Transient and Sustained Changes in Operational Performance, Patient Evaluation, and Medication Administration During Electronic Health Record Implementation in the Emergency Department

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Study objective: Little is known about the transient and sustained operational effects of electronic health records on emergency department (ED) performance. We quantify how the implementation of a comprehensive electronic health record was associated with metrics of operational performance, test ordering, and medication administration at a single-center ED.

Methods: We performed a longitudinal analysis of electronic data from a single, suburban, academic ED during 28 weeks between May 2011 and November 2011. We assessed length of stay, use of diagnostic testing, medication administration, radiologic imaging, and patient satisfaction during a 4-week baseline measurement period and then tracked changes in these variables during the 24 weeks after implementation of the electronic health record.

Results: Median length of stay increased and patient satisfaction was reduced transiently, returning to baseline after 4 to 8 weeks. Rates of laboratory testing, medication administration, overall radiologic imaging, radiographs, computed tomography scans, and ECG ordering all showed sustained increases throughout the 24 weeks after electronic health record implementation.

Conclusion: Electronic health record implementation in this single-center study was associated with both transient and sustained changes in metrics of ED performance, as well as laboratory and medication ordering. Understanding ways in which an ED can be affected by electronic health record implementation is critical to providing insight about ways to mitigate transient disruption and to maximize potential benefits of the technology. [Ann Emerg Med. 2014;63:320-328.]

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INTRODUCTION

Background

Electronic health records are purported to reduce health care costs, lessen unnecessary testing, and improve operational performance of the health system, as well as individual health care settings.[1-9] However, the projected cost savings and efficiency gains have recently been called into question.[10] Further challenges include the actual process of implementation, which is tremendously complex for any major information technology project. This is certainly the case in emergency departments (EDs), and this disruptive period, albeit temporary, can threaten to offset anticipated benefits.[11,12] Failure during the implementation phase is not uncommon, and the resulting removal of a major information technology system can be very costly, cause significant long-term organizational disruption, and jeopardize future information technology investments.[13,14]

Even in well-managed implementations, numerous factors, such as the organizational learning curve, major changes in workflow, and unintended consequences of a new information technology system, frequently result in a reduction in performance during implementation.[15,16] One study found that physician documentation time increased 4- to 5-fold after a paper-to-electronic electronic health record transition.[16] It can take many months to recover from the performance degradation and realize the operational benefits the electronic health record was intended to produce.[15] In overburdened EDs, it is increasingly recognized that the transient reduction in performance has a negative effect on health care delivery. Implementation of an electronic health record reduces staff productivity and morale and affects patient care.[17] Length of stay in the ED has been shown to increase and evidence suggests that patient care changes with an increase in both imaging and laboratory use.[18-20] Indeed, the intensity of ED visits as a result of increased laboratory

Editor's Capsule Summary

What is already known on this topic

Little is known about the transient and sustained effects of implementing electronic health records on emergency department performance.

What questions this study addressed

This study compared length of stay, use of diagnostic and radiographic testing, medication administration, and patient satisfaction before implementation of an electronic health record and at monthly intervals for 6 months after implementation at a single site.

What this study adds to our knowledge

Length of stay and patient satisfaction transiently increased after implementation but returned to baseline, while medication administration and use of laboratory and imaging tests showed sustained, presumably permanent increases.

How this is relevant to clinical practice

This information should help prevent disruptions in care during implementation; it also suggests that health information technology is associated with increased use and so may not be effective in controlling costs.

and radiologic testing, as well as medication administration, may contribute to ED crowding just as much as patients in the ED awaiting an inpatient bed.[21] Similarly, the implementation of computerized physician order entry as a component of electronic health records can result in an increase in errors, with resulting detrimental patient outcomes.[22-26] There is a need to better understand how adult EDs perform during electronic health record implementation and how patients' care changes so that interventions can be identified to offset potential adverse effects.

Importance

As health care moves toward pay for performance, operational efficiency and patient care practices will increasingly be scrutinized. Any degradation in performance or inappropriate patient care during electronic health record implementation may cause EDs to suffer both operationally and financially.[27,28] Quantifying the duration and magnitude of the transient effects of electronic health record implementation on operational performance and on patient care is essential for preparing to mitigate any negative implications of the endeavor.

Goals of This Investigation

We sought to characterize how ED operational performance, measured with metrics describing patient throughput, diagnostic testing, medication administration and patient satisfaction, changed during electronic health record implementation. We also sought to determine whether changes were temporary or sustained. We hypothesized that length of stay would be temporarily prolonged after electronic health record implementation, with a commensurate decrease in patient satisfaction. We also hypothesized that there would be a temporary increase in the volume of diagnostic testing, imaging, and medication administration.

MATERIALS AND METHODS

Study Design, Setting, and Selection of Participants

We conducted a longitudinal analysis of data from a 24-bed, suburban, academic ED in Cincinnati, OH, after approval from the institutional review board. The annual volume was approximately 34,000 patients, and the ED was staffed with board-certified and -prepared emergency physicians, emergency medicine and internal medicine residents, and physician assistants and nurse practitioners. All patient presentations to the ED between May 15, 2011, and November 26, 2011, were included.

To prepare for the implementation, physicians and midlevel providers underwent 10 hours of electronic health record training and 2 hours of training to use an optional voice-recognition system. Residents who had experience working with an electronic health record from the same vendor at another clinical facility were given an abbreviated training session of 4 hours. Nurses and technicians underwent 14 hours of training and unit clerks received 5 hours of training. After implementation, new nurses, technicians, and unit clerks received 8, 2, and 2 hours of training, respectively.

Before implementation, multiple disparate computer systems were used for information retrieval, documentation, and ordering. A paper chart for notes and physician orders, along with an electronic track board (Horizon Emergency Care ED Track Board; McKesson Corporation, San Francisco, CA) and telephone dictation, was used. On June 12, 2011, a single, comprehensive electronic health record (EPIC ASAP; Epic Systems Corporation, Verona, WI) was implemented as part of a hospital-wide system. Voice-recognition software was deployed simultaneously for physician documentation. Decision support for laboratory testing and radiologic imaging were not included as features of the electronic health record implementation software, nor were they available before implementation in the paper environment. Paper-based order sets were available for disease-specific conditions before implementation, and these were replicated in the electronic environment once the electronic health record implementation occurred.

Data Collection and Processing

Data were obtained from the administrative electronic tracking systems in operation for the 4 weeks before electronic health record implementation and served as the baseline. After electronic health record implementation, 24 weeks of data were collected from the electronic health record. The total observation period of 28 weeks was selected because we wanted to be able to