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Beyond image interpretation: Capturing the impact of radiographer advanced practice through activity diaries

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ABSTRACT

Background: There is limited evidence of the impact of radiographers working in advanced roles beyond task substitution. This study reviews the contribution of advanced (and consultant) practitioner radiographers to service delivery whilst reporting radiographs and demonstrates the impact this has on patients and staff, both internal and external to the imaging department.
Method: The study was a prospective exploratory study using activity diaries to allow interval sampling when individuals were rostered to report. Data was coded using a compiled list of activities and recorded in 15-min intervals over the period of one week. Thirteen radiographers who independently report radiographs participated across 6 locations in a busy multisite English National Health Service (NHS) Trust.
Results: Radiographers reported the majority of the examinations during the study period (n = 4512/5671; 79.6%). The total number of coded activities recorded over the study period was 1527, equating to 380.5 relative hours. The majority of available time was spent reporting, including dictating and verifying the reports of colleagues or trainees, although 69.5% of reporting time was interrupted. Based upon the hours of reporting there was an average of 19.3 reports (patient episodes) produced per hour. Direct patient care tasks and support for staff in decision making were regularly documented. Supplementary tasks included administrative activity, amendments to rotas, preparing presentations and documenting incidents identified during reporting.
Conclusion: This study has demonstrated the breadth and complexity of the activities performed by advanced practice radiographers. The findings confirm their role in supporting service delivery beyond image interpretation.

Introduction

Imaging continues to undergo rapid technical evolution[1] and services have had to evolve to keep pace with sustained annual increases in demand.[2] Although image acquisition strategies have delivered capacity growth, reporting remains a challenge[3] and as a result new ways of working have developed at a local and national level. Radiographers have contributed to the reporting of radiographs for over 20 years in the United Kingdom (UK). This responsibility has been incorporated into new clinical roles, particularly at advanced and consultant practitioner levels. Although it is recognised that there is variation in radiographer reporting practices,[4,5] there is little evidence of how this contribution to service delivery impacts on patient outcomes and staff experience beyond direct role substitution.[6]

Historically, radiologist activity has been crudely assessed by measuring the number of images interpreted across imaging modalities. However, this does not take into account the proportion of time taken up by other activities which are harder to quantify, such as multidisciplinary meetings, advising clinicians and vetting or protocolling imaging procedures.[7,8] Further, it is unclear whether radiographers have adopted some of the wider activities, or whether these remain with the radiology community, thereby increasing pressure on medical practitioners.

This study aimed to evidence the role that advanced (and consultant) practitioner radiographers play in service delivery and the impact this has on patients and staff, both within radiology and the wider healthcare setting. The objective was to collate the range of activities radiographers undertake through a standardised diary template and use these to quantify their contribution.

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Study setting

The study was based in a large English National Health Service (NHS) Trust spanning 3 acute hospital sites with a catchment area of 540,000 patients and 1116 beds. Of the 13 (12.6 whole time equivalent [WTE]) radiographers currently employed to report musculoskeletal (plain film) radiographs, 8 also interpret visceral (chest and abdomen) examinations. Radiographers provide 7-day cover with an average of 4 reporters available 9–5 Monday to Friday across the 3 sites. In addition, at least one radiographer is rostered to each evening and weekend with the ability to provide immediate reporting on demand across the organisation at a centralised location. In total 7.6 WTE is committed to reporting, with 11 individuals employed as advanced radiographer practitioners and the remaining 2 in consultant radiographer roles. Independent reporting experience ranges from 0.5 to 20 years. In addition to the four tiers of radiographic roles, the Trust employs 28 consultant radiologists and has up to 10 radiology speciality trainees on placement at any one time.

Over the last 10 years there has been a co-ordinated approach to workforce planning and service delivery, with 3 members of the team externally recruited with an existing reporting qualification to supplement the existing staff base. This strategy has established a team of advanced and consultant practitioners who provide the majority of the Trust's radiographic reporting. In 2015 the team authored 140,517 definitive reports across 3 acute hospitals, out of a total of 205,320 radiography attendances (events). The service operates both immediate (hot) and delayed (cold) reporting, using voice recognition. Co-ordinated availability at fixed workstation locations provides advice to radiographer and clinical colleagues as well as each other. Anecdotally the individuals are undertaking a broad range of support activities in addition to their interpretive role. There is however no data to confirm their contribution, in this context, to wider service delivery or demonstrate them to be working at an advanced level.

The cost of the radiographer reporting service has been calculated based on 2015/16 Agenda for Change salary scales (Table 1).[9] Unsocial hours pay enhancements have been applied at the top increment of band 7 for 7.5 h shifts on both Saturdays and Sundays across the year. The clinical time of the advanced practitioners has been excluded as this is a budgeted activity and would be required in the absence of a reporting service. However, it is recognised that this incurs additional cost as a result of the differential pay between band 6 and 7, therefore this has been included as a cost pressure. The whole time cost of the 2 consultant radiographers is incorporated in this economic evaluation, although both individuals also contribute to modality or whole service leadership as well as a small amount of clinical provision in other modalities.[10] Importantly, the income associated with the consultant role around research and education has not been factored into this assessment. The non-clinical contribution of advanced practitioners to broader service objectives has also not been considered, this includes a formal mentorship programme, protocol management, audit and research; all of which are expectations of the role.

These figures compare to a potential outsourcing cost of £702,585.00 (based on £5 per event) or the requirement for an additional 6.5 WTE consultant radiologists (8.5 direct clinical care sessions and the local standard of 60 events reported per session). Based upon 2015 reporting activity, the cost per case was £3.07, which includes radiographer study leave, annual leave and sickness.

Method

The study was a prospective exploratory study using interval sampling of activities undertaken when individuals were rostered to report. Based upon a literature review and informed by local job descriptions, a generic list of expected activities was compiled. These were given a numerical code and grouped by theme (domain). A pilot study was conducted over repeated hour increments at a single location by 3 radiographers. This led to minor changes to the activity coding resulting in a final version of the data coding list (Table 2).

A data collection tool previously validated by Oddsdóttir and Sveinsdóttir[11] was utilised to collect activity information (Fig. 1). This consisted of 15-min interval sampling with a maximum of 4 activities per time block. Additional free text comments to explain activities could be provided. The same diary template was used for data collection at each reporting location (workstation) regardless of the number of individual staff involved in service provision. The diary was completed over a consecutive 7-day period in May 2016.

The coded activity list and 7 copies of the data collection tool (one for each day) were provided at each reporting workstation used by a radiographer across the 3 hospital sites. These were dated to ensure a new template was completed each 24-h. The workstation sample comprises the reporting 'desks', where participant radiographers were rostered. A single central desk was used for extended day and weekend reporting provision (workstation A). In addition, 3 workstations are used routinely during the working week (workstations B, C and E). At 2 of the hospitals a workstation provided overflow when additional capacity was available beyond the expected single radiographer (workstations D and F).

No change to working practice was employed during the period of the study. Supplementary to activity diary data, the total volume of primary reports authored during the study period was extracted from the radiology information system (RIS).

Activity data points were transcribed into an Excel database (Microsoft Corporation, USA) to evaluate workloads and allow descriptive analysis. Further statistical analysis was performed using the online Social Science calculator (www.socscistatistics.com). The total hours of reporter availability were calculated, as well as the coded activities and their respective domain. As the participants could record multiple consecutive activities (up to 4) in each period, the actual time spent on each is not determined but is recorded as 15 min. In line with Oddsdóttir and Sveinsdóttir[11] the activities are described in terms of 'relative time' with the emphasis being on identifying diversity and multitasking rather than the actual time involved.

The study was a self-recorded observation of current practice, with no change in patient care or role; therefore was considered service evaluation and did not require ethical approval.

Results

Over seven days of data collection, a total of 4817 patient events, comprising 5671 separate examinations, were reported. Of these, the majority were authored by a radiographer (Table 3).

Visceral examinations comprised 43.9% (n = 2489/5671) of the studies reported. Visceral examinations comprised 36.0%

Table 1
An evaluation of 2015 radiographer reporting costs.

Detail	Cost
Advanced practitioner salaries (minus 40% image acquisition role)	£257,224.79
Additional cost of clinical role (difference between band 6 and 7)	£29,709.44
Weekend unsocial hours enhancement	£7584.46
2WTE Consultant practitioners	£137,476.80
Total cost	**£431,995.49**

Table 2
Activity data codes.

Domain	Codes
Reporting	1. Reporting (immediate or delayed)
	2. Check/verify others reports
Direct patient care	3. Intervention (e.g. nasogastric tube removal)
	4. Radiographer discharge (from emergency department (ED) under protocol)
	5. Assess patient (take history or physical examination)
	6. Refer patient to other service (e.g. primary care patient sent to ED)
	7. Clinical radiography (e.g. assist or undertake)
	8. Escalate care (e.g. discrepancy or sick patient)
	9. Requesting radiology investigations
Advice	10. Provide advice – non-reporting radiographers (e.g. which projections, exam completeness)
	11. Provide advice – reporting radiographers
	12. Provide advice – clinicians
	13. Justification of examination (e.g. whether or not to perform)
Supplementary tasks	14. Search for clinical evidence (e.g. book, internet)
	15. Teaching (e.g. student, nurse, doctor sat in on report session)
	16. Reporting admin (e.g. report worklist management)
	17. Problem solving (e.g. queries with anatomical markers or image orientation)
Other	18. Other
	19. Receive request to report (on demand)
	20. Seek advice from another person (e.g. radiographer, radiologist, clinician)

Figure 1. Data collection tool excerpt.[11]

(n = 1625/4512) of radiographers' reports, in comparison to 90.9% (n = 562/618) and 95.6% (n = 258/270) for consultant radiologist and radiology trainees respectively. All of the radiographs outsourced to an independent sector provider were visceral. The number radiographs not receiving a radiology report (auto-reported) was lower in the visceral group (n = 25/2489; 1.0%) compared to musculoskeletal referrals (n = 227/3182; 7.1%). A test of proportion confirmed this to be statistically significant (z = −11.1162; p = 0.000).

The total number of coded activities recorded over the study period was 1527, equating to 380.5 relative hours, although there were differences in the activities and domains across the hospital sites (Table 4). The majority of available time (n = 198/209 h; 94.7%) was spent reporting, including the dictating of reports and verifying the reports of colleagues or trainees. Based upon the hours of reporting and the total reports authored, an average of 19.3 reports (events) were produced per hour.

The available reporting 'relative hours' was identified and compared to the number of time intervals when only a single code was documented. Overall 69.5% (range across locations 57.1–73.8%) of relative reporting time was interrupted (Fig. 2).

Although reporting was the most common clinically focussed activity, direct patient care tasks and support for staff in decision making were also documented throughout the study, particularly during the standard working week (Fig. 3).

Direct patient care activities included patient assessment, in order to correlate image appearances or support the justification of examinations, and 10 relative hours discharging emergency department (ED) patients with normal findings. The radiographer referred patients from primary care to the ED based on radiographic appearances and escalated care of ED patients to a consultant physician. The latter comprised patients who were unwell, demonstrated very abnormal radiographic findings or urgent interpretational discrepancies where abnormalities had been missed on ED initial review. One example documented was a calcified aneurysmal aorta demonstrated on an abdominal radiograph obtained 12 h previously; as a result, the patient was recalled and an ultrasound examination initiated and performed. Patient safety interventions performed by radiographers included the removal of two malpositioned nasogastric (NG) tubes identified during immediate reporting. Advanced practitioners also contributed a small amount of time (3.75 relative hours) to image acquisition during their reporting sessions, either to assist in complex cases or provide additional capacity during busy periods.

The majority of the advice was provided to other (non-reporting) radiographers, although clinician (doctor and nurse) interaction was evidenced, including discussions related to patient presentation, decision making and image appearance. Participants documented 52 separate interruptions to receive a request to report an examination, from both clinicians and secretarial staff. Additionally, radiographers sought advice on image appearances from a consultant radiologist or other reporting radiographer on 36 occasions.

Supplementary tasks related to administrative activity, this tended to be focussed at certain times of the day including report list cleansing at the start of the sessions. A range of activities were described by the participants in the 'other' category, including

Table 3
Reporting by author and referral type.

Report author	Patient events no. (%)	Examinations (total and referral type)				
		Total no. (%)	Inpatient no.	Outpatient no.	Emergency department no.	Primary care no.
Radiographer	3724 (77.3)	4512 (79.6)	578	554	2607	773
Consultant radiologist	575 (11.9)	618 (10.9)	144	79	60	335
Radiology trainee	247 (5.1)	270 (4.8)	66	37	124	43
Outsourced	19 (0.4)	19 (0.3)	–	19	–	–
Auto-reported	252 (5.2)	252 (4.4)	29	213	9	1
Total	**4817**	**5671**	**817**	**902**	**2800**	**1152**

Table 4
Activities undertaken by relative time periods.

Domain	Activity code[a]	Location						Total relative hours
		A	B	C	D	E	F	
Reporting	1	70.00	34.00	42.00	6.75	40.50	4.00	197.25
	2	0.50	4.00	0.25	–	–	–	4.75
Direct patient care	3	–	0.50	–	–	–	–	0.50
	4	2.25	5.75	0.25	–	1.75	–	10.00
	5	3.25	3.00	1.25	–	3.00	–	10.50
	6	0.25	1.75	0.50	–	0.75	–	3.25
	7	1.00	2.00	0.75	–	–	0.25	4.00
	8	1.25	2.50	–	–	0.75	–	4.50
	9	0.50	–	–	–	–	–	0.50
Advice	10	19.00	1.00	8.25	–	4.00	–	32.25
	11	1.75	0.25	1.00	0.25	1.25	0.50	5.00
	12	8.50	0.75	2.50	–	8.25	0.50	20.50
	13	6.00	0.75	3.00	–	2.50	–	12.25
Supplementary	14	1.50	0.25	1.25	0.50	0.50	–	4.00
	15	0.25	–	–	–	0.50	–	0.75
	16	1.25	0.75	2.75	1.00	2.25	–	8.00
	17	3.25	0.25	1.25	0.25	2.00	–	7.00
Other	18	11.25	4.50	0.75	0.50	6.00	1.00	24.00
	19	13.00	0.25	3.25	–	5.75	–	22.25
	20	5.25	–	1.25	–	2.50	0.25	9.25
Total relative hours		**150.00**	**62.25**	**70.25**	**9.25**	**82.25**	**6.50**	**380.50**
Total available hours		**73.50**	**37.75**	**41.50**	**6.75**	**43.75**	**5.75**	**209.00**

[a] See Table 2 for activity code detail.

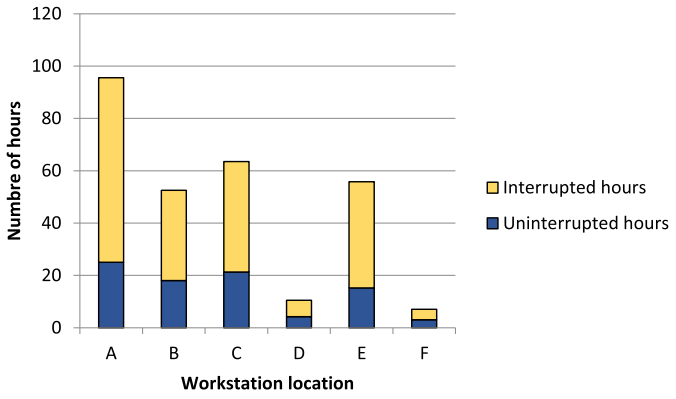

Figure 2. Reporting hours and interruptions.

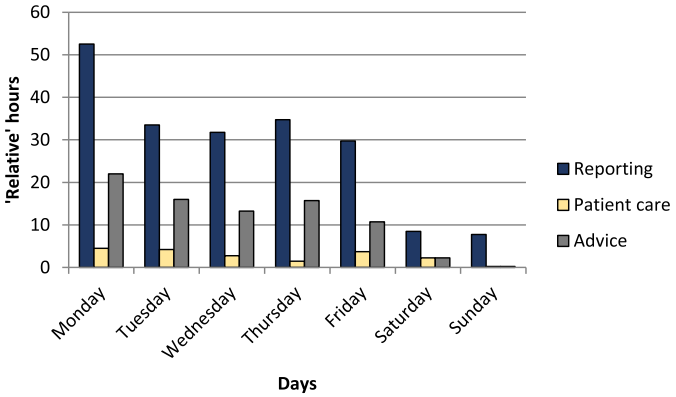

Figure 3. Clinical activity grouped by domain over the data collection period.

amendments to rotas, preparing presentations and formally documenting incidents. Another reporting interruption was caused by a brief system downtime, which occurred simultaneously at all sites and related to a network failure. Although some participants recorded the sending or reading of emails as an activity, subsequent discussion identified that this was inconsistently documented by all radiographers. Where correspondence required an immediate response, this would result in a greater number of interruptions to workflow than presented.

Discussion

There have been various attempts internationally to assess radiologist workload,[7,12–20] although the activities of radiographers employed in reporting roles have not been evaluated previously. The total number of examinations reported,[15,18] relative value units (RVU)[7,14,16,17,20] and independent observations[12,15,19] have been used previously to validate radiologist activity, however in isolation each method cannot fully evaluate workloads. When time-motion analysis has been utilised, convenience sampling over short periods of time (e.g. 2 h) has been preferred, however the current study opted to record all activity over a period of one week, including extended days and weekends. Although all methods are subject some level of bias, the 15 min intervals used in the current study should promote reliability of information; it was hoped that this approach would provide a true snapshot of activity variation over the working week. The similarity in activities recorded between 13 individuals over 3 sites appears to validate this method of data collection. It is recognised that a single week provides a snapshot and activity may vary during the year, for example at peak holiday periods. However, the workload contribution from the preceding year confirms the activity to be representative.

Activity diaries have previously been used by other non-medical health professionals to examine the contribution of advanced roles to clinical practice, demonstrating their diversity and impact.[11,21–23] The concept of 'relative time' has not been used within a radiology context before and differs from the RVU, where differential time periods are allocated to the reporting of examination depending on complexity. The benefit of activity diaries has been to provide insight into the influence of individual contributions to patient care and service delivery whilst recognising the diversity of advanced practice.[23]

Research in the radiology environment has shown that interruptions in workflow can create inefficiencies, introduce workplace stress and may contribute to errors impacting on patient safety.[24] The current study demonstrated significant throughput despite the interrupted environment, possibly because of local pathway design and conditioning of the radiographers. Multitasking and interruptions are recognised as contributors to interpretive discrepancies[25,26] and the number and type of interruptions recorded in the current study will support further review of workflow to identify opportunities to 'protect' certain locations; this should further reduce risk and improve reporting capacity.

The service cost is exaggerated by the inclusion of the non-clinical time of the consultant radiographers but is based on actual activity performed during the year. The saving is significant when costs are compared to alternative models and the use of radiographers also provides service flexibility, support and career development for staff. The economic benefits of imaging skill mix have received little attention from researchers due to the difficulty in assessing individual contributions to the whole imaging pathway. Lockwood[27] and Woznitza et al.[28] demonstrated the impact of radiographer role development on team working with the subsequent release of radiologist time and associated cost reduction. Whatever model of service delivery is adopted, support from radiologists forms an important component,[29] however such provision can also benefit radiologists through capacity release and may protect them from interruptions. This study demonstrates the outcomes of medium and long term workforce planning, with the majority of participants trained locally but supplemented by external recruitment. Although previous research suggests there is still significant untapped potential to increase the contribution of radiographers to reporting workloads,[4] it remains unclear whether future radiology networks will support increased radiographer training in independent reporting.

This is the first time the supplementary roles of advance practitioners have been explicitly measured, although it has been acknowledged in a previous survey of radiographers and ED staff.[30] Differences across workstation location and days of week were evident, likely reflecting the reduced support requirement at weekends as a result of imaging workload reductions, service provision across different hospital sites and staff experience. This study has demonstrated a high level of support provided to clinicians, radiology colleagues and service users, which may be influenced by the wide range of anatomical and referral types within the scope of the participants. This may not be representative of other departments, where previous studies have suggested radiographer practice may be more limited.[4,5]

The range of activities undertaken provides some evidence of the educational requirements for individuals pursuing advanced practice roles. This goes beyond image interpretation and includes other elements of advanced practice such as clinical examination, teaching, advising others on patient management and influencing the patient pathway. The clinical knowledge and experience has been developed locally, but such responsibilities should perhaps be a core component in postgraduate programmes.[31] In addition, the management of patient episodes of care requires additional competencies including adjusting or removing NG tubes to comply with national patient safety guidance.[32,33] Further, radiographers locally contribute to streamlining of the emergency care pathway through the discharge, direct from imaging, of patients with normal radiographs under a documented management plan,[34,35] with a number of examples documented during the study period.

In the current financial climate there is a need to demonstrate value to patients, referrers, stakeholders, the health system and society.[36] Evidencing the value of imaging in patient pathways can be difficult[36,37] and although reporting remains central to the advanced practitioner role in this context, there are other opportunities for radiographers to add value to patient care and evidence their impact on the patient journey. Safer, high-quality and more efficient care has been previously demonstrated through immediate reporting by radiographers,[30] and standardisation of practice using local workload information could further improve workflow and patient throughput, both within and external to imaging services.[38,39]

Limitations

Although this study has identified that interruptions in radiographer reporting occur, interpretive discrepancies have not been collated and are considered outside of the scope of this study, but have been previously evaluated in the study setting.[30] Activity diaries require participants to self-record actions rather than be observed performing tasks and an element of measurement bias may be introduced by missed data collection or incorrect data entry. To limit this, participants were asked to input activity at regular intervals and were limited to 4 activities per time interval for simplicity, although this in itself may be an under-estimation of the number of tasks radiographers performed in each interval. This study has not considered the non-clinical role of advanced and consultant radiographers or compared clinical roles to those of their radiologist counterparts as it was beyond scope of the study.

Conclusion

This localised study has demonstrated the breadth and complexity of the activities performed by radiographers undertaking advanced and consultant roles. It represents the first known study utilising activity diaries to go beyond fundamental reporting statistics to illustrate the diversity of practice and multitasking of radiographers performing definitive image interpretation. Evidence from this single centre study has shown that through workforce and service planning and adequate educational programmes, advanced practitioner radiographers provide a service which, alongside radiology colleagues, directly impacts patient care and streamlines patient pathways, thereby adding value to the organisation.

Conflict of interest

BS and RM participated in data collection as reporting radiographers. No other conflict of interest.

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