Analysis of a Four-Point Order-Priority Score on Imaging Examination Performance Times in the Emergency Department and Inpatient Setting

Ordering systems for imaging as well as laboratory and other ancillary services have historically employed the “traditional” priority categorizations: STAT, ASAP (as soon as possible), and routine. In such systems, the ordering provider selects one of these categories to indicate the relative urgency of the order. These terms can lead to ambiguity or misuse, especially if they are left undefined [1, 2]. As evidence, at one academic medical center, 74% of the orders for portable chest radiographs were ordered as STAT [2].

The benefit of mere binary prioritization compared to no prioritization has been documented [3-5], however, established schema for guiding order prioritization in more modern and complex healthcare scenarios which need more than two levels of priority are largely absent. “One could argue that all emergency department (ED) orders should be STAT, rather than routine, given patient expectations and institutional throughput requirements, however this binary system fails the patient who is in a code category, stroke alert, or trauma alert, because the urgency of their situation is ‘diluted’ by other STAT orders that are less clinically time sensitive [8].”

Providers at the “bedside” are clearly best situated to know the relative urgency of an imaging examination and its likelihood of altering management. However, providers may be challenged in relaying this information effectively if the ordering system lacks clear and appropriate guidelines for priority categorization or is too simplistic to handle a myriad of clinical scenarios. In March 2011, our institution implemented a new electronic health record (EHR; EpicCare; Epic Systems, Verona, Wisconsin) and radiology information system (RIS; Radiant; Epic Systems). We took this occasion to revise our imaging order prioritization schema in an attempt to address the limitations inherent to our traditional model of prioritization for both inpatient and emergency department imaging requests. More specifically, 1) order-priority categories were made numeric, and 2) each numeric category was accompanied by a brief clinical definition to assist the referring provider in selecting the relative urgency of the exam.

We hypothesized that our institution’s new or at least redesigned model would result in desirable prioritization of imaging examination performance by appropriately stratifying median turnaround time and turnaround time consistency by level of priority. The purpose of the study reviewed here was to retrospectively evaluate the impact of this defined numeric order-priority system on the prioritization of imaging examinations at our institution.

FOUR-POINT ORDER-PRIORITY SYSTEM

Our revised order-priority system for inpatients and emergency department patients was implemented in March 2011, and specified four graded categories (priorities 1-4, with 1 being the most urgent). Representative clinical scenarios accompanied each order priority and were visible at order entry. Priority levels are depicted in Table 1, and referring providers received a three-minute tutorial on this new model of prioritization during their EHR training. Furthermore, a programming feature made the selection of a priority category a “hard” requirement before the order could be submitted. To evaluate our new prioritization schema, we selected two variables for comparison to a control: Order to Performance Time (OTPT) and Consistency (of order to performance time).

Median OTPT: Distribution-free randomization tests were used to compare the medians (assessed individually for each imaging modality: CT, MRI, Ultrasound, Radiography) of the OTPT empirical distributions in a pairwise manner between the four order priority levels [6]. We also evaluated OTPT for a combined data set including all tested imaging modalities (CT, MRI, Ultrasound, Radiography).

OTPT consistency: Interquartile range (IQR) length of the empirical OTPT distribution was used as an estimate of the consistency of OTPT. Using distribution-free randomization tests, both the individual and combined-modality OTPT data sets were used to provide “inter-order priority-level comparisons of OTPT consistency [8].”

Comparison of Median OTPT and OTPT consistency to Control Data: Combined-modality data were used to compare median OTPT and OTPT consistency between the traditional (Pre-implementation: STAT, ASAP, Routine) and revised (Post-implementation: Priority 1, 2, 3 and 4) priority categorizations. Prior to making this comparison, which was known to be somewhat limited, we evaluated and confirmed that the percentage of examinations representing each modality (i.e. modality frequency distribution) was similar between the traditional and revised order priority time periods. The following comparisons were made:
Table 1. “Clinical definitions for the new numeric order priority system as provided to the clinicians during a brief training session prior to implementation. Institutional definitions inform ordering providers about appropriate clinical scenarios for each level of priority, eliminating guesswork and potentially reducing the misuse or overuse of high priorities. Priority 1 is established as a more urgent category above what is commonly considered STAT at other institutions (e.g. most Emergency Department exams; our Priority 2) so that providers can better communicate the most truly time-sensitive minority of exams to technologists to perform first. The term “routine” has been replaced by “most inpatients” to indicate that most inpatients will be done “as soon as possible” presuming there is not a more urgent clinical scenario to be addressed first. The system is numerical to communicate clear hierarchy regarding level of urgency to the technologists and other parties.” [8]

1. “Order priority 1 and 2 examinations conducted in 2011-2013 (post-implementation) versus examinations classified as STAT or ASAP during 2010 (pre-implementation) [8].”

2. “All prioritized studies (i.e., everything that is not routine) combined for each period, or stated differently, priorities 1-3 combined (post-implementation) versus STAT and ASAP combined (pre-implementation) [8].”

3. “Order priority 4 (i.e., the routine-equivalent category) examinations conducted in 2011-2013, and examinations conducted during 2010 and classified as routine [8].”

RESULTS

OTPT Distributions in the Four-Point Order-Priority System: With the exception of Ultrasound (where priority 2 examinations were completed slightly more rapidly than priority 1), the higher priority imaging requests were completed more rapidly than those indicated as less urgent. Figure 1 [8] displays the median and interquartile range of the OTPT empirical distribution. For a detailed summary of the OTPT distribution for the mean, median, and measurement consistency, the reader is referred to the original article [8].

Comparison of Pre- and Post-Implementation Data:

We present the results from the comparison of OTPT and OTPT Consistency for the combined (MRI, CT, Ultrasound, and Radiograph) modalities between traditional and revised order priority models (pre-and post-implementation periods, respectively). Of note, there was a large bias toward lower OTPT’s in the control (pre-implementation) group due to the inability to exclude studies whose orders were changed/corrected immediately prior to exam performance, which led to artificially short order-to-performance-times. In spite of this bias, priority 1 studies (post-implementation) were performed with significantly shorter median OTPT’s compared to STAT and ASAP examinations under the pre-implementation model.

Table 2 presents results, including P values, from comparisons of OTPT and OTPT consistency for prioritized and routine examinations under the new model (2011-2013; four-point order-priority) versus control (i.e., 2010; the pre-implementation period with the traditional model). Despite the recognized bias toward OTPT in the control group (i.e., the inability to exclude studies with changed orders immediately prior to the exam thereby resulting in unreasonably short OTPTs), priority 1 studies in the new model were performed with a significantly smaller median OTPT than were STAT or ASAP examinations under the traditional model.

CONCLUSIONS AND FUTURE DIRECTIONS

Coinciding with the launch of a new EHR in 2011, our institution went live with a revised model of prioritization for imaging requests. In order to address the limitations of our conventional model, which employed the prioritization categories STAT, ASAP, and Routine, our new system had two key features: 1) Numerical catego-
Association of an imaging request priority with a clinical location or scenario provided guidelines for ordering providers. This led to a more reliable and consistent “communication” of the information most relevant for technologist prioritization of exam completion. Notably, this led to a smaller percentage of the highest priority orders.

This model for order prioritization is not limited to imaging exam performance, and has potential applicability to laboratory orders, specialty consultations, and other ancillary services. In addition to the prioritization of exam completion, for results requiring physician interpretation such as those in medical imaging, an additional level of prioritization could be applied to the relative urgency of issuing a final interpretation [9,10,11].

REFERENCES:
10. McWeyrP, Hanshew M, Boatman D, Gaskin CM*. Enterprise implementation of a numeric order (perform) priority system and a separate numeric read priority system for stratified improvements in turnaround times for inpatient and emergent radiology exams at a large academic medical center. Oral presentation at SIIM, May 16, 2014, Long Beach, CA.