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Selected Topics: Emergency Radiology

IMPACT OF AN EMERGENCY MEDICINE DECISION SUPPORT AND RISK EDUCATION SYSTEM ON COMPUTED TOMOGRAPHY AND MAGNETIC RESONANCE IMAGING USE

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☐ **Abstract—Background: Increasing computed tomography (CT) and magnetic resonance imaging (MRI) use in the emergency department (ED) over the last decade is well documented. Objective: Our aim was to assess the impact of an electronic decision support and risk education system (DS-RES) on CT/MRI use. Methods: We conducted an age-, sex-, and risk-adjusted analysis of CT/MRI use and ED and inpatient rebound rates before and after implementation in 2009 at a Kaiser Permanente Northwest medical center. Results: In the pre period, a total of 12,531 encounters occurred for unique patients within each of 10 chief complaint categories. In the post period, 16,864 total encounters occurred for unique patients within each chief complaint category, 11.4% of patients were at low risk and 24.8% and 63.8% were at medium and high risk, respectively. Adjusted CT/MRI use increased 1.1% (95% confidence interval [CI] 0%–2.3%) between pre and post periods. Among low-risk and medium-risk patients, CT/MRI use decreased by 5.0% (95% CI 2.5%–7.5%) and 10.4% (95% CI 7.9%–12.8%). Among patients at high risk, CT/MRI use increased by 3.9% (95% CI 2.5%–5.3%). The proportion of patients with a 3- or 7-day rebound to the ED or an inpatient facility decreased between pre and post periods by 1.4% (95% CI 0.7%–2.2%) and 0.7% (95% CI 0.2%–1.5%). Conclusions: DS-RES implementation did not decrease overall CT/MRI rates, but it was associated with a shift in use toward high-risk patients and less patient rebound to the ED and hospital. Further research is required to identify mechanisms underlying imaging utilization shifts.** © 2015 Elsevier Inc.

☐ **Keywords—computed tomography; magnetic resonance imaging; quality improvement; utilization; clinical decision support systems**

INTRODUCTION

Increasing rates of imaging during emergency department (ED) visits in the last decade are well documented (1–9). Approximately 16% of ED visits nationwide include computed tomography (CT) or magnetic resonance imaging (MRI) (10). Other estimates suggest a similar percentage for CT scans alone in adult ED visits (11). Increased use of imaging prolongs length of stay in the ED, confers little or no additional clinical benefit, and raises concerns about radiation exposure (12–18). The ED is the only setting in which the use of CT scans among the Medicare population failed to decrease between 2000 and 2010 (19).

Reported strategies to decrease overuse of imaging in the ED include preauthorization and real-time reminders on radiology requisitions, which variably impact utilization (20–22). Health-information exchange reduced neuroimaging in repeat ED visits by patients with headache (23). Clinical guidelines can potentially decrease the use of CT imaging by as much as 35%, although this suggestion has not been validated (12).

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Our objective in this quality-improvement project was to assess the impact of a multimodal emergency medicine decision support and risk education system (DS-RES) on the use of CT and MRI imaging.

METHODS

Emergency Medicine DS-RES

DS-RES focuses on the diagnostic process in the ED with the goal of eliminating diagnostic delays and errors. It is based on a foundation of sound risk-reduction principles and includes point-of-care decision support tools in an integrated electronic health record (EHR), online risk-reduction training, and regular feedback to physicians and nurses about their documentation performance using the EHR decision support tools (Figure 1).

DS-RES templates for certain conditions include multiple alerts, key information (eg, identification of conditions as high risk, risk factors), documentation and flowsheet templates, order sets and order entry, trackboards to follow patient status and ordered/completed testing, and discharge documentation.

Design, Setting, and Population

We conducted an age-, sex-, and risk-adjusted analysis of CT/MRI use and rebound rates before and after implementation of DS-RES. The medical center began using DS-RES in July 2009. Among patients who were not subsequently transferred to the hospital, we analyzed ED encounters for 10 chief complaints: abdominal pain, chest pain, fever in children, headache, head injury, laceration, lower and upper extremity injury, neck injury, shortness of breath, and vaginal bleeding. Provider use of DS-RES was voluntary; excluding fever in children, the proportion of ED encounters in which physicians used the system for the listed complaints ranged from 64.3% to 95.5%. Overall, physicians used DS-RES in 81.6% of encounters for these complaints.

We designated the pre period as July 2008 to June 2009 and the post period as October 2009 through September 2010.

Statistical Analysis

Data were available at three levels: encounter, chief complaint, and patient. Encounters during the pre and post periods included multiple visits from the same patients for one or more chief complaints. We examined imaging utilization at the level of encounters because each encounter represented an imaging opportunity. After excluding patients with a second or subsequent encounter for the same chief complaint, we adjusted encounters that occurred before and after DS-RES implementation for patient-level age, sex, and risk status. The latter was measured by DxCG score (Verisk Health,Inc.,Waltham, MA) and categorized into one of three risk groups: low (DxCG < 1), middle (DxCG ≥ 1 and < 5), and high (DxCG ≥ 5). We segmented the patient population with post-implementation encounters into these risk groups and divided the pre-implementation encounters into a similar risk distribution to adjust for these factors. We measured imaging utilization by physician orders and assessed the statistical significance of differences between the pre and post periods with the *Z*-test. We repeated this analysis after excluding encounters in which the chief complaints seemed least likely to require an order for imaging: fever in a child, laceration, and vaginal bleeding.

We also assessed the proportion of 3- and 7-day rebound visits in the pre and post periods, similarly adjusting for age, sex, and risk status. Rebound was defined as a return visit to the ED or admission to an inpatient facility.

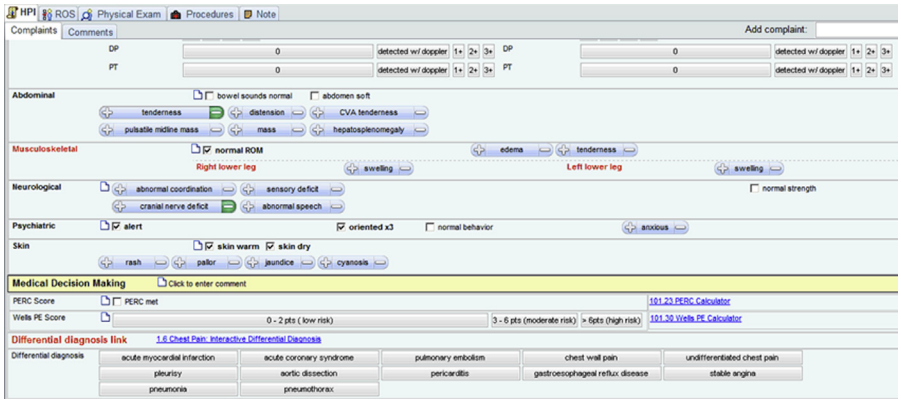

Figure 1. Decision support and risk education system (DS-RES) screenshot. DS-RES provides documentation templates and point-of-care decision supports, as in this screenshot.