Expectations Among Academic Clinicians of Inpatient Imaging Turnaround Time:

Does it Correlate with Satisfaction?

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Rationale and Objectives: Imaging report turnaround time (RTAT) is an important measure of radiology performance and has become the leading priority in customer satisfaction surveys conducted among nonradiologists, who may not be familiar with the imaging workflow. Our aim was to assess physicians' expected RTAT for commonly ordered studies and determine if satisfaction correlates with met expectations.

Materials and Methods: Retrospective review of inpatient imaging was conducted at a single academic institution, and RTAT for 18,414 studies was calculated. Examinations were grouped by study type, priority, and time of day. A cross-sectional survey instrument was completed by 48 internal medicine and surgery resident physicians with questions regarding RTAT and their level of satisfaction with various examinations.

Results: Actual RTAT ranged from 1.6 to 26.0 hours, with chest radiographs and computed tomographies generally faster than magnetic resonance images and ultrasounds. Urgent (STAT) examinations and those ordered during business hours have shorter RTAT. The time for image interpretation largely contributed to the RTAT because of the lack of night-time radiology coverage. Referring physician expectations were consistently shorter than actual RTAT, ranging from 30 minutes to 24 hours. Overall satisfaction scores were inversely correlated with RTAT, with a strong correlation to the time from study order to imaging ($r^2 = 0.63$) and a weak correlation to the image interpretation time ($r^2 = 0.17$). Satisfaction scores did not correlate with whether the actual RTAT met expectations ($r^2 = 0.06$).

Conclusions: Referring physician satisfaction is likely multifactorial. Although RTAT has been reported as a priority, shortening turnaround time alone may not directly improve clinician satisfaction.

Key Words: Turnaround time; satisfaction; RTAT; coverage.

Medical imaging report turnaround time (RTAT) is an important and recognized measure of radiology performance (1). Timely completion of a finalized radiology report has been a priority among ordering clinicians for over 30 years, and prolonged reporting times can negatively impact clinical outcomes and the perceived value of a radiologist (2–4). Multiple surveys conducted among clinicians have demonstrated that RTAT is a potential unmet need, and with increasing focus on volume and efficiency, turnaround time has become the leading factor affecting ordering customer satisfaction (5–7). Patients also desire faster diagnoses, with most expecting results "within a few hours" (8). Furthermore, future radiology reimbursements and pay-for-performance measures may increasingly focus on RTAT as a quality metric (9,10).

Although radiology workflow at most institutions is complex, with a myriad of steps and processes that affect RTAT, one significant cause of delays in turnaround time is reduced radiology staffing during evening hours and weekends (11). This has led to the adoption of night-time teleradiology coverage in many community practices. Although some academic groups have implemented around-the-clock attending radiology coverage with reductions in turnaround time (12,13), most academic programs remain with resident-only coverage during nontraditional work hours because of financial or education reasons (14,15).

Despite the numerous surveys having identified turnaround time as a top priority among nonradiologists, there is a paucity of research defining "how fast is fast enough?" Furthermore, nonradiologists may have varied, and possibly unrealistic, expectations of how long an imaging study should take to be

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performed and interpreted because they are not familiar with the workflow. For example, a study by Howard et al demonstrated that up to one-third of physicians demanded clinical laboratory turnaround times that were faster than technically feasible (16).

In our study, we aim to establish the expected turnaround times and degree of satisfaction among referring physicians for common imaging studies in an urban academic hospital. These expectations and level of satisfaction are compared against actual turnaround times. Our hypothesis is that ordering clinicians expect a short turnaround time for most studies and that their degree of satisfaction correlates with how close their turnaround time expectations are met.

MATERIALS AND METHODS

This study was performed at a single urban level-1 trauma hospital with reduced radiology coverage outside of normal business hours. All research activities performed complied with an approved institutional review board protocol. We defined RTAT as the period from when a study is selected in a computerized order entry system (CPOE) to when a written radiology interpretation is first available in the electronic medical record, which is usually a resident-dictated preliminary report. The preliminary report is typically the first available actionable item, particularly outside of normal business hours, making this definition of RTAT more appropriate than time to final report which may be created after clinical decisions have been made based on the actionable preliminary report. This definition of RTAT also allows for a closer approximation to community practices where after-hour nighthawk services are frequently used to provide limited, but nonetheless actionable preliminary reports. We selected four groups of commonly ordered imaging studies across multiple modalities: chest radiographs, computed tomographies (CTs) of the abdomen and/or pelvis, magnetic resonance images (MRIs) of the brain, and abdominal ultrasounds. Each examination group included the spectrum of study codes corresponding to the anatomic location and modality to account for different protocols; for example, the CT group included noncontrast supine abdomen and/or pelvis and imaging for urolithiasis (KUB), single-contrast examinations, multiphasic liver, pancreatic, or renal studies, as well as examinations with oral or rectal contrast. CT and MR angiograms were excluded because these exams are often performed for thoracic surgery planning and the postprocessing and measurements are not typically dictated outside of normal hours.

A retrospective review of imaging studies from July 1, 2012 to June 30, 2013 was performed using a radiology information system (RIS). Inclusion criteria consisted of CPT codes included in the selected 4 examination groups listed as previously mentioned performed in inpatients at the time of examination. We recorded the electronically documented date and time when each examination was ordered by the clinician in CPOE, at completion of imaging, as well as when the electronic signatures were placed on the preliminary and final reports. Using CPOE order times, examinations were categorized as either ordered during normal work hours (Monday–Friday, 7 AM–4 PM) or during nonstandard work hours. The durations from CPOE order to completion of imaging (O-C or image acquisition component) and completion of imaging to preliminary report generation (C-P or interpretation component) were calculated. The priority status of an examination (routine vs STAT) and the presence of a critical results "flag" were recorded.

Because our hospital has a 24-hour coverage in the emergency department (ED), studies ordered from the ED reflect a different radiology workflow than for inpatients. Imaging studies performed in the ED are interpreted, and a preliminary report generated in real time throughout the 24-hour cycle. Inpatient examinations are not included in the normal workflow of the after-hour ED radiologist, and preliminary reports are not routinely generated for these examinations during the after-hour period unless a specific request by phone or in person is made. For comparison purposes, data from ED imaging studies performed during a 2-month period were also obtained.

A cross-sectional online 8-item survey instrument (Appendix 1) was created to investigate the expectations and level of satisfaction among nonradiology clinicians regarding imaging turnaround time of inpatient radiologic examinations. The survey instrument was validated by cognitive debriefing through face-to-face interviews with members of the research team and selected referring providers. The instrument was administered anonymously in a Web-based format to the internal medicine and general surgery residency programs through institutional mailing lists. These programs were selected because of their large number of residents in training and relatively large numbers present in the hospital both during normal and after-hour periods and are involved in the regular after-hour management of a relatively large percentage of patients in the hospital. In addition, residents in these training programs typically rotate on numerous different subspecialty services and therefore have broad experience with the ordering of a wide range of studies. The referring physicians were asked to rate their level of satisfaction of RTAT from the four groups of examinations, during both normal and for nonstandard work hours and for STAT and routine examinations. These physicians were also asked to select, for each group of examinations, if they expect the turnaround time to take less than 30 minutes, between 30 and 60 minutes, between 1 and 4 hours, between 4 and 24 hours, or greater than 24 hours. Finally, the respondent's level of training and medical specialty are also surveyed.

Non-Gaussian statistics were used to analyze the RTAT data. Quartile and outlier analysis, multivariate modeling, and Student's t tests comparing the RTAT for STAT versus normal priority studies were performed using SAS JMP 11 (SAS Institute Inc, Cary, NC). The median RTAT for each examination group was compared against respondents' expectations to determine if expectations were met, and this result was compared against indicated level of satisfaction. Linear