An investigation into the use of radiographer abnormality detection systems by Queensland public hospitals

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Abstract
Introduction: A Radiographer Abnormality Detection System (RADS), such as the ‘red dot system’, involves radiographers highlighting the presence of potential acute abnormalities on radiographs in the emergency setting. The literature suggests little additional training is required of radiographers to participate in such a system, posing little impact on current workflow while remaining a cost-effective, easy-to-implement program. However, its use outside the United Kingdom is sporadic. The purpose of this study was to investigate the frequency of use of a RADS in Queensland public hospitals.

Methods: A cross-sectional web-based questionnaire was developed and distributed to 28 medical imaging department directors throughout metropolitan, rural and remote Queensland (Australia) public hospitals. The results of this survey were analysed using conventional descriptive statistics of response frequencies and the percentage of the sample.

Results: The questionnaire was completed by 25 radiography directors (89% response rate). Sixteen percent of respondents, all metropolitan-based, indicated a RADS was in operation (n = 4/25; 16%). Respondents without a RADS (n = 21/25; 100%) expressed interest in a trial. Just over half (n = 13/25; 52%) of the respondents believed their staff members were not trained appropriately to implement a RADS successfully.

Conclusion: This study found an infrequent use of RADSs in Queensland public hospitals. This finding presents a unique opportunity for medical imaging professionals to enhance communication between the facets of a multidisciplinary emergency team via the implementation of RADS complemented by a radiographer commenting system.
availability of the radiology report. The proposed ‘multi-
team approach’ to image interpretation within the
emergency department was widely implemented in the
United Kingdom. Traditionally referred to as the ‘red dot
system’, over time evolving to the more collective name
of a Radiographer Abnormality Detection System
(RADS). The RADS is a comprehensive definition within
the UK, concerning abnormality detection systems
ranging from the ‘red dot’ to a brief written comment to
the referrer. The use of RADS within this article is
limited to a ‘visual cue’ on a radiograph, signalling a
potential abnormality.

In 2008, a study found 92% of emergency departments
in the United Kingdom utilised some form of RADS
within their radiography department. Furthermore
research in 2011 conducted by the same authors found a
small decrease in this statistic to 88.6%. The United
Kingdom’s extensive use of a RADS has not only
improved the diagnostic process but has also had a
positive impact on emergency management by supporting
junior medical doctors in interpreting radiographs of
trauma patients.

At the time this study was undertaken (2013), only
66% of radiology reports were available within 24 h of
the radiographic examination in Queensland public
hospitals. Data collected 2 years later (2015) reported a
marginal decline of 4% (62%). This less-than-optimal
delay in radiology reporting poses a problem, given that
the Australian National Emergency Access Target (NEAT)
expects an agreed upon proportion of patients should be
either admitted, discharged or transferred from
emergency departments within 4 hours. This clear
discrepancy between time to radiological diagnosis and
the expected care in emergency departments
reinforces the benefits of a team-based approach to
patient care in the form of a RADS as a precursor to the
definitive report.

The scope of the radiographer to be involved in a
RADS is explicitly stated by the profession’s national
registration board, the Medical Radiation Practice Board
of Australia (MRPBA). Their ‘Professional Capability’
document clearly states radiographers must be responsible
for conveying information to the appropriate parties
when significant findings are present, and that this should
be done either verbally or via systematic written
communication. As the radiological workload increases
within Queensland’s public hospitals, the question of
whether or not to engage in a RADS is becoming one of
patient care rather than professional preference.

The purpose of this study was to elicit unbiased
information regarding the use of RADS throughout
Queensland public hospitals. The study explored data
pertaining to radiology coverage, whether medical
imaging directors felt participation in such a system
should be mandatory or voluntary, and if, at the time of
the survey, medical imaging directors perceived their staff
members appropriately trained to participate in such a
system.

Methods

Study design

A cross-sectional web-based questionnaire was developed
and distributed to medical imaging department directors
throughout the Queensland public hospital system during
May of 2013. All medical imaging directors operating
within Queensland public hospitals are required to
possess a medical imaging degree or equivalent.

Participants and setting

The final web-based questionnaire was distributed via the
chairperson of the Medical Imaging Directors Association
of Queensland (MIDAQ), formally known as the
Association of Medical Radiation Directors of Queensland
(AMRDQ). A total of 28 public hospital medical imaging
departments are represented by the MIDAQ, 27 of which
operate in conjunction, or within emergency departments,
the remaining operating an acute injuries unit. The 28
departments are comprised of metropolitan (n = 22/28;
79%), rural (n = 5/28; 18%) and remote (n = 1/28; 4%)
departments. Geographical demographic classifications are
predetermined according to population density per square
kilometre of land, based on the rural, remote and
metropolitan areas classification.

Questionnaire content and procedure

Following a review of both radiography and
questionnaire-related literature, a cross-sectional web-
based questionnaire was proposed to be the most efficient
way of collecting data throughout Queensland public
hospitals.

The questionnaire underwent a feasibility pilot,
presented independently to a panel of senior
radiographers (n = 5). The pilot questionnaire ensured
the research purpose held true for every question
presented. The panel assessed for any of the major pitfalls
often identified in other questionnaire-based literature
including question validity, bias, readability and time
consumption.

The questionnaire was divided into three sections. The
first explored hospital demographic data (metropolitan,
rural or remote). The second asked respondents to
provide information about RADS in the respective
departments, including questions regarding participation in RADS being a mandatory or voluntary component of plain radiography. The third section explored potential opportunities and barriers within the respondent’s department regarding the use of RADS, including the viability of a RADS trial, the need for an implementation guide, the perceived barrier of radiographer education, and the department’s reporting radiologist coverage.

**Ethical considerations**

This investigation was approved by the Human Research Ethics Committee of Metro South Hospital and Health Service. Completing the survey implied consent. Participation was voluntary.

An information pamphlet accompanied the invitation to participate in the online questionnaire. The pamphlet summarised the importance of this study, contact details, confidentiality concerns and ethical consideration. Both items were distributed to all members of the MIDAQ. The collected data were stored and managed by the research team with access restricted to the researchers of the study to ensure confidentiality was maintained.

**Data analysis**

The results of this web-based questionnaire were analysed using conventional descriptive statistics including response frequencies and percentages of the sample. The data analysis was undertaken using MATLAB version R2015a.

**Results**

Twenty-five radiography directors completed the questionnaire within the allocated timeframe of 1 month (response rate 89%). Twenty-one of the 25 respondents were from metropolitan areas within Queensland, with 3/25 rural and 1/25 remote. At the time of this study (2013), Queensland Health had 27 certified public emergency departments throughout the state.11,15

**RADS: frequency and implementation**

A minority (n = 4/25; 16%) of respondents had an existing RADS in place. Of these, all four were from metropolitan public hospitals. No rural or remote public hospitals indicated ‘yes’ to operating a RADS.

Of the four locations with an established RADS, two processes for flagging abnormal images were noted; the most popular (n = 3/4; 75%) an asterisk (*) annotated onto the radiographic image and secondly (n = 1/4; 25%), a verbal message communicated to the referring clinician.

All sites surveyed that did not have a RADS in place (n = 21/25; 84%) expressed interest in both trialling a RADS and a desire for an implementation guide to assist in the commencement of such a system.

**RADS: mandatory or voluntary**

When respondents were asked if they believed that participation in a RADS should be voluntary or mandatory within their departments, 16 respondents (n = 16/25; 64%) considered a RADS should be voluntary, whilst eight respondents (n = 8/25; 32%) replied it should be mandatory. One respondent did not specify a preference (n = 1/25; 4%). More specifically, of the respondents surveyed with an existing RADS in place (n = 4/25; 16%), two respondents (n = 2/4; 50%) reported that their RADS was voluntary, one site (n = 1/4; 25%) answered mandatory and the final site (n = 1/4; 25%) did not specify a preference.

**Radiology coverage**

Just under half (n = 10/25; 40%) of respondents operated a 24-h radiographer-staffed medical imaging service. One respondent did not specify the operational hours of their department. Of the ten departments with 24-h medical imaging services, three had 24-h on-site radiologist coverage (n = 3/10; 30%), with the remaining seven sites (n = 7/10; 70%) maintaining a mixture of on-site and after business hours remote (off-site) radiologist reporting. Specific reporting turnaround times were not investigated in this study as each district within Queensland may have differing reporting time targets.

**Education**

Respondents were asked if they believed their radiographers had the appropriate training to participate in a RADS successfully. While two respondents did not specify (n = 2/25; 8%), only nine (n = 9/25; 36%) respondents declared they believed their radiographers had sufficient training. The remaining thirteen (n = 13/25; 52%) respondents answered ‘no’. Of the four public hospitals with an existing RADS, only two respondents reported that they did have confidence in their radiographers’ current training to participate in such a system.

**Discussion**

The results of this study indicate radiographer abnormality detection systems are not extensively used in Queensland public hospitals. Interestingly, directors of...
medical imaging departments without a RADS in place acknowledged a desire to implement such a system.

To the author’s knowledge, there have been limited survey-based studies undertaken on this subject native to the Australian setting. However, pertinent research has explored the impact of varying education ‘course methods’ employed to empower radiographers within Queensland, Australia to participate in such a system.16,17

This study involved surveying the directors of medical imaging departments from the three key geographic demographics in Queensland (metropolitan, rural and remote). The results found, of the medical imaging departments surveyed, those in metropolitan areas were more likely to have implemented a RADS than those in rural and remote locations. A paucity of educational and resource support in rural and remote areas, combined with a shortage of healthcare workers in these regions, is likely a contributing factor to these findings.18

The seemingly small sample size of this study (n = 25) makes up 92% of emergency departments within Queensland’s public health system (n = 27). Queensland is the second largest state in Australia. With a population of 4.853 million, 90% of the landmass of Queensland is classified as rural or remote. Most significantly, 97% of the population can be found in the southeast region of the state.15 The public health system is divided into 16 health and hospital services throughout the state. The over-representation of metropolitan centres (n = 21/25; 84%) is reflective of the population distribution in Queensland.15 This is indicated in the organisational structure of public health care regions. Of the 16 designated public health regions, only four (n = 4/16; 25%) are registered to the Queensland Health Rural and Remote Clinical Support Unit.19

With the results demonstrating a desire for an implementation guide, it can be assumed that medical imaging departments would be more likely to implement a RADS if there was a guide on how to introduce the system. The development of a guide that is only applicable to one department may not be the most efficient solution, whereas a state-wide or nationally developed RADS guide would be consistent, centrally developed, and validated for all sites to follow. Widespread implementation may face a potential barrier if medical imaging directors feel their staff members do not have the appropriate training to participate in such a system. These centres may lack the educational resources to conduct required training; issues such as this should be met with strong concern and addressed in the planning phase. Taking this into account, it is worth noting that previous studies regarding radiographer education and image interpretation have reported promising results.17,20 Mackay conducted a study investigating the impact of a short course of study on the performance of radiographers when highlighting fractures on trauma radiographs.20 The results indicated short course study was conducive to an improvement in radiographers’ plain radiographic image interpretation skills. However, access to continued education was recommended to preserve these skills in the long term.20 Similar findings were noted by McConnell and colleagues when assessing radiographers’ ability to describe musculoskeletal trauma radiographs following a pilot education program.17 It is apparent from these two studies that targeted education does improve radiographers’ ability to interpret radiographs.

The system of highlighting abnormal trauma skeletal radiographs has been shown to reduce errors in emergency departments and has now become standard practice in the UK with a reported 92.8% implementation rate.2–4,21,22 However, limitations within the system do exist. The inconsistencies in practice between departments and the ambiguity of a single ‘flag’ on radiographs with multiple abnormalities can prove problematic, resulting in uncertainty around the system for the referrer.4,22 A RADS working parallel with a preliminary image evaluation (PIE) system is a potential solution to these pitfalls.4,22–24 A PIE is a method of radiographer commenting whereby the radiographer communicates to the referrer their reasoning for flagging an image in a brief written ‘comment’. A PIE does not replace or intend to replace the need for a definitive report, merely provide a preliminary evaluation to the referrer until a radiological report becomes available.22–24

Although just over half (n = 13/25; 52%) of medical imaging directors surveyed believed their radiographers did not have the appropriate training to participate in a RADS, the current literature disagrees.24–27 Statements made by the MRPBA imply that participating in such a system is within radiographers’ scope of practice and therefore an expectation of everyday work.10 A study conducted by Hall and Kleinmann found untrained radiographers to have a diagnostic accuracy of 91.2% when asked to flag abnormal images.5 Additionally, a study published in 1997 comparing emergency doctors’ and untrained radiographers’ accuracy in identifying abnormal radiographs found comparable rates of detection (89% and 87% respectively).26 Recent research into Australian radiographers’ confidence and self-perceived accuracy in systems such as a PIE has shown an overall readiness to participate and, given the opportunity, further educate themselves to improve their image interpretation ability.28 The most effective method in which education is delivered to improve radiographic image interpretation warrants further research.

Total presentations to public emergency departments in Queensland are increasing by around 50,000 patients a
year.\textsuperscript{15} If the current trend continues, there will be 600,000 more emergency presentations in 2026 than 2014–15.\textsuperscript{15} The 2014–15 Queensland Radiology Services Profile found only 62% of radiological examinations were accompanied with an available diagnostic report in less than 24 h of the examination; with general radiography accounting for the highest proportion of radiological examinations (54%) within Queensland public hospitals.\textsuperscript{8} These reporting statistics highlight a less-than-ideal model of emergency care, where NEATs are now a reality in all emergency departments throughout Australia.\textsuperscript{9,29} A team-based approach to patient care via the use of a RADS may in time no longer be optional, but a requirement. This notion for radiographers to become more active members of the team-based patient care model is already reflected in MRPBA’s ‘Professional Capabilities for Medical Radiation Practice’.\textsuperscript{10}

This investigation displays several strengths and limitations. The investigation utilised an already established sample consisting of all the directors of radiography departments within the Queensland public health system. This sample strengthens the validity of the results, providing a pragmatic means of correspondence with managers around the state. The method of survey distribution proved an advantage during the data collection. The cross-sectional web-based survey overcame the barrier of distance between departments, allowing participants of the study to complete the survey regardless of geographical location. A limitation of the study that exists of all voluntary studies, is the inherent bias of participants. Respondents may have had a preconceived idea around the use and/or appropriateness of a RADS within their department and henceforth exhibited this bias in their responses.

This study only involves respondents from Queensland. Therefore, the findings of this study may not necessarily represent the overall use of RADS in Australia. A further limitation relates to the age of the data as it is now approximately 4 years old. Therefore, the results of this study may underestimate the current uptake of RADS in Queensland. Further, more recent studies into its use Australia wide are warranted.

**Conclusion**

The results of this study revealed the infrequent use of a RADS in Queensland public hospitals. Use outside of the metropolitan medical imaging departments was non-existent. The need for an implementation guide to support regional and rural sites in introducing a RADS was highlighted and should be a priority for future development. Radiographer training is still perceived by many medical imaging directors to be a barrier, although the literature suggests otherwise. The MRPBA formally acknowledges radiographers conveying information regarding clinically significant findings to the referrer to be within the scope of practice in Australia. The implementation of a RADS working in conjunction with a PIE is a more accurate method of communicating potential abnormalities to a referrer. This parallel approach will ultimately improve patient care in the emergency department.

**Conflict of Interest**

The authors declare no conflict of interest.

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