previously.⁶ A recent Health Education England (HEE) funding opportunity was widely publicised promising to invest in 300 extra reporting radiographers as part of the Cancer

Workforce Plan.²¹ It is possible that this funding stream was accessed in those four departments but was perhaps used for a different cancer pathway, such as for a Computed Tomography (CT) virtual colonoscopy trainee. Though, this was not explored in this study but does provide a potential path for further research. Upon examining the responses further, the demographic data demonstrates no regional pattern to these occurrences.

Workforce development

Developing the workforce to ensure longevity of the reporting radiographer service, was a common reason for training a radiographer to report CXRs and is viewed as an effective way to improve recruitment and retention of staff (n = 11/28, 39%). Acknowledgement of the individual and the subsequent impact on radiographer workforce development was also a prevalent factor in the employment of CXR reporting radiographers (n = 14/53, 26%);

“Job satisfaction and promote advanced practice” URN599

“Career progression at level 7 Career pathway” URN619

Being able to identify the value in developing radiographers with clear career progression should be applauded and advocated as an appropriate method of maintaining staff engagement. A point reiterated by the recent national Getting it Right First Time (GIRFT) radiology report.¹⁹ Many departments see the reporting of CXRs as the logical progression for current reporters, with career progression noted as being a key factor in maintaining the service;

“Increased chest reporting capacity and provide greater resilience - Continue to develop existing reporters - Continue to improve plain film standards - Promote recruitment and retention of radiographers” URN962

“... extending our reporting services to longer days 7 days per week for MSK and CXR/AXR to achieve instant reporting for images taken in working hours.” URN958

The desire to improve the reporting service for the benefit of patients is prevalent throughout; and should form the basis of all service and advanced practice developments. A small cohort (n = 8) longitudinal case study reported that consultant radiographers believed that their appointments had been beneficial to service delivery and quality of patient care.²² In addition to this, the impact of advanced practice radiographers has been illustrated as offering more than just reporting but also supporting service delivery.²³

Though, it is interesting to note that the systematic review by Hardy et al.²⁴ found limited evidence of advanced practice impacting positively on patient outcomes and service quality. Empirical research assessing the impact of CXR reports by radiographers on patient diagnosis and management decisions would provide necessary data to promote the patient-specific benefits of this service development.

It is clear that those departments that do employ CXR reporting radiographers appreciate the value of their skillset. Participants (n = 5/53, 9%) indicated their forward planning and training regime in order to future-proof the service with one participant providing an interesting forethought regarding the potential increase in CXR reporting backlog post-COVID-19;

“... clear requirement for a drastic increase in workforce to handle the ever-rising demand ... even before COVID-19. If we do not address the skill shortage now, we will face major difficulties down the road.” URN363

Future-proofing the service by training more reporting radiographers is a sensible approach given the year-on-year increase in demand for CXR examinations¹ the persistent radiologist shortages^{2,14} and a likely post-COVID-19 surge in examinations. CXR reporting backlogs may well increase when post-pandemic normality is resumed; therefore, preparation is vital.

Reporting sessions and scope of practice

Reporting sessions

The progression of radiographers reporting CXRs is illustrated further by the number of reporters currently practicing. Previously it was stated that only 39 out of 259 (15%) reporting radiographers reported CXRs in England in 2015.²⁵ Our data shows a marked increase with 121 out of 160 (76%) reporting radiographers reporting CXRs, across 53 departments. The mean (SD, min, range) number of reporting sessions (4 h per session) allocated to CXR reporting is 3.5 (0.18, 1, 9) equating to 14 h a week. The mean (SD, min, range) number of total reporting sessions is 5.3 (0.21, 1, 9) equating to 21.2 h, and represents a considerable increase of almost 50% when compared with previous work that reported a mean 14.5 h per week.²⁵ This growth indicates an increasing dependence on radiographers to reduce reporting workloads.

Thirty-nine of these reporters (32%) have 100% of their reporting sessions allocated to CXR reporting. Two reporters have 10 sessions a week allocated to report CXRs, though questions are raised

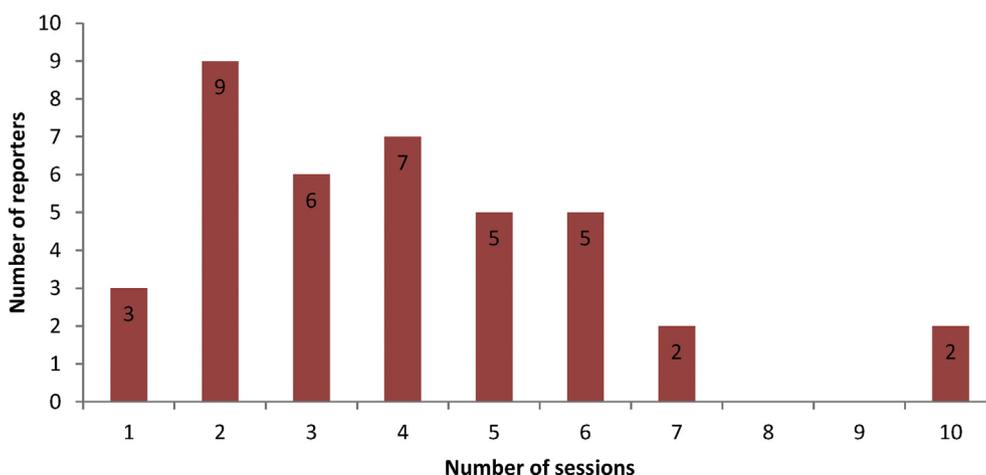


Chart 5. Distribution of the number of sessions allocated to the reporters who only report CXRs.

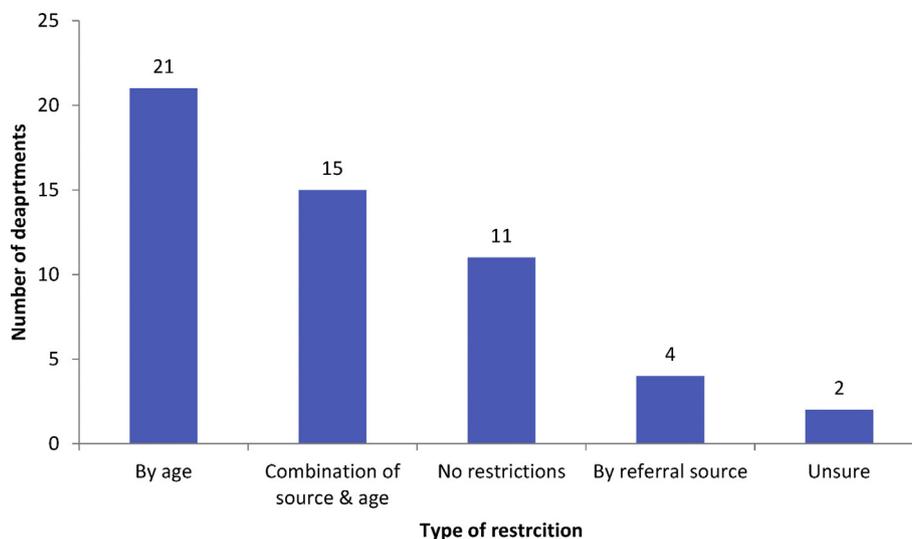


Chart 6. Types of restrictions on CXR reporting scope of practice.

regarding how this affects their ability to fulfil the Four Core Domains of higher practice, as is expected of advanced practitioners.²⁶ Further breakdown of the number of sessions for these CXR-only reporters is shown in [Chart 5](#). Reporting only CXRs suggests that reporters either bypassed the traditional pathway of undertaking musculoskeletal (MSK) training first or no longer report MSK examinations, underlining the necessity for this service development in some departments. The accelerated process of bypassing MSK training facilitates the radiographer in being competent to report CXRs by 2–3 years thus providing quicker financial gains for the Trust. These findings substantiate previous assertions that radiographers contribute significantly to reporting capacity²⁷ and that there is an increasing reliance on radiographer to meet CXR reporting demand.³

Scope of practice

Wide variations in SoP were reported and these are illustrated in [Chart 6](#). Recent studies found that reporting radiographers' SoP are restricted by patient age,^{3,25} and this type of restriction was also most prevalent in this study ($n = 21$, 40%). However, there were numerous discrepant views on the age definition of a paediatric patient;

"... no restriction apart from children under 12 years", URN652

"No paediatric chests under the age of 16 years" URN557

"Adults only, i.e. over 18 years old. All referral sources accepted", URN561

There were also several different combinations of referral source with varying stipulations restricting SoP;

"No GP and OP in the first year following qualification" URN557

"GP only after 12 months post-preceptorship with an additional 100 reviewed by a consultant radiologist" URN950

Culpan et al.⁶ suggest these variations are likely related to local demand and/or radiologist shortages. Alternatively, the differing combinations of restrictions with varying stipulations could be construed as a way of radiologists maintaining control over the CXR reporting service, perhaps reflecting the varying degrees of radiologists' acceptance of advanced practice. A nation-wide adoption

of the reporting standards outlined by Woznitza et al.²⁸ might help to reduce these types of variations in service provision.

The benefits of CXR reporting radiographers may not be experienced in some departments, but those that do embrace advanced practice evidently encourage their reporting radiographer to develop further. Examples of pushing reporting boundaries were described, demonstrating worth and confidence in the abilities of reporting radiographers.

"... two of our CXR reporters also report CT lung nodules. Two further in training." URN948

"Consultant radiographers have trained to report CT pelvis scans for ?NOF # patients ... respected and valued by our Clinical and Divisional Directors." URN473

Extra-modality reporting realises a previous foresight suggesting that progressive departments may inadvertently widen the variations in practice.²⁷ However, these types of developments may become commonplace in the future if local capacity and demand issues ensue in other modalities as forecasted.¹³

Limitations

Despite the excellent response rate, there were 44 Trusts in which the survey was not set-up. This was due to either no response from the R&D departments or local restrictions on the setting-up of new studies other than those specific to COVID-19. It is unfortunate that these Trusts were unable to approve the study, as the response rate would have been increased.

The effect of skewed responses needs to be acknowledged given the majority of responses being from radiographers and only one radiologist. It is recognised that each profession will have differing opinions and this needs to be appreciated when interpreting the results. Canvassing the opinions of only radiologists would give an idea of any contrasting opinions and provides an avenue for further investigation.

Conclusion

This study shows that the majority of departments employ radiographers to report CXRs, and almost half of all responding departments had at least one current trainee. The enabling factors

associated with training and employing CXR reporting radiographers predominantly arise from financial pressures, service improvements to reduce backlog and improve turn-around-times and developing the radiographer workforce. The main challenges originate from staffing issues; generally, the lack of radiologist support, unsuitable staff, inadequate staffing levels and lack of radiographer interest. In order to prevent accountability concerns impacting on continued progression in this area of advanced practice, it is recommended that departments explicitly inform any potential trainees of the legal protection that they will be afforded when reporting within their agreed SoP. Wide variations in SoP are still evident but the number of reporting hours allocated to reporting radiographers per week demonstrates progression highlighting the continuing reliance on reporting radiographers.

These conclusions provide an up-to-date evaluation of the service enablers and challenges associated with radiographers reporting CXRs in England, UK. It is hoped that these outcomes can provide supporting influence for the continuing development of advanced practice in radiographer departments in the future.

Conflict of interest statement

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.radi.2021.03.006>.

References

- NHS England. Diagnostic imaging dataset annual statistical. *NHS Engl [Internet]* 2020:1–27. Available from: <http://www.wjgnet.com/1949-8470/full/v6/i1/1.htm>.
- Commission CQ. *Radiology review A national review of radiology reporting within the NHS in England A national review of radiology reporting within the NHS in England*. 2018. Available from: <https://www.cqc.org.uk/sites/default/files/20180718-radiology-reporting-review-report-final-for-web.pdf>.
- Stevens BJ. A survey assessment of reporting radiographers' scope of practice in the West Midlands region of the United Kingdom. *Radiography* 2019 Aug 1;25(3):214–9.
- Stevens BJ. Reporting radiographers' interpretation and use of the British Society of Thoracic Imaging's coding system when reporting COVID-19 chest x-rays. *Radiography* 2020;27(1):90–4.
- Woznitza N, Piper K, Burke S, Ellis S, Bothamley G. Agreement between expert thoracic radiologists and the chest radiograph reports provided by consultant radiologists and reporting radiographers in clinical practice: review of a single clinical site. *Radiography* 2018;24(3):234–9.
- Culpan G, Culpan AM, Docherty P, Denton E. Radiographer reporting: a literature review to support cancer workforce planning in England. *Radiography* 2019;25(2):155–63.
- Kelly J, Piper K, Nightingale J. Factors influencing the development and implementation of advanced and consultant radiographer practice - a review of the literature. *Radiography* 2008;14:e71–8.
- Woznitza N, Piper K, Burke S, Bothamley G. Chest X-ray interpretation by radiographers is not inferior to radiologists: a multireader, multicase comparison using jafroc (Jack-knife alternative free-response receiver operating characteristics) analysis. *Acad Radiol* 2018;25(12):1556–63.
- Woznitza N, Devaraj A, Janes SM, Duffy SW, Bhowmik A, Rowe S, et al. Impact of radiographer immediate reporting of chest X-rays from general practice on the lung cancer pathway (radioX): study protocol for a randomised control trial. *Trials* 2017;18(1).
- Piper K, Cox S, Paterson A, Thomas A, Thomas N, Jeyagopal N, et al. Chest reporting by radiographers: findings of an accredited postgraduate programme. *Radiography* 2014;20(2):94–9.
- Woznitza N, Piper K, Burke S, Patel K, Amin S, Grayson K, et al. Adult chest radiograph reporting by radiographers: preliminary data from an in-house audit programme. *Radiography* 2014;20(3):223–9.
- Office for National Statistics. *NHS England regions [internet]*. 2020. Available from: [https://geoportal.statistics.gov.uk/search?collection=Document&sort=name&tags=all\[MAP_NHSER\]](https://geoportal.statistics.gov.uk/search?collection=Document&sort=name&tags=all[MAP_NHSER]).
- Richards SM. *Diagnostics: Recovery and renewal*. Independent Review of Diagnostic Services for NHS England; 2020 October. p. 1–86. Available from: <https://www.england.nhs.uk/wp-content/uploads/2020/11/diagnostics-recovery-and-renewal-independent-review-of-diagnostic-services-for-nhs-england-2.pdf>.
- Royal College of Radiologists. *The radiology crisis in Scotland: sustainable solutions are needed now*. The Royal College of Radiologists [Internet]; 2017. Available from: <https://www.rcr.ac.uk/posts/radiology-crisis-scotland-sustainable-solutions-are-needed-now>.
- The Society and College of Radiographers. *Preliminary clinical evaluation and clinical reporting by Radiographers: policy and practice guidance*. 2013.
- Harcus JW, Snaith B. Expanding training capacity for radiographer reporting using simulation: evaluation of a pilot academy project. *Radiography* 2019;25(4):288–93.
- Woznitza N, Steele R, Piper K, Burke S, Rowe S, Bhowmik A, et al. Increasing radiology capacity within the lung cancer pathway: centralised work-based support for trainee chest X-ray reporting radiographers. *Journal of Medical Radiation Sciences* 2018; Sep;65(3):200–8.
- The Society and College of Radiographers. *Diagnostic radiography workforce UK census 2018*. 2019 May. p. 1–18. Available from: https://www.sor.org/sites/default/files/document-versions/diagnostic_workforce_census_2018.pdf.
- Halliday K, Maskell G, Beeley L, Quick E, Advisors R. *Radiology GIRFT programme national specialty report*. 2020 November. Available from: <https://www.gettingitrightfirsttime.co.uk/wp-content/uploads/2020/11/GIRFT-radiology-report.pdf>.
- NHS Improvement. *The Model hospital*. 2020.
- NHS. *Cancer workforce plan [Internet]*. Available from: [https://hee.nhs.uk/sites/default/files/documents/Cancer Workforce Plan phase 1 - Delivering the cancer strategy to 2021.pdf](https://hee.nhs.uk/sites/default/files/documents/Cancer%20Workforce%20Plan%20phase%201%20-%20Delivering%20the%20cancer%20strategy%20to%2021.pdf); 2017.
- Henwood S, Booth L, Miller PK. Reflections on the role of consultant radiographers in the UK: the perceived impact on practice and factors that support and hinder the role. *Radiography [Internet]* 2016;22(1):44–9. <https://doi.org/10.1016/j.radi.2015.06.001>.
- Snaith B, Milner RC, Harris MA. Beyond image interpretation: capturing the impact of radiographer advanced practice through activity diaries. *Radiography [Internet]* 2016 Nov 1;22(4):e233–8. <https://doi.org/10.1016/j.radi.2016.07.005>.
- Hardy M, Johnson L, Sharples R, Boynes S, Irving D. Does radiography advanced practice improve patient outcomes and health service quality? A systematic review. *Br J Radiol* 2016;89(1062).
- Milner RC, Culpan G, Snaith B. Radiographer reporting in the UK: is the current scope of practice limiting plain-film reporting capacity? *Br J Radiol* 2016 Sep;89(1065):20160228.
- Society of Radiographers. *The four Core Domains [internet]*. 2020. Available from: <https://www.sor.org/learning/document-library/consultant-radiographer-guidance-support-new-and-established-roles/four-core-domains>.
- Snaith B, Hardy M, Lewis EF. Radiographer reporting in the UK: a longitudinal analysis. *Radiography* 2015;21(2):119–23.
- Woznitza N, Steele R, Groombridge H, Compton E, Gower S, Hussain A, et al. Clinical reporting of radiographs by radiographers: policy and practice guidance for regional imaging networks. *Radiography* 2020. <https://doi.org/10.1016/j.radi.2020.08.004> [In-press].