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QUARTERLY REPORTING OF COMPUTED TOMOGRAPHY ORDERING HISTORY REDUCES THE USE OF IMAGING IN AN EMERGENCY DEPARTMENT

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☐ **Abstract—Background: Computed tomography (CT) is a useful and necessary part of many emergency department (ED) assessments. However, the costs of imaging and the health risks associated with radiation exposure have sparked national efforts to reduce CT ordering in EDs. Study Objective: We analyzed CT ordering habits prior to and following implementation of a feedback tool at a community hospital. Methods: In this intervention study, we identified the CT-ordering habits of physicians and mid-level care providers (physician assistants and nurse practitioners) at baseline and after implementation of a system that sent quarterly feedback reports comparing their ordering habits with those of their peers. Variability in ordering and subgroup analyses by body region were included in these reports. Results: We examined the records of 104,454 patients seen between October 1, 2013 and December 31, 2014. There were 5552 or 21.0% of patients seen during the baseline period that underwent CT imaging. We observed an absolute reduction in imaging of 2.3% (95% confidence interval 1.7–2.8%) after implementation, avoiding approximately $400,000 in costs, 22 days of scanning time, and radiation exposure equivalent to 33,000 chest films annually. These changes occurred across physicians and mid-level providers, regardless of the number years of practice or board certification. Conclusions: Implementation of a feedback mechanism reduced CT use by emergency medicine practitioners, with concomitant reductions in cost and radiation exposure. The change was similar across levels of medical care. Future studies will examine the effect of the feedback reporting system at other institutions in our hospital network.** © 2016 Elsevier Inc. All rights reserved.

☐ **Keywords—department operations; radiation; advanced imaging**

INTRODUCTION

Although computed tomography (CT) is a necessary diagnostic tool for many conditions, risks of radiation exposure and cost are major concerns that have sparked national and institutional efforts to reduce CT utilization in emergency departments (EDs) (1–4). EDs have seen an increase in CT utilization in recent years, being used in the assessment of 11–16% of adult ED patients (5–8). A similar use rate has been reported for combined imaging modalities (magnetic resonance imaging [MRI] or CT) (9). And although CTs are used more frequently in the United States than in Canada, it is expected to continue to rise in both countries (8). CT overuse has been explored for many conditions, including appendicitis, pulmonary embolism, chest pain, dyspnea, gallstones, and headache (1,10–13).

Many different strategies have been tried: preauthorization by a radiologist, computerized decision support

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(CDS), regional health exchanges, and patient and physician education (2,14–17). Although physicians strongly support CDS and improved patient education about radiation exposure during CT, some have found that CT and MRI use actually increased following implementation of an electronic decision support and risk education system (14). Health data exchanges have been shown to reduce the number of duplicate scans in trauma patients, but did not reduce overall costs (18–20). Although health information exchange can help reduce CT utilization in integrated health care systems, reduction at an individual institutional level is necessary.

Our study was conducted at a community medical center with which several of the authors are affiliated. We retrospectively reviewed CT utilization in our ED between October 1, 2013 and December 31, 2014 (the longest time period for which data were available). On January 1 of 2013, we implemented a simple provider feedback intervention that notifies physicians of their CT total use and compares their ordering pattern with those of their colleagues at the same hospital. We hypothesize that this feedback intervention will decrease CT use, hospital costs, and patients' radiation exposure.

METHODS

To measure the number of CT orders placed by emergency physicians (MD/DO), physician assistants, and nurse practitioners, we used Clarity, the retrospective Oracle (Redwood Shores, CA) SQL reporting tool associated with Epic's electronic medical records platform (Epic Systems Corporation, Verona, WI), to identify and count the number of patients seen by each practitioner during the reporting period. (Our use of "seen by" means that a full emergency medicine evaluation note was completed.) We then counted the number of CT scans in three anatomic areas of interest (head, chest, and abdomen/pelvis) ordered by each practitioner over the study period. If a CT scan spanned more than one anatomic area of interest (e.g., the chest and abdomen/pelvis), we counted that scan in each anatomic bin. The resulting percentage of each type of study ordered was the count of scans in that anatomic region divided by the number of patients seen for each time period.

After the baseline data collection period, the information described above was compiled (using a combination of Crystal Reports [SAP America, Inc., Newtown Square, PA] and Microsoft Excel [Microsoft Corporation, Redmond, WA]) and presented to the care providers on a quarterly basis. An example of the report given to each provider is shown in Figure 1. The recipients were shown their own performance relative to their peers in blinded fashion; each could see his or her ordering percentage relative to the three anatomic regions for patients they

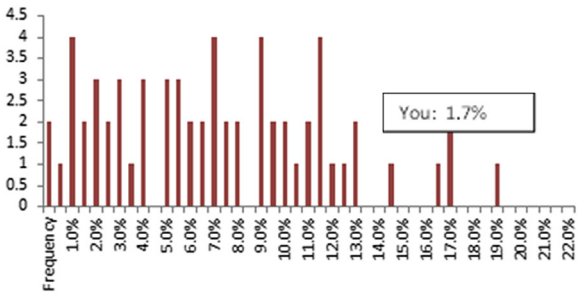

Figure 1. Example of a quarterly report given to an emergency physician in this community ED. The x-axis shows the proportion of patients evaluated by this physician who ordered a head computed tomography (CT) scan. The y-axis shows the number of providers in this ED with the same proportion. This physician ordered head CTs on 1.7% of the patients they evaluated over the last quarter. There is one other physician with the same CT ordering habits, and this is well below the mean for the physicians in this practice. Similar reports were generated for all three anatomic regions (head, chest, and abdomen/pelvis).

treated, for a total of five data points per provider (baseline period, and Q1–Q4). These data were assembled for 4 months prior to the intervention (120-day baseline period, Q0) and distributed to all providers every quarter after the intervention (Q1, Q2, Q3, and Q4). No other QA/QI interventions were implemented at this ED during the study period.

Radiation Exposure and Cost Calculations

Because the radiation received for each examination depends on local practice patterns and the individual patient's proportions (a taller patient would have a longer thorax and therefore receive more radiation during their chest CT compared with a shorter person), it is not possible to measure radiation exposure for the entire study period. We did measure radiation exposure for a small sampling of examinations and used those as estimates for the American College of Radiology's Dose Index Registry to estimate the amount of radiation exposure during the study period. By inputting a CT scanner model and a sample measurement, one can estimate the radiation dose of your scanner based on data received from similar scanners across the United States. Assuming each scanner was used equally across all time periods, we were able to estimate the range of radiation delivered by the four CT scanners at the study site (Siemens SOMATOM Definition AS+ [Siemens Healthcare, GmbH, Erlangen, Germany], Toshiba Aquilion [Toshiba American Medical Systems, Tustin, CA], GE LightSpeed VCT, and GE LightSpeed Ultra [CT02; GE Healthcare, Waukesha, WI]) for each of the different studies included in this analysis (head, chest, and abdomen/pelvis). This result was multiplied by the number of studies ordered