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The impact of electronic health record implementation on emergency physician efficiency and patient throughput

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ABSTRACT

Background: In emergency departments (EDs), the implementation of electronic health records (EHRs) has the potential to impact the rapid assessment and management of life threatening conditions. In order to quantify this impact, we studied the implementation of EHRs in the EDs of a two hospital system. *Methods*: using a prospective pre–post study design, patient processing metrics were collected for each ED physician at two hospitals for 7 months prior and 10 months post-EHR implementation. Metrics included median patient workup time, median length of stay, and the composite outcome indicator "processing time." *Results*: median processing time increased immediately post-implementation and then returned to, and surpassed, the baseline level over 10 months. Overall, we see significant decreases in processing time as the number of patients treated increases. *Conclusions*: implementation of new EHRs into the ED setting can be expected to cause an initial decrease in efficiency. With adaptation, efficiency should return to baseline levels and may eventually surpass them. *Implications*: while EDs can expect long term gains from the implementation of EHRs, they should be prepared for initial decreases in efficiency and take preparatory measures to avert adverse effects on the quality of patient care.

1. Introduction

Clinical care in the United States is being impacted by health information technology (HIT), particularly the implementation of electronic health records (EHRs). In 2005, a team of researchers at the RAND Corporation modeled the benefits to be realized by the health system after widespread adoption of health information technology (HIT).[1] Included in those projections were $81 billion in annual savings and thousands of deaths averted each year. As part of the American Recovery and Reinvestment Act of 2009, the U.S. Federal Government mandated that all public and private healthcare providers will have implemented “meaningful use” of EHRs by 2014.[2]

This massive administrative restructuring of the healthcare sector has been expected to affect quality of care, provider and patient satisfaction, productivity, and cost of care. The newly accelerated uptake of HIT spurred by the Recovery and Reinvestment Act has led many to speculate we have reached a tipping point and the gains in reduced mortality, morbidity and expenditures are only a few years off.[3] While there have been positive reports of some progress[4,5], many potential gains have remained elusive despite greatly increased uptake of HIT.[6–9] Recent work has highlighted an important discrepancy between the current state of progress and the underlying assumptions of the RAND model: the existence of interconnected and interoperable systems, widely adopted and used effectively.[1,10]

Nowhere is it more important to understand the effects of these widespread changes than in the Emergency Department (ED), where patient outcomes hinge on rapid assessment and care. The ED is a high patient volume area within health systems that operates under constant time pressure. Unlike general ambulatory care, where HIT implementation has been studied[11–13], in the ED patients must be quickly and efficiently triaged, stabilized, treated and processed for admission or discharge. HIT has the potential to either disrupt or improve the processes of clinical care, with serious implications for patient outcomes and quality of care.

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To date, the impact of HIT changes in the ED setting has been poorly studied. Our aim was to address this gap by studying the effects of introducing HIT into the operations of two busy EDs. Informed by previous work looking at HIT and efficiency in the inpatient setting,[14] our driving hypothesis was that the implementation of an EHR in the ED would adversely impact physician efficiency, as measured by physician-patient throughput time.

2. Methods

2.1. Study setting and population

We conducted a quasi-experimental, pre and post-intervention study. Data were collected for seven months prior to the intervention and 10 months post-intervention. Our study sites were the EDs in two suburban hospitals. Both hospitals are community hospitals and not referral or trauma centers. *SITE A* has an overall volume of 60,000 annual visits. It has both adult and pediatric EDs, with 80% of the visits for adults and 20% for children. Twenty-seven percent of adult patients are admitted, while 4.5% of pediatric patients are admitted. *SITE B* has 32,000 annual visits and an admission rate of 18%. The EDs at both sites are primarily staffed with attending emergency physicians, though mid-level providers see lower acuity patients at both sites. ED physicians who were working throughout the 17-month study period were the population. The research was reviewed and approved as non-human subjects research by the University of Maryland, Baltimore's Institutional Review Board.

2.2. Intervention

The intervention of interest was the introduction of the electronic physician documentation product *Forerun* into the ED setting. Forerun provided a digital platform for the combination of point and click documentation at workstations. Forerun was introduced in August of 2012. At both sites, Forerun was introduced with one extra 8 h shift of additional health provider coverage for one week to offset any serious detrimental effects on ED care. September health provider coverage returned to the baseline. The introduction of Forerun was combined with the implementation of Dragon Naturally Speaking pen technology. All physicians were provided 1–2 h of a one-on-one training session, including both the documentation as well as a new voice recognition software. Prior to this intervention, both sites used paper template records for all patient processing, labs and orders. There was no addition of computerized physician order entry and no change in the mechanism for ordering laboratory and radiological studies.

2.3. Study variables

For each ED physician in the two EDs, we calculated baseline efficiency by analyzing median patient workup times and median lengths of stay (LOS), separately computed for admitted and discharged patients, over the seven months prior to implementation. The median patient workup time was calculated from the time the patient was first seen by a physician to the placement of disposition orders, be they admission or discharge orders. The median length of stay was calculated from registration in the ED until departure from the ED, i.e., the patient's physical presence in the ED. These measures were calculated monthly after implementation for each physician and compared to the pre-implementation baseline. Timestamps were captured within the information technology system based upon provider input as part of required steps during patient care work flow. The core Meditech data system, from which the timestamps were obtained, was not changed during the study period. Thus, the timestamps were the same both pre- and post-intervention.

The primary outcome of interest was median patient processing time for each physician. “Processing Time” was comprised of four values: Workup Time (time from doctor arrival to admit/discharge decision) for admitted patients, Workup Time for discharged patients, Overall LOS (arrival to admit/discharge) for admitted patients, and Overall LOS for discharged patients. To compute the percentage increase in processing time, we took the percentage change from the pre-implementation baseline in each of the four categories and averaged them. This was mapped over time to analyze adaptation. Additionally, the outcome was stratified by physician age to assess the influence of that factor on adaptability.

2.4. Data analysis

Data were analyzed using multiple linear regression analysis. The percent increase in processing time for each physician in each month was regressed on the total number of patients the physician had treated since implementation of the EHR, the physician's age, and gender. Control variables for the physician's workload in each month, the month of the year, and the hospital were also added. The final dataset had 374 observations, corresponding to a specific doctor at a single hospital in a given month.

3. Results

In total, 34 physicians were involved at the two hospitals during the full study period. Median processing times, combined from both sites, increase immediately after implementation and then slowly return to the baseline level, eventually dropping below the initial starting point of August, 2012 (Figs. 1 and 2). Of note, due to the smaller sample, there was larger data variance at Site B than at Site A. In the two months after implementation, processing times increase by an average of 8% ($p < 0.001$). However, after this initial peak, processing time trended downward for both hospitals during the subsequent 9 months. By the 6th month after implementation, the median processing time had returned to pre-implementation baseline levels, and by the 10th month after implementation, the processing time had significantly decreased below pre-implementation levels, by an average of 5% ($p = 0.09$). Overall, within the EDs, as the total number of patients treated

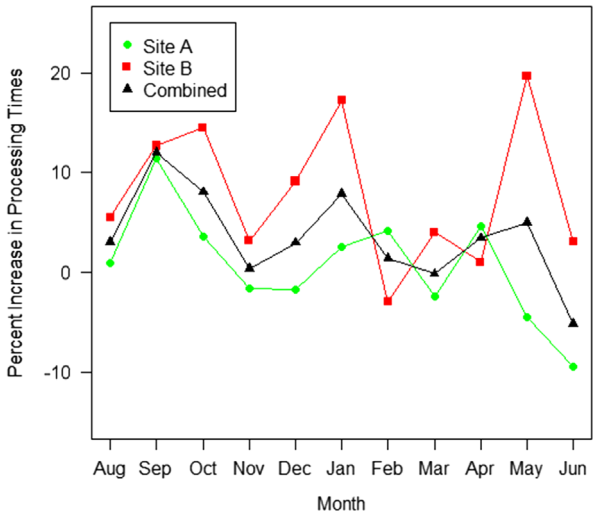

Fig. 1. Average increase in processing times at Site A and Site B for the 10 months post-implementation.