Improving Performance by Using a Radiology Extender

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DESCRIPTION OF THE PROBLEM

Academic radiology centers challenged by reduced reimbursements have relied on a strategy of mergers, consolidations, and buyouts of nonacademic practices [1] to improve case volumes and revenue and to distribute operating costs. Our institute is a level 1 trauma center located in a large urban area and supports the region across multiple service lines. Resulting from recent mergers and acquisitions (M&A) activities, its radiology service now provides care in multiple affiliated hospitals and diagnostic imaging centers located across the region, performing over a million cases annually. Teaching hospitals have relied on residents and fellows to share the burden of interpreting films at lower cost, but their supply has not kept pace with the increasing volume of work at our institute.

The musculoskeletal section of the Department of Radiology is staffed by 10 board-certified radiologists, 3 fellows, and a variable number of residents, who read a total of 1,300 plain film cases per week on average. Reading plain films involves busywork such as retrieving patient history, comparing prior images, and using standard dictation templates. For experienced radiologists, evaluating plain film x-rays is often characterized by low task complexity and variability, resulting in uninteresting and repetitious work, thus reducing job satisfaction. Experienced x-ray technicians are also faced with similar issues when tasked with x-ray image acquisition and are further faced with limited options for professional upward mobility.

Hackman et al [2] suggests that routine and repetitive tasks often lead to feeling a lack of meaningfulness, achievement, and responsibility, resulting in issues of inefficient resource allocation and employee dissatisfaction in the organization. When these viewpoints were expressed repeatedly by our technicians and radiologists, we devised a solution to these issues for both radiologists and technologists. We recruited an experienced radiologic technologist from the department to provide a preliminary read of musculoskeletal plain films and measured the resulting improvement in radiologists' performance by calculating changes in their flow rate, which is the number of radiographic studies evaluated per unit time.

The technician's job role was analogous to physician extenders such as a physician's assistant, routinely used to improve the efficiency in other clinical domains, and therefore is called a radiology extender (RE). This job role is distinct from existing roles of ancillary radiology personnel such as radiologist assistants or radiology physician assistants, who primarily assist in the performance of low-complexity procedures and the preliminary interpretation of the procedure images, but who are not expected to evaluate images in general [3]. But just as both these roles are not recognized as medical providers by Medicare [4], the RE's role is limited by a requirement for a board-certified radiologist to finalize each report. Although Blackmore et al [5] described a pilot project employing intermediaries to filter out low-complexity radiographs in an emergency department and interventional radiology settings, there are a few key distinctions from our current work. That program was far more ambitious than ours and employed physician assistants with yearlong emergency department and interventional radiology experience to accomplish a multitude of tasks, including performing ultrasound examinations, prereading films, and providing a continuity of care. Our program was limited in scope to deal with only training the RE to read musculoskeletal radiographs and measure their value by evaluating their effect on radiologists' efficiency. Finally, diagnostic technologists have long performed this task informally, especially as

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mammography technologists and sonographers, and occasionally assisting inexperienced residents on call. Although the similar role of a radiographer exists in other countries such as the United Kingdom with expanded responsibilities to evaluate ultrasounds, mammograms, and plain films [6], there is no such formal role currently in the United States.

WHAT WAS DONE

The RE was trained by methods similar to the training of radiology residents, namely, one-on-one review of cases that he had reviewed, and directed reading in both an online course designed to train radiographers in the UK to interpret images (http://eintegrity.org, Ware, United Kingdom), as well as standard radiologic texts.

This project was reviewed and determined to qualify as quality improvement by our institute's Institutional Review Board. All radiographs were read in the musculoskeletal section's reading room on a GE Centricity Universal Viewer picture archiving and communication system (GE Healthcare, Milwaukee, Wisconsin, USA) routinely used for clinical studies. Six radiologists participated in the study reading a median of 24 cases (range 17-57), which were not controlled for case variety or complexity, so as to replicate the realistic clinical scenario of the daily workflow.

A single observer (A.B.) timed radiologists reading radiographs under three conditions: radiologists read cases alone, radiologists review RE-read cases sitting alongside RE and subsequently sign off on the reports edited by the RE, and radiologists review the cases separately from RE and edit and sign off on the RE's preliminary report. The reason for distinguishing the latter two conditions was to determine any impact of either approach on radiologists' efficiency. Read time, defined as the time taken between opening the first case in the queue till finalization of the last case, was recorded as a fraction of a minute. The flow rate is calculated as the number of cases per minute. One radiologist was not able to complete reading cases alongside the RE; hence, there were only 23 measurements in all. Performance improvement was calculated as the percent change in flow rates of both RE-read studies compared with radiologist reading studies alone, resulting in 15 measurements. A senior radiologist with over 30 years of experience was timed in three separate sessions to determine intrareader variability in improvement, measured as coefficient of variation (standard deviation or average percent improvement).

Analysis of variance was performed on flow rate measurements with three-level categorical dependent variables when radiologists read alone, reviews alongside RE, or reviews separately from RE, resulting in a t test with pooled standard error using JMP Pro 13 (SAS Institute, Cary, North Carolina, USA).

OUTCOMES

A significant difference was observed with respect to the flow rates between radiologists reading solo and both methods of finalizing RE-read cases (Fig. 1). The summary data are shown in Table 1. On average, the radiologists' flow rate for solo reads was 0.62 ± 0.12, mean ± standard error. This improved significantly ($P < .001$) when evaluating RE-read cases either alongside (1.33 ± 0.13 cases per minute) or separately from the RE

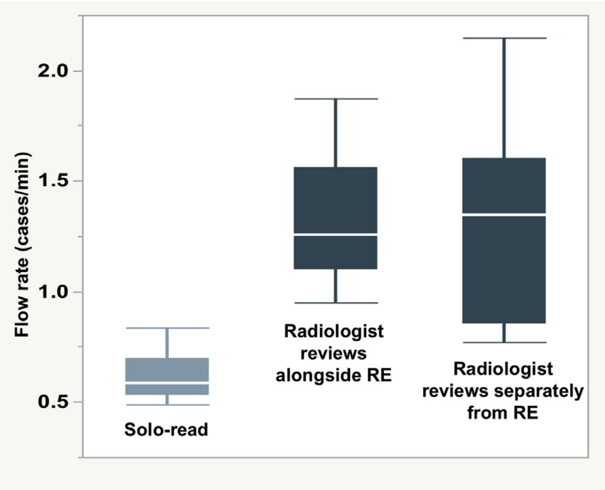

Fig 1. Outlier box plots of flow rates (cases per minute) when a radiologist performs a solo read (lighter box plot), reviews alongside radiology extender (RE), or reviews separately from RE (darker box plots). The average flow rate for all cases was 1.09 cases per minute. The height of each box is the interquartile range (the third quartile minus the first quartile). Whiskers drawn to the furthest point within 1.5 × interquartile range from the box. The line at the median is shown by the white space in each box. Potential outliers (disconnected points) were not observed. Although there was significant difference in the means from solo read to them, the latter two groups were not significantly different from each other at the 95% confidence interval.

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