The Effect of a Technologist-Centered Electronic Review and Feedback System on Image Quality

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DESCRIPTION OF THE PROBLEM

Reduction of errors should be a goal of any service-related industry including radiology. Proper image acquisition is essential for accurate diagnosis. There is much evidence on perceptual and cognitive errors in imaging diagnosis; however, there is a relative paucity of literature on the key role technologists play in obtaining optimal images for diagnosis.

In an effort to achieve high image quality at our medical center, we have long had a retrospective system for reviewing examination quality and completeness. In this system, a predetermined number of random imaging studies from each technologist were systematically reviewed by the manager, lead technologist, or imaging technical coordinator (ITC) for image quality and completeness, and then subjectively "graded." However, it became apparent that this process was problematic. First, there was heterogeneity in the evaluation system each modality group and often each individual reviewer employed. In addition, there was variation in the manner in which the manager, lead technologist, and ITC would "score" the same examinations. Finally, collecting data results for analysis was laborious and inefficient given that the scoring was performed using various tools that required separate tabulation steps whenever data summaries were required. We sought a more efficient, less heterogeneous workflow that would help improve image quality in the long term.

WHAT WAS DONE

In an attempt to address these shortcomings as well as reduce the overall burden on each modality's reviewers, a new IT-based system was created ("PACS retrospective review tool"). All modalities were required to use the same quality report system that was managed by each modality ITC and overseen by the manager to mitigate the issue of heterogeneity in scoring. The IT-based system generates quarterly reports for each individual technologist as a means of constructive feedback. The full implementation of this quality IT workflow began at the beginning of the second quarter of fiscal year 2016-2017 (October 2016).

Imaging studies from each modality were randomly selected for each individual technologist for scoring by the modality ITC each quarter. The image quality of an examination was categorized subjectively as excellent, acceptable, and not acceptable. If the study was deemed not acceptable, one or more of the following causative processes were flagged: quality (eg, incomplete examination, artifacts, poor positioning, patient motion), protocol (eg, physician protocol not followed, wrong protocol selected, field of view or coverage issue), or process (eg, incorrect patient imaged, wrong examination performed). Free text could also be entered for further clarification or if the specific issue at hand was not addressed in one of the selectable options.

Data entered into the PACS retrospective review tool were stored in a department database, and the data could be accessed by a visualization module in the department's analytics web portal. This portal was accessible to the modality managers, assistant directors, and the director for review. Rather than requiring manual and repeated tabulation of data for analysis at the end of each quarter, the system automatically summarized all pertinent data organized by tabs: image quality

1546-1440/18/$36.00 ■ https://doi.org/10.1016/j.jacr.2018.01.014

(percentage of studies scored excellent, acceptable, and not acceptable), rating details selected (the reason for a not acceptable score), technologist details (extraction of rating details selected relative to a specific technologist), and detail category (subcategory of the error in image acquisition: quality, protocol, or process).

These image quality scores were based primarily on two factors: diagnostic quality (ability to make a diagnosis) and absence of any errors in imaging acquisition or reconstruction. Excellent examinations were those in which there was no discernible error in acquisition, reconstruction, or anatomic inclusion. These were cases that were such good quality that they could be used to educate other technologists in the future (essentially "textbook" cases). Acceptable examinations were those that only had mild errors in acquisition, reconstruction, or anatomic inclusion, which did not interfere with diagnosis—for example, a chest radiograph that was not centered on the thorax but included all portions of the thorax within the field of view, or a pulmonary embolism CTA in which contrast opacification was higher within the left side of the heart rather than the right side of the heart but opacification of the right side of the heart was still high enough for reliable evaluation for thrombus. Not acceptable examinations were studies that were obtained with an incorrect methodology, reconstruction, or anatomic inclusion—for example, a chest radiograph that excluded the lung apices or a CT scan that was reconstructed in minimum intensity projection algorithm rather than maximum intensity projection algorithm or vice versa.

To close the feedback loop, each technologist was shown a report card summary of his or her performance relative to his or her past performance (Fig. 1) as well as a tabulated summary of comments from examinations scored as not acceptable and then met with his or her manager and ITC for constructive feedback personalized for the technologist. Sessions were designed to be nonthreatening and treated as an opportunity for improvement and discussion.

OUTCOMES

Four quarters of data were collected while using this new workflow. During the first quarter of data collection, 1,596 examinations were scored using the review system. Nearly a quarter of all studies (382 of 1,596, 23.9%) were considered not acceptable; 13.9% (222 of 1,596) and 62.2% (992 of 1,596) of reviewed cases were scored as excellent and acceptable, respectively. The percentage of not acceptable examinations (14.3%, 165 of 1,154) significantly decreased in the second quarter with a concomitant increase in the percentage of excellent examinations (22.9%, 264 of 1,154; $P < .001$, two-tailed χ^2 test). The percentage of not acceptable examinations in the third quarter was unchanged compared with the second quarter ($P = .942$) and in the fourth quarter relative to the third

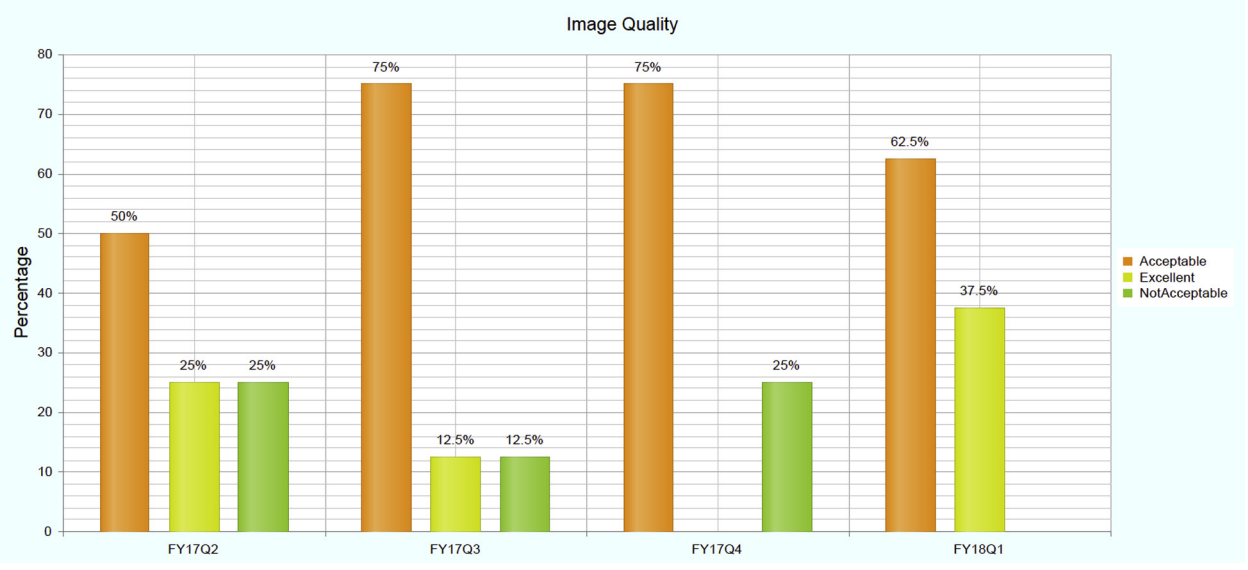

Fig 1. Example of report card for an individual technologist over four quarters.