Emergency Physician Task Switching Increases With the Introduction of a Commercial Electronic Health Record

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Study objective: We evaluate how the transition from a homegrown electronic health record to a commercial one affects emergency physician work activities from initial introduction to long-term use.

Methods: We completed a quasi-experimental study across 3 periods during the transition from a homegrown system to a commercially available electronic health record with computerized provider order entry. Observation periods consisted of pre-implementation, 1 month before the implementation of the commercial electronic health record; "go-live" 1 week after implementation; and post-implementation, 3 to 4 months after use began. Fourteen physicians were observed in each period (N=42) with a minute-by-minute observation template to record emergency physician time allocation across 5 task-based categories (computer, verbal communication, patient room, paper [chart/laboratory results], and other). The average number of tasks physicians engaged in per minute was also analyzed as an indicator of task switching.

Results: From pre- to post-implementation, there were no significant differences in the amount of time spent on the various task categories. There were changes in time allocation from pre-implementation to go-live and go-live to pre-implementation, characterized by a significant increase in time spent on computer tasks during go-live relative to the other periods. Critically, the number of tasks physicians engaged in per minute increased from 1.7 during pre-implementation to 1.9 during post-implementation (difference 0.19 tasks per minute; 95% confidence interval 0.039 to 0.35).

Conclusion: The increase in the number of tasks physicians engaged in per minute post-implementation indicates that physicians switched tasks more frequently. Frequent task switching behavior raises patient safety concerns. [Ann Emerg Med. 2015;■:1-6.]

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INTRODUCTION

Background

The Health Information Technology for Economic and Clinical Health Act has encouraged eligible hospitals and providers to adopt certified commercial electronic health records, driven by the potential for incentive payments. For some providers, the transition was from paper medical records to a commercial electronic health record, whereas for others the transition was from a customized homegrown electronic health record to a commercial one. If designed and implemented appropriately, commercial electronic health records have the potential to improve the delivery of care in the emergency department (ED).[1,2] However, there is often an incongruity between provider work flow and commercial electronic health record design, resulting in potentially serious shortcomings in supporting physician work processes.[2,3] Furthermore, there may be unique challenges associated with transitioning to a commercial electronic health record, depending on whether a provider is transitioning from paper or a homegrown electronic health record.

Physicians have reported increased workload because of the mismatch between commercial electronic health record functionality and clinical work flow in several qualitative studies; however, traditional time and motion studies do not always support this assertion.[2-4] Researchers have recognized the need for studies that quantify changes in physician work activities, not just time allocation, from introduction of the commercial electronic health record to long-term use.[4]

Importance

The ED is a complex and dynamic environment in which emergency physicians with limited resources must manage multiple patients. Emergency physicians' task

Editor's Capsule Summary

What is already known on this topic

The introduction of electronic records and computerized order entry into emergency departments often produces complaints of increased workload.

What question this study addressed

This single-organization study used direct observations of physician activities before, during, and 3 to 4 months after the transition from a homegrown electronic medical record to a widely used commercial electronic medical record with provider order entry.

What this study adds to our knowledge

During the go-live period, time engaged in computer tasks increased, whereas that for other tasks decreased, but this returned to baseline in the postimplementation period. However, the number of tasks engaged in per minute (a measure of task switching) increased significantly from pre- to postimplementation (the equivalent of 91 additional tasks per 8-hour shift).

How this is relevant to clinical practice

Frequent task switching poses a safety risk, suggesting a need for electronic medical record designs that can be better and more easily customized to fit clinical work flow.

prioritization shifts quickly to address competing demands, and the work environment is characterized by frequent interruptions.[5,6] Given the complexities of the environment, electronic health records must be designed to support clinician work flow to ensure the safe delivery of care.[7] Electronic health records that increase task demands may overextend the attentional capacity of care providers and result in adverse patient safety events.[7-9]

Studying the effect of electronic health record use on physician activity is imperative to ensuring safe delivery of care and for improving electronic health record design. To fully understand this effect, assessing physician work activity during both the initial implementation phase and the long-term use phase of electronic health records can illustrate the changes that occur as physicians become accustomed to new systems. Observing these changes can provide insight on how physicians adjust their work activities to accommodate new technology.

Goals of This Investigation

This study focused on changes in physician work activities across 3 periods: before the transition from a homegrown system to a commercially available one, immediately after implementation of the new system, and after long-term use. We quantitatively examined time allocation on broad task categories and the number of tasks physicians engaged in minute-by-minute, which served as an indicator of task switching.

MATERIALS AND METHODS

Study Design

This study used a quasi-experimental design with 3 observation periods: pre-implementation, 1 month before implementation of the new system; go-live, 1 week after implementation; and post-implementation, 3 to 4 months after widespread use of the system, when physicians had grown accustomed to the electronic health record.[10]

Setting

This study was completed in an urban, tertiary care, academic ED with 90,000 annual patient visits. Observations were conducted while the ED transitioned from a homegrown electronic health record to a commercially available one. The homegrown system allowed patient tracking and viewing of results (laboratory results, radiology results, ECGs, dictated reports, etc), with optional physician documentation. It would rank as an approximately stage 2 Health Information Management Systems Society electronic health record adoption model with picture archiving and communication system available outside radiology.[11] The implemented electronic health record added multiple new features: an interface for patient tracking and viewing results, all nursing documentation (including closed-loop medication administration), and, most notably, computerized physician order entry, approximately stage 5 and a significant change to work flow. Physician documentation remained unchanged, primarily on paper and scanned into the chart.

Selection of Participants

A convenience sample of emergency medicine resident and attending physicians was observed in the ED. Fourteen physicians were shadowed in each period (N=42 across the study) for 2 hours each (28 hours of observation per period, 84 total hours across the study). Within each observation period, the participants were unique; however, across the observation periods some participants were the same. A total of 24 unique physicians were observed across the 3 periods. Observation sessions were balanced across time of day to capture variability in patient volumes. The study

was approved by the health care system's institutional review board.

Methods of Measurement

Observational data were recorded with a paper-based, minute-by-minute template to track physician work activities. Two independent research assistants with extensive experience conducting observations in medical settings completed data collection. The observers were trained under the advisement of a practicing emergency physician.

Data recording consisted of noting the duration of 5 task categories: use of the computer, verbal communication, time in patient room, time on paper (chart/laboratory results), and other. The categories were adapted from previous studies of ED work flow but not specific to electronic health record implementation.[12] Task categories were refined during pilot testing in which 2 observers shadowed the advising emergency physician.

During each observation minute, observers documented the task(s) the physician was working on. Physicians could perform more than 1 task in a given observation minute. Observers used stopwatches to ensure accurate time recording. Observers recorded time spent in patient rooms but did not physically enter them. Before the start of data collection, the 2 observers performed 1 joint 2-hour session. The raw interrater agreement for each task category ranged from 0.81 to 1.0.

Outcome Measures

Two outcome measures were used to quantify physician work activities. To examine physicians' task allocation time, the total time spent performing tasks in each category was analyzed. Additionally, the number of tasks physicians engaged in per minute was assessed as a measure of task switching.

Primary Data Analysis

Analysis of observational data was conducted with R software (R Foundation for Statistical Computing, Vienna, Austria) and SPSS (version 22; IBM Corporation, Armonk, NY).

Because physicians engaged in multiple tasks within the same minute, the total time spent on each task during that minute was calculated by dividing the 1-minute period by the total number of tasks performed and allocating an even amount of time to each task. For example, if physicians performed tasks in 2 different categories within 1 minute, 30 seconds was allocated to the total time for each task category.

To assess the degree of task switching, the number of tasks each physician engaged in per minute (1, 2, 3, or 4) was computed. Although there were 5 task categories (computer, verbal communication, time in patient room, time on paper [chart/laboratory results], and other), no instances of physicians engaging in 5 tasks within 1 minute were encountered. Subsequently, the average number of tasks engaged in per minute was calculated for each participant.

RESULTS

Characteristics of Study Subjects

Participants included second- and third-year emergency medicine resident physicians and attending physicians. In the pre- and post-implementation observation periods, 2 residents and 12 attending physicians were observed. During the go-live observation period, 5 residents and 9 attending physicians were observed.

Main Results

The first analysis examined physicians' time allocation across task categories during the 3 observational periods. The Table provides a summary of the effect size and confidence interval (CI) comparisons between the 3 phases. Notably, the time spent on the various tasks stayed fairly consistent from the use of the homegrown system (pre-implementation) through long-term use of the commercial electronic health record containing computerized physician order entry (post-implementation) (Figure). With Bonferroni CIs, no significant differences were detected in the time allocation for any of the tasks between the pre- and post-implementation periods.

There was, however, a demonstrable shift in the types of tasks performed while transitioning to the commercial

Table. Summary statistics for time-task allocation paired comparisons across observation periods.

Paired Observation/Period Comparison, Mean Difference (95% CI)		
Pre-Implementation/ Go-Live	**Go-Live/ Post-Implementation**	**Pre-Implementation/ Post-Implementation**
Computer		
−13 (−23 to −4)*	13 (4.4 to 22)*	0.44 (−8.5 to 9.4)
Patient room		
9.5 (−1.2 to 20)	−12 (−23 to −1.6)*	−2.8 (−13 to 7.9)
Paper (charts/laboratory results)		
−5.2 (−13 to 2.9)	5.7 (−2.4 to 14)	0.51 (−7.5 to 8.6)
Verbal communication		
8.0 (1.0 to 15)*	−5.8 (−13 to 1.2)	2.2 (−4.8 to 9.3)

The category "other" was not included in this table as it comprised less than 5% of the time allocation across all three periods.
*Comparisons with significant differences.

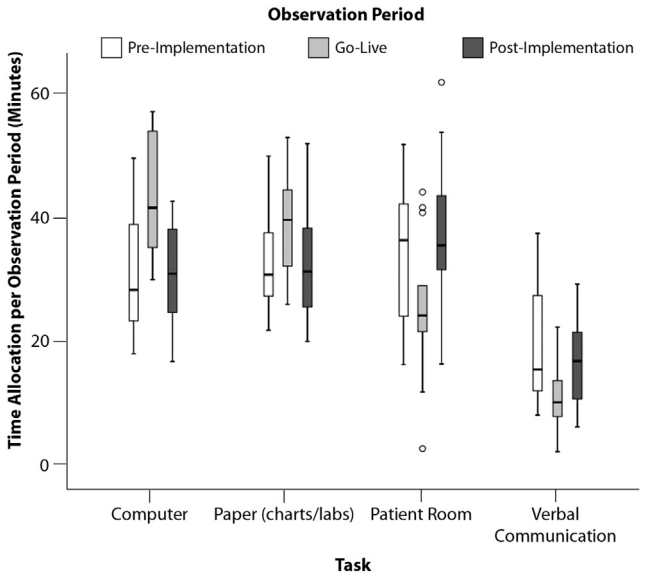

Figure. Box and whisker plots illustrating the difference in distributions of time allocation for various task categories across the three observation periods.

electronic health record with computerized physician order entry (go-live). The average time spent on computer-based tasks increased from 31 minutes pre-implementation to 44 minutes in the go-live period (difference 13 minutes; 95% CI 4.0 to 22 minutes), whereas time spent engaging in verbal communication decreased significantly, from 19 minutes pre-implementation to 11 minutes during go-live (difference –8.0 minutes; 95% CI –15 to –1.0 minute). Subsequently, the time spent on computer-based tasks decreased from 44 minutes in the go-live period to 31 minutes in the post-implementation period (difference –13 minutes; 95% CI –22 to –4.4 minutes). Additionally, the amount of time spent in patient rooms increased from 25 minutes in the go-live period to 38 minutes in the post-implementation period (difference 12 minutes; CI 1.6 to 23 minutes).

Generally, no sustained differences in the amount of time emergency physicians allocated to defined task categories were discovered with the implementation of a commercialized electronic health record with computerized physician order entry, although there were significant differences during the transition period. This reflects the findings of previous studies demonstrating that the implementation of a new electronic health record may cause differences initially that eventually return to baseline.[10]

The second analysis examined the number of tasks physicians engaged in in any given minute to determine whether they were switching tasks more often with the commercial electronic health record. Critically, physicians engaged in more tasks per minute during long-term use of the commercial electronic health record compared with the homegrown electronic health record. The average number of tasks physicians engaged in per minute increased significantly, from 1.7 tasks per minute during the pre-implementation period to 1.9 during post-implementation (difference 0.19 tasks per minute; 95% CI 0.039 to 0.35). Additionally, physicians engaged in significantly fewer tasks per minute during the go-live period (1.7 tasks per minute) than during post-implementation (difference 0.16 tasks per minute; 95% CI 0.0071 to 0.31).

Overall, although the amount of time physicians allocated to the defined task categories did not change from pre-implementation to post-implementation, physicians engaged in more tasks per minute after long-term use of the commercial electronic health record.

LIMITATIONS

This study had limitations related to the observational template used for data collection, the manner in which participants were selected, the structure of the observation session, and the inability to consistently track additional metrics across study periods.

The paper-based observational template used in this study is limited in that it does not provide millisecond-level data afforded by digital data collection tools. Furthermore, we could not differentiate between serial and parallel processes within the same minute. Generally, the broad task categories were conducive for live observation, but nuanced task differences may have been missed.

Recorded tasks included both clinically relevant and irrelevant ones. It was too difficult to distinguish between relevance, and therefore we could not account for physician downtime.

Additionally, our inability to collect data in patient rooms may have missed important interactions or shifts in work activities.

The convenience sampling technique was also a limitation, and although it was necessary for this study, given other constraints, it did not account for the potential confounding variable of individual differences in physician work activities.

Our method necessitated physician observation in the middle of shifts, which made collecting demographic information, subjective workload assessments, and qualitative feedback too disruptive to physician work. One advantage is that this allowed the observers to see typical work flow instead of the beginning of a shift that may be patient-room heavy or the end of a shift focused on completing paperwork.

This study could have benefited from the inclusion of supplementary metrics such as ED crowding measures, door-to-physician times, and length of stay. Unfortunately,

when the ED transitioned from the homegrown system to the commercial one, the data to perform these analyses were unreliable.

DISCUSSION

This study demonstrated that there were no sustained changes in the amount of time physicians allocated to the defined task categories when transitioning from a homegrown electronic health record to a commercial one with computerized physician order entry. However, physicians engaged in more tasks per minute, an indicator of increased task switching, after long-term use of the commercial system.

Although physicians did not encounter differences in how they allocated their time across task categories in the long term, there were significant shifts during the immediate transition (go-live) period. Changes in time allocated to the various task categories were consistent with what one would expect to observe while integrating new technology into a complex system. Physicians increased computer time and decreased time on other tasks from pre-implementation to go-live. These changes then reversed with long-term use of the electronic health record.

Solely analyzing the allocation of physician time on various tasks might lead to the conclusion that transitioning from a homegrown electronic health record to a commercial one does not significantly affect emergency physician work activities in the long term. However, the analysis examining the number of tasks physicians engaged in minute by minute provides critical insight into how work activities change as a result of a commercial electronic health record.

The increase in task switching observed post-implementation imposes a cognitive burden on the physician and may provide quantifiable support for the perceived increase in stress and workload that many physicians have described in other qualitative studies.[2,3] The increase in task switching was present 3 to 4 months after use of the electronic health record began, well beyond the period of its being novel technology for physicians. In addition to increased stress and frustration, rapid task switching can have serious patient safety implications. It results in work flow fragmentation and is well recognized in the human factors literature as increasing the likelihood of errors.[4,9] Therefore, the connection found between commercial electronic health record use and increased task switching may indicate an increased potential for patient safety hazards.

Design shortcomings of the electronic health record system may be one factor that contributed to the increased task switching. For example, when writing an order for patients to receive their home medications in the hospital, physicians cannot view the home medication list while writing new electronic orders. As a result, they need to either remember the home medications or take notes on paper and then switch back and forth between the computerized physician order entry system and paper. This work flow forces physicians to perform multiple tasks in service of the specific goal they are attempting to accomplish.

Given that many electronic health records are used to complete critical tasks, such as ordering medications and diagnostic tests, any errors during these tasks can have severe consequences. Health information technology–associated issues in the ED and associated patient safety implications have been described in previous studies.[13] Future studies should examine the specific tasks within the electronic health record and specific conditions under which physicians' task switching increases so that those tasks can be identified for optimized design and development.

The results of this study highlight important differences between homegrown electronic health records and commercial ones. Homegrown electronic health records, like the one replaced in the ED that we studied, tend to be customized to the work flow processes of the specific provider environment. This customization occurs over time as clinicians' needs are identified and integrated with the electronic health record. Commercial electronic health records are designed to fit the needs of a large base of users from multiple provider sites and therefore are not customized. The increased task switching observed during our study may be a result of a lack of customization. It will be important to determine whether commercial electronic health records can be easily customized to better meet the work flow needs of clinicians and prevent cognitive costs such as increased task switching.

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