ORIGINAL RESEARCH

Typed Versus Voice Recognition for Data Entry in Electronic Health Records: Emergency Physician Time Use and Interruptions

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Supervising Section Editor: James Killeen, MD
Submission history: Submitted September 17, 2013; Revision received February 26, 2014; Accepted March 3, 2014
Electronically published [date]
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2014.3.19658

Introduction: Use of electronic health record (EHR) systems can place a considerable data entry burden upon the emergency department (ED) physician. Voice recognition data entry has been proposed as one mechanism to mitigate some of this burden; however, no reports are available specifically comparing emergency physician (EP) time use or number of interruptions between typed and voice recognition data entry-based EHRs. We designed this study to compare physician time use and interruptions between an EHR system using typed data entry versus an EHR with voice recognition.

Methods: We collected prospective observational data at 2 academic teaching hospital EDs, one using an EHR with typed data entry and the other with voice recognition capabilities. Independent raters observed EP activities during regular shifts. Tasks each physician performed were noted and logged in 30 second intervals. We compared time allocated to charting, direct patient care, and change in tasks leading to interruptions between sites.

Results: We logged 4,140 minutes of observation for this study. We detected no statistically significant differences in the time spent by EPs charting (29.4% typed; 27.5% voice) or the time allocated to direct patient care (30.7%; 30.8%). Significantly more interruptions per hour were seen with typed data entry versus voice recognition data entry (5.33 vs. 3.47; p=0.0165).

Conclusion: The use of a voice recognition data entry system versus typed data entry did not appear to alter the amount of time physicians spend charting or performing direct patient care in an ED setting. However, we did observe a lower number of workflow interruptions with the voice recognition data entry EHR. Additional research is needed to further evaluate the data entry burden in the ED and examine alternative mechanisms for chart entry as EHR systems continue to evolve. [West J Emerg Med. 2014;15(4):541–547.]

INTRODUCTION

Recent healthcare reform has placed a high emphasis on the electronic health record (EHR).[1] The Centers for Medicare and Medicaid Services has gone as far as rewarding hospitals to implement EHR and computerized physician order entry (CPOE) systems through incentive programs. Accompanying these incentives is a 2015 deadline that threatens to decrease reimbursement for institutions that do not implement these systems. As a result, EHR and CPOE systems are more widely used in today's emergency departments (ED). EHR and CPOE have the advantages of keeping patient information organized and readily accessible in addition to decreasing medical errors resulting in poor patient outcomes.[2-4] An unintended consequence of this shift towards an electronic working environment is the time burdens it places on the ED providers that use it. One of the major concerns of EHR and CPOE is that ED providers are spending more time in front of their computers charting and placing orders and away from their patients than through traditional paper or dictation systems.[5,6] In addition, the ED has been described as "interrupt-driven," whereby workflow is subject to high numbers of interruptions and breaks in tasks.[7-9] This has been shown to lead to increased risk for medical error and poor patient outcomes.[10-13] Placing ED providers away from the bedside and in front of computers for prolonged periods of time puts them at risk for interruptions and increases in the number of tasks they leave incomplete.[5] The pressures from CMS make it unlikely for a paper-based system to survive in today's healthcare reform climate. Finding ways to work efficiently in these electronic environments has become an important issue discussed at the administrative level of most EDs, The use of scribes is one example of how some departments have intervened to make EHR and CPOE work more efficiently.[14-16] The cost and turnover of such services make implementation of this technique unavailable to some. Software engineers have developed a potential solution to these problems in voice recognition dictation software. The voice recognition software has been proposed as a way to reduce time in front of the computer compared to more traditional charting. The goal of voice recognition data entry is to reduce the amount of time the emergency physician (EP) spends interacting with the computer and increase the amount of time the EP spends interacting with patients.

The purpose of this study is to compare time use and the number of interruptions between a group of EPs using EHR with typed data entry and a group of EPs using EHR with voice recognition data entry. The study compares the time an EP spends performing data entry and the time spent performing direct patient care between typed data entry and voice recognition data entry. The study also compares interruptions that occur during the data entry phase of the 2 data entry modalities.

MATERIALS AND METHODS

We performed a prospective observational study at 2 community teaching hospital EDs. Site 1 used Cerner FirstNet EHR (Cerner Corporation, North Kansas City, MO, USA) with typed data entry and Site 2 used Meditech EHR (Meditech, Westwood, MA, USA) with voice recognition-assisted dictation software (Dragon, Nuance, Burlington, MA, USA). The study was reviewed and approved by our local Institutional Review Board.

We used observation research assistants in the study. Only 3 observesr were trained and used to minimize variation in data collected. The assistants included 2 medical students and 1 undergraduate research assistant. None of the research assistants had worked in either department prior to the study and were new to each hospital staff. Their training included a half-hour training session with the primary investigator reviewing their job descriptions and primary observation goals. Each research assistant then performed a training observation shift with the primary investigator with receptive feedback to help standardize their performance on data collection. After the training shift, the research assistants then performed formal observation shifts during which data were collected on individual physicians in a structured fashion over 180-minute time frames. These shifts were performed between the hours of 9am and 9pm at each site during the bulk of each ED's visit volume. Throughout the data collection phase of the project, the research assistants made contact, after each shift, with the primary investigator to address any concerns or issues identified during the shift. Permission was obtained from the EPs being observed; however, all were blinded as to what data were being collected during their observation periods. A convenience sample of data was then collected based upon research assistant availability, and each research assistant performed observations at both ED sites.

Both sites have rotating residents; however, observations were only completed when no residents were present to control for any effect they would have on collected data. During the observation periods,the research assistants noted and logged physician tasks in 30-second intervals. Tasks listed were identified from a predetermined standardized list presented at observer training (Table 1). Tasks were noted if they were completed, truncated, or placed in queue once a change in task was observed. We defined completed tasks as those not needing any immediate follow-up after a change in task. Truncated tasks were defined as tasks that were finished prematurely after a change in task that required no immediate follow up. We defined a task placed in queue as a task that was left incomplete following a change in task that later required follow-up.

We then collected and compiled data collected between the two sites. Tasks were further categorized as direct patient care and indirect patient care to compare patient contact times between the two sites (Table 1). We tabulated time spent with direct patient contact along with percentiles, means, and standard deviations calculated for both sites. Physician interruption data were tabulated by defining an interruption as a change in task with the previous task left incomplete or truncated. We tabulated the number of interruptions, and calculated means along with standard deviations for comparison. We performed all analyses using SAS v9.2 statistical software (SAS Institute Inc., Cary, NC, USA)

RESULTS

We compiled aggregate data for the 2 study sites.

Table 1. Standardized physician task list and categorization.

Direct patient care	Indirect patient care
Evaluating new patient	Charting (computer)
Evaluating old patient	Charting (paper)
Answering patient question	Dictating
Answering relative question	Asking nurse question
Performing procedure	Answering nurse question
	Talking with nurse
	Asking technician question
	Answering technician question
	Talking with technician
	Asking medical doctor question
	Answering medical doctor question
	Talking with medical doctor
	Asking student question
	Answering student question
	Talking with student
	Offline
	Reviewing old records
	Working on patient disposition
	Reviewing test results
	Reviewing radiology report
	Looking for chart
	Talking on phone
	Listening to student presentation
	Giving orders
	Writing orders

Table 2. Emergency department demographics at the two sites used in physician time use study.

	Site 1	Site 2
Average daily patient volume	190	147
Daily midlevel hours	38	39
Daily physician hours	76	43.5
Patients/ hour/ provider	1.7	1.8
Length of physician shifts	12	11
Admission rate	20.02%	11.60%
Average length of stay	248.3 minutes	179.2 minutes

Demographics of each ED are shown in Table 2. A total of 7 providers were observed at Site 1 and 5 providers at Site 2. All observed were attending physicians at their respective EDs. The number of months experience each site had with their EHR system was 8 years months at Site 1 and 10 months at Site 2. We collected a total of 4,140 minutes of data. Site 1 was observed for 2,340 minutes, and Site 2 for 1,800 minutes. Raw data totals for each site are included in Table 3 and 4.

Overall, the observed physicians spent 29.4% of the time charting using typed data entry (688/2340 minutes) vs 27.5% (495/1800 minutes) using voice recognition data entry. We identified no significant difference was identified between the 2 techniques (p=0.61). No significant differences were observed between the sites with regards to the time spent on direct patient care. Observed physicians spent 30.7% (718/2340 minutes) of their time in direct patient care at the site with typed data entry and 30.8% (554/1800 minutes) at the site using voice recognition data entry (p=0.98).

Regarding interruption data, EPs who used typed data entry were interrupted 5.33 times an hour compared to 3.47 times an hour using voice recognition data entry. This difference was statistically significant (p=0.017). Although the students are not allowed to chart for attendings, there did appear to be a difference in the time spent interacting with students between the sites (5.4% of physician task time at Site 1 and 1.4% at Site 2).

DISCUSSION

Our study data indicate there is no difference in the amount of time EPs spend charting between the 2 data entry techniques examined at our study sites. When comparing the 2 sites it is important to note that at Site 2 time allotted overall for charting involved 2 categories, "dictating" (333 minutes) and "charting (computer)" (129.5 minutes). In reviewing the notes from the observers, "charting (computer)" correlated with the time spent by providers reviewing and correcting their dictations. This indicated that although EPs spent less time dictating at Site 2 than EPs at Site 1 did with traditional charting, the time savings were spent on correcting dictated charts. This is somewhat consistent with previous studies that found voice recognition data entry led to more average corrections per chart and more time for review and correction than that compared with tradition dictation using a transcription service.[12,13,17-19] These studies have also suggested a steep learning curve for physicians to become efficient with this technology. Through our search in the literature, there were no studies or guidelines as to how long it takes physicians to become efficient with voice recognition data entry. The voice recognition site studied had 10 months of experience with the system compared to 8 years of experience in the typed data entry site. This experience discrepancy may have had an effect on the data collected as there is a chance efficiencies may be gained with continued use. However, Kennebeck et al. reported a return to a steady-state workflow after 3 months of implementing a EHR in a pediatric ED.[20] It is unknown the magnitude of efficiency gains that would occur after 10 months of continued use of the voice recognition data entry system.

The data from this study also displayed no significant difference in the amount of time physicians spent with their

Table 3. Data collection at site 1 (no voice recognition).

Task	Number of times placed in queue	Number of times truncated	Number of times interrupted	Time spent on task (minutes)
Charting (computer)	161	9	170	668
Charting (paper)	2	2	4	20.5
Dictating	0	0	0	0
Evaluating new patient	7	1	8	352.5
Evaluating old patient	0	0	0	180
Asking nurse question	2	0	2	23.5
Answering nurse question	3	2	5	86.5
Talking with nurse	0	4	4	64
Asking technician question	0	0	0	10
Answering technician question	0	0	0	9
Talking with technician	0	0	0	21.5
Asking medical doctor question	0	0	0	10
Answering medical doctor question	1	1	2	26.5
Talking with medical doctor	0	0	0	107
Asking student question	0	0	0	4.5
Answering student question	0	0	0	8
Talking with student	5	1	6	66.5
Answering patient question	0	0	0	8.5
Answering relative question	0	0	0	28
Offline	0	0	0	60.5
Reviewing old records	1	0	1	44.5
Working on patient disposition	2	0	2	37
Reviewing test results	6	1	7	53
Reviewing radiology report	8	3	11	37
Looking for chart	2	0	2	15
Talking on phone	1	0	1	127
Listening to student presentation	5	0	5	48
Giving orders	1	2	3	49
Performing procedure	0	0	0	149
Writing orders	1	0	1	25.5
Total	208	26	234	2340

patients with either charting method. EPs roughly spent a quarter of their time in direct patient evaluation, half of their time with indirect patient care, and a quarter of their time charting at both sites. These numbers are similar to those previously reported. [21,22] Hollingsworth et al., 1998 reported on average physicians spend 32% on direct patient care, 47% on indirect patient care, and 21% on non-patient care activities, while Chisholm et al., 2011 reported on average physicians spend 30% on direct patient care, 53% on indirect patient care and <1% on non-patient care activities.[21,22] Both these studies looked at academic teaching hospitals.[21,22] The difficulty in comparing these numbers arises with the definitions of direct and indirect patient care used in each study. Both previous studies included patient charting in the realm of indirect patient care. Hollingsworth included a sub-analysis comparing resident and attending charting time and found they spent 21% and 11.9% of their time charting, respectively.[22] Although not formally reported in their study, contacts with the studied site

Table 4. Data collection at site 2 (with voice recognition/dictation).

Task	Number of times placed in queue	Number of times truncated	Number of times interrupted	Time spent on task (minutes)
Charting (computer)	22	7	29	129.5
Charting (paper)	3	0	3	32.5
Dictating	44	6	50	333
Evaluating new patient	2	2	4	284.5
Evaluating old patient	4	4	8	168
Asking nurse question	0	2	2	19.5
Answering nurse question	0	0	0	63
Talking with nurse	0	0	0	58
Asking technician question	0	2	2	6.5
Answering technician question	0	0	0	9
Talking with technician	0	0	0	13
Asking medical doctor question	0	0	0	1.5
Answering medical doctor question	0	0	0	3.5
Talking with medical doctor	7	4	11	83
Asking student question	0	0	0	0
Answering student question	0	0	0	2.5
Talking with student	2	0	2	18
Answering patient question	0	0	0	27.5
Answering relative question	0	2	2	16.5
Offline	0	0	0	33.5
Reviewing old records	7	3	10	96
Working on patient disposition	1	1	2	2.5
Reviewing test results	3	1	4	56.5
Reviewing radiology report	0	0	0	9
Looking for chart	0	0	0	11.5
Talking on phone	1	1	2	117
Listening to student presentation	0	0	0	4
Giving orders	0	0	0	41.5
Performing procedure	1	0	1	57.5
Writing orders	7	5	12	102
Total	104	40	144	1800

verify that paper charting was used. When compared to our study sites that used EHR, attendings at our teaching hospitals spent more time charting (29.4% and 27.5%). If we included charting into our analysis of indirect patient care and compared it to those previously recorded the EPs we observed spent roughly 1.5 times more time on indirect patient care. This supports the statement that the introduction of EHR adds an extra workload to attendings working in the ED. Interestingly, when looking at percent time spent in direct patient care, percentages were similar across all study ranging from 30-32%. The increase ddemands EHR adds to indirect patient care times seems to have been shifted away from that time previous reported as "non-patient care" activities. These included breaks, social time, and personal time. The "Offline" task classification used in our study is the best comparison we could use against previously reported "non-patient care" activities. Both of our study sites had EPs spent 2-3% of their time "Offline," which is far less than that reported by Hollingsworth at 21%.[22]

When analyzing interruptions data we found that EPs at Site 2 were interrupted almost 2 times less an hour than their counterparts at Site 1. This was found to be significantly different. The number of interruptions documented at each site was less than that found in previous studies reporting 6.9-15 interruptions per hour.[5,8,9,23] The differences found could be attributed to the study classification of an interruption, staff operations of each studied institution, and medical recordkeeping system. It is unknown what type of medical record techniques were being used at the previously studied institutions. However the 5.33 interruptions per hour found at Site 1 approximates what has been previously reported.[23] It has been noted that EPs were interrupted most frequently while reviewing data or charting.[5] One possible explanation of the decrease in interruptions recorded at Site 2 could be the fact that when physicians are dictating they are not interrupted and are allowed to finish. When comparing measures of site patient acuity and length of stay, Site 1 had a much higher admission rate and length of stay for its patients (Table 2). Higher acuity patients with longer stays in the ED could result in increased physician tasks and increased likelihood for interruptions.

LIMITATIONS

There are several limitations to the study. One limitation is that we did not collect the amount of time EPs spent charting outside the. There is a possibility that EPs at each of the sites may have spent additional amounts of time outside the ED reviewing and finishing charts started during the observation periods. This additional charting time could have an impact on the overall charting time observed for each site. A second limitation with the charting data may involve the total amount of observation minutes used for the study. The observed effect size between the 2 sites with regards to time spent charting was -1.9% for the voice recognition data entry site. We would have needed 331 individual 3-hour time blocks from each hospital for that difference to be statistically significant. Additional observation shifts were planned but not completed. However, Site 1 made a significant change to its ED operations, implementing increased provider hours in a front-end triage process. Site 2 shortly followed with a similar change in operations. We determined that inclusion of data from observation shifts after these ED changes would further compromised our findings. These types of operation changes within the ED environment will present a challenge for future studies in this area.

A third limitation of this study is that it was performed at 2 different EDs serving different patients and operating with different staff, resources, and administration. The 2 sites studied were chosen given that are were 0.6 miles away from each other in a metropolitan area of ~200,000 people serving a similar population base. Each site has similar lab and imaging capabilities. The majority of patients in the area receive their care via 2 large clinical practice groups. Both of these clinical groups have privileges at each site and rotate the same hospitalist, surgery, and specialty surgery staff, which does limit some variation with regards to consultation services and tasks. ED providers also see patients at similar rates at both facilities (1.7 and 1.8 patients/hr/provider).

As noted in the discussion section, patient acuity was different between the 2 sites with admission rates of 20.02% at Site 1 and 11.60% at Site 2 suggesting that even though both EDs serve the same population, the patients that visit each ED differ in their complaints and resource consumption. Length of stay was also much longer in Site 1 (248.3 min) than Site 2 (179.2 min) suggesting likely differences in ED operations and patient flow. These numbers, however, may also be skewed as each site uses different methods to measure and report these metrics. In regards to nursing and ancillary staff differences, 214.5/2,340 (9.2%) minutes at Site 1 and 169/1,800 (9.4%) minutes at Site 2 of physician task time were devoted to nursing and ancillary staff communication. These numbers suggest differences in nursing and ancillary at each site had minimal effect on direct patient care time data. However, differences in their staffing hours and experience could have skewed interruption data. Increased number of staff and inexperience of staff during any observations could have an effect of increased interruptions. Thesedata were not available for comparison. Physician pay and incentives also differ between the sites. Site 1 physicians were paid on a strict hourly basis while Site 2 had an RVU component based on patient satisfaction. This RVU incentive could have led to inflated direct patient contact times during data collection.

CONCLUSION

We identified no significant difference in the amount of time physicians spend charting or in direct patient contact between the two EHR systems examined in this study; typed data entry versus voice recognition data entry. However, we found a significant decrease in the amount of interruptions at the site that used voice recognition data entry for their EHR. Although voice recognition data entry does not necessarily require less time for data entry, our findings provide preliminary evidence for the potential to decrease the number of provider interruptions that occur during data entry. Additional studies are needed to further examine and better define the relationship between the data entry charting options to improve overall ED efficiency and workflow operations.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. The authors disclosed none. Neither EHR vendor nor the voice recognition software company had any part in the planning or reporting of this study.

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