Research and Applications

Doctors documenting: an ethnographic and informatics approach to understanding attending physician documentation in the pediatric emergency department

Sarah D. Fouquet,^{1,2} Laura Fitzmaurice,³ Y. Raymond Chan,^{1,4,5} and Evan M. Palmer⁶

¹Human Factors Collaborative, Children's Mercy Hospital Kansas City, Kansas City, Missouri, USA, ²Department of Biomedical and Health Informatics, University of Missouri, Kansas City, Missouri, USA, ³Department of Emergency Medicine, Children's Mercy Hospital Kansas City, Kansas City, Missouri, USA, ⁴Division of Hospital Medicine, Children's Mercy Hospital Kansas City, Kansas City, Missouri, USA, ⁵Department of Pediatrics, University of Missouri, Kansas City, Missouri, USA and ⁶Department of Psychology, San José State University, San José, California, USA

Corresponding Author: Sarah D. Fouquet, PhD, Children's Mercy Hospital 2401 Gillham Road, Kansas City, MO 64108, USA (sdfouquet@cmh.edu)

Received 4 March 2020; Revised 22 September 2020; Editorial Decision 22 September 2020; Accepted 29 September 2020

ABSTRACT

Objective: The pediatric emergency department is a highly complex and evolving environment. Despite the fact that physicians spend a majority of their time on documentation, little research has examined the role of documentation in provider workflow. The aim of this study is to examine the task of attending physician documentation workflow using a mixed-methods approach including focused ethnography, informatics, and the Systems Engineering Initiative for Patient Safety (SEIPS) model as a theoretical framework.

Materials and Methods: In a 2-part study, we conducted a hierarchical task analysis of patient flow, followed by a survey of documenting ED providers. The second phase of the study included focused ethnographic observations of ED attendings which included measuring interruptions, time and motion, documentation locations, and qualitative field notes. This was followed by analysis of documentation data from the electronic medical record system.

Results: Overall attending physicians reported low ratings of documentation satisfaction; satisfaction after each shift was associated with busyness and resident completion. Documentation occurred primarily in the provider workrooms, however strategies such as bedside documentation, dictation, and multitasking with residents were observed. Residents interrupted attendings more often but also completed more documentation actions in the electronic medical record.

Discussion: Our findings demonstrate that complex work processes such as documentation, cannot be measured with 1 single data point or statistical analysis but rather a combination of data gathered from observations, surveys, comments, and thematic analyses.

Conclusion: Utilizing a sociotechnical systems framework and a mixed-methods approach, this study provides a holistic picture of documentation workflow. This approach provides a valuable foundation not only for researchers approaching complex healthcare systems but also for hospitals who are considering implementing large health information technology projects.

Key words: documentation, work system, emergency department, human factors, electronic medical records

INTRODUCTION

Patient care is often nonlinear with complex processes, teamwork, and tasks such as electronic medical record (EMR) documentation. The pediatric emergency department (ED) is 1 of the most complex, high-risk, and vulnerable environments in healthcare,^{1,2} with an estimated 30 million children visiting the ED in the United States yearly.³ Factors contributing to ED complexity include rising patient volumes, increasing number of patient care tasks, and evolving technology.⁴ Communication, which consumes up to 90% of physicians' time, is often riddled with interruptions.^{5,6} Providers are responsible not only for direct patient care but also aspects of indirect patient care, such as working within the EMR and keeping up with documentation. EMR documentation has the potential to facilitate collaborative assessment and care of patients, yet is often found to be lacking.^{7,8} Once at the discretion of physicians, documentation is now governed by stringent guidelines, codes, and policies for legal and billing purposes.⁹ Several researchers have suggested that providers spend disproportionately more time in documentation than with patients,^{10,11} and that current EMR systems do not match physician workflow, especially under time pressure, as in the ED.¹² On the other hand, some practitioners believe that EMR documentation saves time and improves quality¹³ while reducing patients' length of stay.^{14,15} Beyond the impact on patients, EMR implementation has been shown to increase the length of physicians' work day, with some doctors spending 1–2 hours on documentation-related activities after their shift.¹⁶

Complex systems, such as the ED, and tasks, such as documentation, can be illuminated by the human factors perspective,¹⁷ taking into account work interactions at the individual, interpersonal, and institutional levels.^{18,19} Marrying engineering and the social sciences, the field of human factors brings forth a rich methodology for understanding how people operate, particularly in complex sociotechnical systems. This knowledge, alongside theories, principles, and data, is used to help people within the system by building and promoting better processes, jobs, and tools. Most importantly, human factors is human-centered, and, whether examining a device or a process, its focus is on the people who are doing the work. It is often assumed that work processes, such as documentation, can be analyzed and understood in a clear, linear manner. This view is built from sources such as hospital policies, protocols, algorithms, and trainings that describe work processes as if they occur in an ideal environment. This view of work has been referred to "work-as-imagined"²⁰ and does not take into consideration constantly changing work environments, resource limitations, or the ebb and flow of patient census. In contrast, human factors examines "work-as-done," which most often requires physically observing and spending time alongside frontline staff. This approach allows an in-person view of factors within the sociotechnical system that influence work, examining the intersections between people, technology, processes, organizations, and policies.^{19,21,22} Accordingly, the World Health Organization encourages the use of human factors and its systems-level approach to improve patient safety.²³

The authors of this paper were approached by a pediatric hospital that was considering implementing iPads for all ED physicians to improve documentation. The rationale for the proposed technology change was: 1) iPads would provide more mobility than desktops or computers on wheels, and 2) the assumption that bedside documentation is superior to workroom documentation, in which case an iPad would be quicker and more efficient. Before proceeding with the technology shift, the authors consulted the literature on docu-

mentation practices but found little relevant information to inform the project. Consequently, the authors conducted this study to determine the current documentation practices of the pediatric ED.

One outstanding question, not only for this hospital, is how documentation is being done. Some research has investigated documentation's role in physician workflow in primary care offices,²⁴ but little has examined documentation locations within the context of ED workflow.^{25,26} In theory, bedside documentation should provide quick, easy access to information at the point of care, while encouraging both provider and patient to create a narrative. In reality, bedside documentation faces myriad challenges including slow computers, poor EMR connectivity, poor usability of healthcare information technology, and a lack of eye contact and rapport between patient and provider.^{27,28} In the case of teaching hospitals, the role of the resident in the documentation process is important to consider, as their strategies and contributions also impact documentation.²⁹ Finally, work processes in the ED, including documentation, are often interrupted.^{30–33}

The Systems Engineering Initiative for Patient Safety (SEIPS) is a useful framework for understanding the complex sociotechnical systems of healthcare.^{18,19,34} The SEIPS model, and more specifically, its division of the work system into 6 factors (external environment, internal environment, tools and technology, organization, person[s], and tasks) has been used to develop consumer informatics products, examine nurse fatigue, and identify work system barriers to technology implementation.^{35–37} Just as the systems approach requires a multifaceted examination of the work system, it often requires a multifaceted approach to data collection. Mixed-methods approaches provide great value to studies utilizing SEIPS, with qualitative and quantitative data providing rich context to explore and understand the complex layers of healthcare.^{38,39} Stemming from the field of anthropology, ethnography (particularly, focused ethnography^{40,41}) is the methodological, systematic study of people, their thoughts, and behaviors and affords both qualitative and quantitative data collection through participatory observation.^{42,43} Complementary to human factors, the ethnographic approach has been long-used in the field of system design⁴³ and its virtue is that it illuminates a real-world setting through direct involvement by the researcher. This naturalistic method allows researchers to view the system through the lens of the individuals in the environment.

The objective of this study was to understand how documentation occurs in the pediatric ED, including when, where, and how often attending physicians document, how often they are interrupted, and by whom. This objective served several purposes: the first being for the hospital whose assumption that technology was the barrier to efficient documenting; and the second being for the literature to contribute a better understanding of how documentation occurs.^{44,45} Additionally, this study serves as an example of a mixed-methods, human factors approach to understanding complex work systems, like the pediatric ED, utilizing both objective and subjective data from the EMR, surveys, and ethnographic observations.

MATERIALS AND METHODS

For this mixed-methods study, we utilized the SEIPS model^{18,19,34} to guide a focused ethnographic approach to understanding documentation workflow in the pediatric ED. Phase 1 consisted of a Hierarchical Task Analysis (HTA) and provider survey; Phase 2 included observations of pediatric ED attending physicians, surveys, and

Table 1. Methods of collection and data gathered

Phase 1: All ED documenting providers			
Hierarchical task analysis (HTA)		Documentation survey	
Goal driven task analysis of patient flow through the ED	Estimate of when documentation occurs		
	Documentation location frequency and pros/cons of following locations: patient room, workroom, home, private office		
	Percentage of documentation completed by residents		
Phase 2: ED Attending physicians			
Observation Data	Demographic Survey Data	Post-Shift Survey Data	EMR Data
Interruptions:	Demographics:	Subjective rating of shift busyness	Patient data:
• Frequency	• Age	Satisfaction with shift documentation	• Acuity
• Source	• Gender	Satisfaction with resident shift documentation	• Length of stay in the ED
• During Documentation?	• Years of experience	Amount of documentation left to complete	• Room Number
Timestamps of workroom and patient room entry/exit	Satisfaction with current documentation	Amount of documentation left for residents to complete	Length of progress notes
Length of time spent in rooms	Documentation location preference		List of personnel contributing to progress notes
Paper artifact usage (yes/no) Examples: note cards, sticky notes, notebooks	Estimate of time to complete single patient documentation		Note actions (eg, editing, signing)
Qualitative comments from attending physicians			Timestamps of note actions
Field Notes			Time to complete notes

documentation data pulled from the EMR. Table 1 depicts the methods and data gathered during the study's 2 phases, which will be expanded upon below. This study was approved by the hospital's Institutional Review Board.

Study setting and design

This 2-part project took place in the Level I Pediatric Trauma Center and emergency department at Children's Mercy Hospital in Kansas City, MO, which has over 70 000 ED visits each year. This ED has 39 private patient rooms, laid out in 3 different zones: red (high acuity), yellow (moderate acuity), and green (low acuity). Attending physicians work 8-hour shifts and see patients in all 3 zones of the ED. Patient care is also provided by pediatric ED fellows and 20 rotating residents each month.

Phase 1: Hierarchical task analysis and provider documentation survey

Hierarchical task analysis

The goal of any HTA when analyzing tasks, is that the HTA representation is merely the "starting point for analysis rather than the end point."⁴⁶ The HTA divides processes into the goals they are trying to achieve, the subgoals that support them, and the relationship between the rules, decisions, and processes that are required for completion.⁴⁶ In the months prior to the observations in phase 2 of the study, an attending physician and coauthor of this paper conducted an HTA of patient flow through the ED.

Provider documentation survey

Following the HTA, a survey was completed by ED attending physicians ($n = 19$) and ED fellows ($n = 3$). This 11-question survey was created by the authors to better understand current documentation practices and perceptions, including when and where documentation occurred, the pros and cons of those locations, and estimate percentage of chart completion by residents.

Phase 2: Observations, surveys, and EMR log data

Observation participants and procedure

A trained observer shadowed 11 pediatric emergency medicine attending physicians (7 females, 4 males) over the course of 2 months. Observation data were collected using a time-stamped paper collection sheet. Secondary participants were the patients seen by the attending physicians. Information sheets were given to patients or their family upon request. During observations, 288 patients were treated, with a mean of 13 patients per shift (range: 5–21 patients, $SD = 3.59$). Each of the 11 attending physicians were observed on multiple occasions, totaling 23 eight-hour shifts ($M = 7$ hours, 32 minutes, $SD = 52$ minutes) spread across day, swing, and overnight shifts.

On the day of observation, attending physicians signed the consent form, completed a demographic questionnaire, then proceeded with their shift as normal with the observer. Participants could interact with the observer and qualitative observations were recorded. Participants were also instructed that the observer would wait outside the patient room if they felt it was in the patient's best interest.

Table 2. Interruption sources

Interruption source	Example of interruptions
ED Attending Physician	Deferring resident checkout, patient case discussion
Resident	Patient checkouts, questions regarding patient plan or treatment
Fellow Nurse	Assistance with diagnostic dilemmas, Informing attending physicians of high acuity patients, notifying physicians of special social information that might not be in the EMR
Telephone	Returned pages from specialists, administrative calls
Transport Phone	Physician from outside hospital/institution transferring patients
Patient	Discussion of chief complaint, questions regarding treatment
Patient's Family	Clarification of patient information, questions regarding patient care
Study Observer	Clarification of observations, questions regarding processes
Other	Interruptions by specialists or staff members (eg, surgeons, respiratory therapists, administrators)

Abbreviations: ED, emergency department; EMR, electronic medical record.

This rarely occurred; however, during traumas, the observer observed via live feed in 1 of the ED workrooms. Throughout the shift, the observer recorded timestamps whenever the attending physician entered a workroom or patient room and whenever an interruption (as defined by⁴⁷) occurred. The observer noted whether the attending physician documented in each location and if any interruptions occurred during documentation. Interruptions were further categorized by source (Table 2).

ED attending physician self-report survey

At the end of their observed shift, attending physicians completed a short self-assessment survey. Five questions examined the perceived busyness of the shift, satisfaction with their documentation and their resident's documentation, and an estimate of documentation remaining to be completed.

EMR log data materials and procedure

Data from the EMR system were gathered by informatics analysts at the hospital using the Lights On Network by Cerner Corporation, which collects EMR users' activity in near real time and provides quantitative metrics. After the 23 observations were completed, data were collected from the EMR specific to each observed shift including the patients seen, their acuity, room number, length of stay, and the number of characters in the progress note filled out by the attending physicians. All identifying patient information was anonymized to preserve confidentiality. Progress note data were also pulled including which attending physicians, residents, and/or fellows were assigned to the note, the actions they performed, and the timestamp of that action. The names of fellows and residents were kept confidential.

Statistical analysis

Descriptive statistics are reported in terms of means and standard errors, with information about ranges and percentages, when appropriate. All inferential statistics used an alpha level of .05 for significance. Correlations were assessed using the Pearson correlation

coefficient; differences between 2 means were assessed with paired-samples t-tests; and differences between 3 or more means were assessed with analyses of variance, with post-hoc comparisons using the Scheffé criterion for significance. For Phase 1, the provider documentation survey utilized both correlation and descriptive analysis. In Phase 2, correlations were used for the pre- and postshift surveys. The interruptions data were analyzed using correlations, t-tests, and analyses of variance depending on the comparison variables. Finally, the data pulled from the EMR were analyzed via descriptive statistics and correlations.

RESULTS

Phase 1: Hierarchical task analysis

The 3 main tasks of patient flow were identified in the HTA (Figure 1) as 1) patient entering the system, 2) patient care, and 3) disposition. As patients enter the system, most often they are seen by access representatives, security, and triage nurses. This was the only time during system entrance that the attending physician would be expected to document. The other 2 primary tasks, patient care and disposition, carried documentation throughout all its subtasks and included complex relationships between residents, locations, and discharge. The HTA highlighted when providers might interact with patients and ED staff, where in that process they may document, and where the observer should expect to be present during the observations.

Phase 1: Provider documentation survey

Alongside the HTA, a survey was sent to documenting providers in the ED. Attending physicians split on whether they documented after each patient or after several. Attendings also reported frequently completing documentation after their shift or even a day or more after shift, consistent with the literature indicating physicians spend significant personal time on documentation.¹⁶

When asked specifically about the frequency of documenting in the patient room or workroom, everyone reported rarely documenting at bedside and most often or always documenting in the workroom (see Table 3). Thematic analysis of the pros and cons of these locations revealed that advantages for documenting in the patient room included faster documentation, efficiency, and consulting with the patient/family. The disadvantages were being too impersonal, computer or EMR login issues, and loss of eye contact. The advantages of workroom documentation included better space for concentration, dedicated computer continuously logged in, and not interfering with patient rapport. The downsides were that the workroom was noisy, distracting, and laden with interruptions. Lastly, the survey revealed that residents completed about 79% of documentation, with considerable individual differences in the sample.

Phase 2: Pre- and postshift survey analyses

Prior to observations, attending physicians were asked to rate their overall satisfaction with their documentation. Attending physicians reported a mean satisfaction level of 2.91 (range = 1–5; SD = 1.38), with both a mode and median of 2. There was no significant correlation between experience and satisfaction ($r(9) = .27, P = .42$).

Correlations between shift-specific documentation satisfaction data, busyness of day perceptions, and estimates of documentation remaining were analyzed. Results revealed significant positive correlations between day busyness and documentation remaining for both attendings ($r(20) = .44, P < .05$) and residents ($r(20) = .50, P < .05$). Attending physicians' documentation satisfaction was positively

Figure 1. Hierarchical task analysis of patient flow through the Children's Mercy Hospital Emergency Department.

Table 3. Frequency of documentation in the workroom vs the patient room by provider

	Never	Rarely	Sometimes	Often	Always
Documenting in the workroom					
Attending Physicians	0	0	2	9	8
Fellows	0	0	1	2	0
Documenting in the patient room					
Attending Physicians	11	4	1	3	0
Fellows	3	0	0	0	0

correlated with their satisfaction with their residents' documentation ($r(20) = .64, P < .01$) but negatively correlated with the amount of documentation remaining for themselves ($r(20) = -.77, P < .001$) and the residents ($r(20) = -.52, P < .05$). Satisfaction with resident documentation was also negatively correlated with the amount of documentation remaining for both attendings ($r(20) = -.72, P < .001$) and residents ($r(20) = -.72, P < .001$). The amount of documentation remaining for attending physicians was positively correlated with the amount of documentation remaining for residents ($r(20) = .66, P < .001$).

Phase 2: Observation: how does documentation fit within attending physician workflow?

Location

Prior to observation, all attending physicians reported liking to document in the ED workroom, but some also liked to document in

other locations. Observations revealed that all 11 attending physicians did indeed document in the workroom during their shift, with some exceptions. Two attending physicians also documented in the patient room, taking notes while the patient or patient's family relayed information regarding history, physical, chief complaint, etc. One other attending physician documented in the patient room during 2 trauma cases, but otherwise documented in the workroom. When asked why attending physicians do not document in the patient room, examples given were "lack of eye contact" and "people don't like to wait for the computers to load." One attending physician stated they documented in the patient room because "I can see the patient by myself, document, and discharge all in 1 place." In a discussion between 2 attending physicians, 1 complained that "I always document at home" while the other said he preferred documenting at home where he can better utilize the macros he had made for documentation. The location of patients within the department is another important aspect of ED workflow. In this ED, attending physicians (or by proxy, residents) self-assigned their patients rather than having them assigned by nursing staff or by room location. This meant that ED physicians would see patients across the entire unit. For example, the first attending physician observed treated patients in rooms 13, 12, 6, 2, 7, 25, 26, 11, 14, and 24. This spread of rooms meant the physician spent a significant amount of time traveling across the 3 zones. In an effort to keep track of their patient's room numbers, some providers used paper artifacts such as sticky notes or note cards to keep track of their patient's room numbers across their shift. Several attending physicians were also observed going into rooms incorrectly, either misremembering the

Figure 2. Average number of interruptions per shift by source. Residents interrupted significantly more often than any other source, followed by nurses who interrupted more often than any other source except for residents and attendings. Attendings interrupted more often than patients and the observer.

room number or visiting a room that had previously been occupied by 1 of their patients.

Multitasking

A common documentation strategy was multitasking during resident checkout, when residents relay patient information to the attending regarding history and physical, chief complaint, plan, and treatment. Six of the 11 attending physicians multitasked during the checkout and typed while the resident spoke. These physicians self-identified as “typers” and residents seemed to have experience with this form of multitasking, often approaching an attending at checkout and asking, “Are you a typer?”

For typers, when the resident started the checkout, the attending would typically ask, “Have you closed the note?” since the EMR system did not allow for a patient note to be open on multiple computers. Quite frequently, if a resident had their note open, the attending would ask them to close it before continuing the checkout, causing the resident to go to their computer in another room to close the note. The other 5 attending physicians who were not “typers” would face the resident in their chair and have a face-to-face conversation regarding the patient before beginning the documentation process.

Dictation

Dictation was another strategy utilized by attendings to complete documentation. Two of the attending physicians used the microphone to dictate their notes. However, 1 of the physicians was only able to dictate for 1 shift and not the other because the software would not load. One of the attending physicians stated, “When I’m dictating, people interrupt me less because I’m talking.”

Seeing patients without a resident

Five of the 11 attending physicians saw patients both with and without a resident. Two of those attending physicians also coupled this with the strategy of documenting in the room. When asked if they see patients without a resident for a faster turnaround, they replied “Ideally, yes... Sometimes you want to take the complex [patients] too though because if a resident sees them, they have to talk to me repeatedly, which can also take longer.” Another attending physician stated that they would see patients on their own when necessary such as, in 1 observed shift, when a significant number of patients were waiting to be seen.

Phase 2: Observation: when and where do interruptions occur and by whom

Number of interruptions

Across the 23 observed shifts, 923 interruptions were recorded. Interruptions during documentation accounted for 97 (11%) of the total. An average of 35 interruptions occurred per shift ($M = 35.35$, $SD = 19.11$), with a large spread between the shifts (range = 9–72). On average, attending physicians were interrupted 4.83 times per hour ($SD = 2.79$) during the observation period.

Interruptions by source

Figure 2 depicts the average number of interruptions per shift by source, which significantly differed depending on source, $F(9, 220) = 41.05$, $P < .001$. The average number of interruptions by residents ($M = 18.65$, $SD = 10.64$) was significantly higher than all other sources. Following residents, the second highest interruptions were by nurses ($M = 6.04$, $SD = 3.61$) who were significantly higher than all other sources but not significantly higher than attending physicians ($M = 4.74$, $SD = 4.74$) or others (eg, specialists) ($M = 4.13$, $SD = 3.36$). Other attending physicians interrupted significantly more often than both the observer ($M = .09$, $SD = .42$) and patients ($M = .04$, $SD = .21$).

Interruptions by location

Significantly more time was spent in the workroom (Figure 3; $M = 15.94$ minutes, $SD = 17.49$) than in patient rooms ($M = 5.67$, $SD = 6.31$), $t(439) = 12.77$, $P < .01$. Consequently, most interruptions occurred in the workroom. In total, 811 of the 923 interruptions occurred in the workroom, while 112 occurred in the patient rooms. After adjusting for time spent in each location, there were still significantly more interruptions per hour in the workroom ($M = 8.52$, $SD = 5.43$) than in patient rooms ($M = 3.50$, $SD = 6.08$), $t(22) = 6.73$, $P < .01$. While interruptions occurred less frequently in the patient rooms than in the workrooms, it is important to note that some of the longest times spent in the patient room were for procedures (eg, sedation) where neither the patient nor the patient’s family would be capable of interrupting the physician. In the case of the highest acuity trauma patients, the attending physician spent more time in the patient room, but the observer did not—potentially missing a large number of interruptions.

EMR log data: what do EMR data reveal about attending and resident documentation?

Most ED patients were seen by both a resident and an attending physician, thus documentation was a shared task between both providers. EMR data recorded 4 possible provider actions within documentation: perform, modify, verify, and sign. Perform is open-

ing the progress note the first time, modify is editing, verify and sign are parallel processes wherein providers first verify the information, then sign the progress note. Resident documentation is not sent to attending physicians for verification and signature until the resident has verified and signed the progress note themselves.

Number of Attending and Resident Note Actions Across Patients

Across the 288 patients seen during observations, there were a total of 2741 note actions with attending physicians completing 1024 and residents completing 1717. As depicted in Figure 4, while documentation is a shared task, resident physicians are doing more of the work within the EMR, which was alluded to in the Phase 1 survey.

Time to complete documentation

The EMR data also provided time taken to complete documentation, operationalized as the time between initial document opening and final signature by the attending physician. The majority of documentation was completed within 24 hours (Figure 5), which coincides with the time estimated by attending physicians in the preshift survey. The data are positively skewed with the range of time for completed documentation being as fast as 3 minutes to as long as 21 days. The median length of time to complete documentation was 5 hours and 15 minutes.

Length of the progress note

The length of the progress note in characters was also gathered from the EMR. There was a significant positive correlation between length of documentation and patient acuity, $r(286) = .40, P < .001$. There was also a small but significant positive correlation between patient acuity and length of stay in the ED, operationalized as the time the patient was assigned to an ED room to the time of either discharge or admit orders, $r(286) = .17, P < .01$. Two qualitative observations give context for this smaller correlation. First, the goal of the ED is to stabilize patients before admission or discharge. For the highest acuity patients, admission is likely, so time spent in the ED is relatively short while an inpatient bed is secured (eg, ICU). On the other hand, a moderate acuity asthma patient may need to be observed for several hours while undergoing breathing treatments. Both factors would reduce the correlation between patient acuity and length of stay in the ED.

Figure 3. Average amount of time spent in the workroom and in the patient rooms per room visit. Attending physicians spent significantly more time in the workroom than in the patient room.

Figure 4. Number and type of note actions by provider. Residents perform a majority of documentation in the EMR, consistent with the results of Phase 1.

Figure 5. Time to complete documentation. The majority of patient documentation was completed within 24 hours.

Table 4. The work system factors that influence the process of documentation and the recommendations for interventions and future research based on those factors

Work system factors	Influencing components	Recommended interventions and future research
Person Factors	Attending Physician Resident	<ul style="list-style-type: none"> • Explore differences between documentation strategies • Investigate resident documentation workflow
Task Factors	Patient Documentation complexity	<ul style="list-style-type: none"> • Examine efficacy and perceptions of resident documentation training • Investigate patient satisfaction and perceptions when physicians document in the room • Future research exploring the Lights On Network and EMR data using larger sample sizes
Technology and Tools	Shared task with resident Functionality, accessibility, and usability of software	<ul style="list-style-type: none"> • Focus research on the contributions of residents vs attendings to documentation • Explore work dynamics between residents and attendings • Provide in situ training for documentation • Offer EMR refresher courses • Both may be facilitated by “expert” documenters
Organizational Factors	Functionality, accessibility, and usability of hardware Culture	<ul style="list-style-type: none"> • Explore pros/cons of different documentation input methods (eg, dictation, tablet) • Investigate hardware adoption rates using the Technology Acceptance Model • Critically evaluate the safety culture and promotion of psychologically safe systems, including possible implementation
Internal Environment	Physical Layout of the ED Interruptions	<ul style="list-style-type: none"> • Explore possible solutions (eg, zoning) to mitigate the barriers of the current layout • Further explore work-relevance of interruptions and whether some can be avoided
External Environment	Federal Policy	<ul style="list-style-type: none"> • Examine downstream effects of Meaningful Use implementation

Abbreviations: ED, emergency department; EMR, electronic medical record.

Documentation work systems and influencing components

Using the results above and the work systems factors from the SEIPS framework, the authors of this study identified influencing components on documentation and provide recommended interventions and topics as recommendations to the hospital as well as for future research (Table 4).

DISCUSSION

This mixed-methods study provided a quantitative and qualitative analysis of how and where ED attendings document, alongside recommendations to improve the process. The SEIPS framework helped identify factors likely influencing documentation and the data collection methods included a hierarchical task analysis, survey data, focused ethnography via observations, and EMR data analysis.

For this hospital, attending physician satisfaction with documentation on each shift was influenced by how busy the day was. Previous work has demonstrated that ED patient volume has an impact on documentation errors and that information is easily lost or forgotten when documentation occurs after several patients or in the workroom.^{24,48,49} Strategies such as documenting in the patient room may help overcome the loss of information by recording information in the moment,²⁴ however this was not a consistent strategy used by attending physicians in our sample. Consistent with clerical burden as a longstanding complaint among providers,^{8,50,51} our study found a 5-hour median time for documentation completion for an 8-hour shift.

Documentation satisfaction was influenced by the amount remaining to be completed. Attending physician satisfaction with their own documentation was positively correlated with their satisfaction with their residents' documentation, which could reflect positive aspects of teamwork including shared goals and ownership. Overall, residents both performed more actions in the EMR than attendings but also interrupted attendings more than any other source, being both a help and a hindrance to documentation comple-

tion. In some cases, attendings were observed to take patients on their own, without residents, to speed completion and reduce patient census. Working alone and working with residents are 2 strategies used by attending physicians in teaching hospitals and the literature reflects mixed results regarding efficiency and productivity for these strategies.^{52,53}

Using the SEIPS framework, several factors can be identified that influence attending physician documentation: resident completion, patient acuity, EMR usability and functionality, and physical layout.⁵⁴ This study also identified strategies used by attending physicians to complete documentation: multitasking, documenting in different locations, and dictation. Each strategy had both strengths and weaknesses. While each factor individually might affect documentation, most were intertwined, which reflects previous findings in the ED [29]. For example, the inability to have a patient note open by several EMR users simultaneously, and the fact that documentation is shared between residents and attendings, meant that attendings frequently had to physically track down residents to ask them to close their notes. Given the layout of the ED with 2 workrooms, multiple residents per attending, and self-assigned patient rooms, attendings were observed walking between workrooms and around the floor looking for residents before they could document.

In addition to understanding how documentation occurs, this study demonstrated the power of a mixed-methods approach. In this study, the HTA, surveys, and EMR data all reflect work-as-imagined. As demonstrated in this study, it is the focused ethnographic approach that pulls in the qualitative aspects of observation and provides context for understanding work-as-done. The observations revealed complex relationships between various factors within the system, such as the teaching and communication differences between attendings and residents, or that while fewer interruptions occurred in the patient room, that may have less to do with the environment and more to do with the patient being sedated. Only by combining data that reflect both work-as-imagined and work-as-done can a full understanding of complex work processes be achieved.

In response to this study, the hospital decided against implementing iPads across the emergency department as the only solution for documentation. Instead, they chose to implement several smaller recommendations from Table 4. This study also revealed inefficiencies of self-assigned patients and its possible impact on interruptions and documentation. In its current state, a provider could see 4 patients in 4 different rooms spread across the 3 zones of the ED, with 3 different residents and 3 different nurses. From our study, we know that residents and nurses are the highest sources of interruptions, so it is possible to have interruptions from 6 different staff members regarding only 4 patients. In comparison, some hospitals use a “pod-based” or “zone” approach, wherein providers (and nurses) are geographically zoned to specific rooms. In this case, a provider could still be assigned to 4 patients but in 4 contiguous rooms, with only 1 nurse and 2 residents. These approaches have been informally compared and the hospital plans to explore this approach.⁵⁵

There were limitations in this study. First, the observations occurred in December and January, so workload and resident training levels might be different in other months. From an external validity standpoint, the findings from this study are specific to this emergency department, whereas other EDs will have different policies, EMRs, and cultures. This study was also exploratory in nature, but the lack of intervention reflects the lack of knowledge in the literature about how documentation is done. What can be extrapolated from this study are the user-centered approaches to understanding the system, the methodology, the findings about interruptions and work styles, and perhaps some of the recommendations.

For years, there have been calls to find better ways to document, but before solutions such as iPads or scribes are recommended, it is important to understand the process itself.⁵⁶ Taking the approach of understanding work-as-done requires examining processes where they occur. In conjunction, making large scale decisions in complex environments should involve the people doing the actual work and not just those in leadership or administration positions. The participants in this study ranged in years of experience from 6 months to several decades. This allowed the observer to better understand the barriers for those who are new, as well as the barriers that remained even for those who had the time to build work-arounds. This approach also recognizes that some factors cannot be changed or controlled by hospitals. For example, EMR usability issues cannot be addressed by hospitals alone but by those who design them and policy makers who promote and incentivize their use. However, to support providers now, training focused on the adaptations and work-arounds expert documenters use may provide some relief to physicians struggling to complete documentation.⁵⁷ The providers in this study reported overall low satisfaction with documentation, which is concerning but not surprising. Unfortunately, technology that should support providers (eg, EHRs, patient portals) has been associated with an increased risk of physician burnout.^{8,58,59} Processes such as documentation will always remain complex aspects of healthcare and changing these processes should be done thoughtfully and collaboratively with stakeholders.

AUTHOR CONTRIBUTIONS

SDF and EMP designed the study. SDF collected the survey and observational data, with institutional support from LF. YRC conducted the hierarchical task analysis. SDF and EMP wrote the paper with input from all authors.

ACKNOWLEDGMENTS

SDF would like to acknowledge her dissertation committee, Drs. Evan Palmer, Barbara Chaparro, Alex Chaparro, Joseph Keebler, Elizabeth Lazara, and Sarah Taylor for their support of this work. We would also like to thank the ED physicians and staff at Children's Mercy Hospital who so graciously let us into their world.

CONFLICT OF INTEREST STATEMENT:

The authors have no conflicts of interest to declare.

REFERENCES

1. Dobson I, Doan Q, Hung G. A systematic review of patient tracking systems for use in the pediatric emergency department. *J Emerg Med* 2013; 44 (1): 242–8. http://ac.els-cdn.com/S0736467912002351/1-s2.0-S0736467912002351-main.pdf?_tid=3eb81802-b16b-11e4-ad8a-00000aacb362&acdnat=1423603670_b2783e748a37008ea62f8b2db7e4f13b Accessed February 10, 2015
2. Landrigan PJ. Children as a vulnerable population. *Int J Occup Med Environ Health* 2004; 17 (1): 175–7.
3. McDermott KW, Stocks C, Freeman WJ. *Overview of Pediatric Emergency Department Visits, 2015*. HCUP Statistical Brief #242. Rockville, MD: 2018. <https://hcup-us.ahrq.gov/reports/statbriefs/sb242-Pediatric-ED-Visits-2015.jsp> Accessed May 26, 2020
4. Abraham J, Kannampallil TG. Quantifying physician activities in emergency care: an exploratory study. *Proc Hum Factors Ergon Soc 58th Annu Meet Published Online First* 2014; <http://pro.sagepub.com/content/58/1/798.full.pdf> Accessed 5 May 2015
5. Spencer R, Coiera E, Logan P. Variation in communication loads on clinical staff in the emergency department. *Ann Emerg Med* 2004; 44 (3): 268–73.
6. Grundgeiger T, Sanderson P. Interruptions in healthcare: theoretical views. *Int J Med Inform* 2009; 78 (5): 293–307.
7. Harris DA, Haskell J, Cooper E, et al. Estimating the association between burnout and electronic health record-related stress among advanced practice registered nurses. *Appl Nurs Res* 2018; 43: 36–41.
8. Shanafelt TD, Dyrbye LN, Sinsky C, et al. Relationship between clerical burden and characteristics of the electronic environment with physician burnout and professional satisfaction. *Mayo Clin Proc* 2016; 91 (7): 836–48.
9. Kuhn T, Basch P, Barr M, et al. Clinical documentation in the 21st century: Executive summary of a policy position paper from the American College of Physicians. *Ann Intern Med* 2015; 162 (4): 301–3.
10. Pitts SR, Pines JM, Handrigan MT, et al. National trends in emergency department occupancy, 2001 to 2008: effect of inpatient admissions versus emergency department practice intensity. *Ann Emerg Med* 2012; 60 (6): 679–86.e3.
11. Mamykina L, Vawdrey DK, Hripcsak G. How do residents spend their shift time? A time and motion study with a particular focus on the use of computers. *Acad Med* 2016; 91 (6): 827–32.
12. Babbott S, Manwell LB, Brown R, et al. Electronic medical records and physician stress in primary care: results from the MEMO Study. *J Am Med Inform Assoc* 2014; 21 (e1): e100–6.
13. Moody LE, Slocumb E, Berg B, Jackson D. Electronic Health Records Documentation in Nursing. *Comput Inform Nurs* 2004; 22 (6): 337–44.
14. Furukawa MF. Electronic medical records and the efficiency of hospital emergency departments. *Med Care Res Rev* 2011; 68 (1): 75–95.
15. Zikos D, Diomidous M, Mpletsa V. The Effect of an Electronic Documentation System on the Trauma Patient's Length of Stay in an Emergency Department. *J Emerg Nurs* 2014; 40 (5): 469–75.
16. Chen Y. Documenting transitional information in EMR. *Proc SIGCHI Conf Hum Factors Comput Syst* 2010; 1787–96.
17. Palmer EM. Cognitive factors in emergency medical services. In: Keebler J, Lazara E, Misasi P, eds. *Human Factors and Ergonomics of Prehospital Emergency Care*. Boca Raton, FL: CRC Press; 2017: 13.

18. Carayon P, Schoofs Hundt A, Karsh B-T, *et al.* Work system design for patient safety: the SEIPS model. *Qual Saf Health Care* 2006; 15 (suppl 1): i50–8.
19. Holden RJ, Carayon P, Gurses AP, *et al.* SEIPS 2.0: A human factors framework for studying and improving the work of healthcare professionals and patients. *Ergonomics* 2013; 56 (11): 1669–86.
20. Hollnagel E, Wears RL, Braithwaite J. *From Safety-I to Safety-II: A White Paper*. The Resilient Health Care Net: Published simultaneously by the University of Southern Denmark, University of Florida, USA, and Macquarie University, Australia. 2015. <https://www.england.nhs.uk/signupto-safety/wp-content/uploads/sites/16/2015/10/safety-1-safety-2-white-papr.pdf> Accessed January 2020.
21. Castro GM, Buczkowski L, Hafner JM. The Contribution of Sociotechnical Factors to Health Information Technology–Related Sentinel Events. *Jt Comm J Qual Patient Saf* 2016; 42 (2): 70–AP3.
22. Sittig DF, Singh H. A new sociotechnical model for studying health information technology in complex adaptive healthcare systems. In: Patel V, Kannampallil T, Kaufman D, eds. *Cognitive Informatics for Biomedicine. Health Informatics*. Springer, Cham: QualSafHealthCare.
23. Walton M, Woodward H, Van Staaldin S, *et al.* The WHO patient safety curriculum guide for medical schools. *Qual Saf Heal Care* 2010; 19 (6): 542–6.
24. Schaeffbauer CL, Siek KA. Cautious, but optimistic: an ethnographic study on location and content of primary care providers using electronic medical records. 2011 5th Int Conf Pervasive Comput Technol Healthc Work 2011:63–70. doi: 10.4108/icst.pervasivehealth.2011.246024
25. Asaro P, Boxerman S. Effects of computerized provider order entry and nursing documentation on workflow. *Acad Emerg Med* 2008; 15 (10): 908–15.
26. Vishwanath A, Singh SR, Winkelstein P. The impact of electronic medical record systems on outpatient workflows: A longitudinal evaluation of its workflow effects. *Int J Med Inform* 2010; 79 (11): 778–91.
27. Makoul G, Curry RH, Tang PC. The use of electronic medical records. *Am Med Informatics Assoc* 2001; 8 (6): 610–5.
28. Irani, JS Middleton, JL Marfatia, R Omana, ETD'Amico, F. The use of electronic health records in the exam room and patient satisfaction: a systematic review. *J Am Board Fam Med* 2009; 22 (5): 553–62.
29. Neri PM, Redden L, Poole S. Emergency medicine resident physicians' perceptions of electronic documentation and workflow: a mixed methods study. 2015. *Appl Clin Inform* 2015; 6(1): 27–41. doi: 10.4338/ACI-2014-08-RA-0065
30. Chisholm CD, Collison EK, Nelson DR, *et al.* Emergency department workplace interruptions: are emergency physicians 'interrupt-driven' and 'multitasking'? *Acad Emergency Med* 2000; 7 (11): 1239–43.
31. Chisholm CD, Dornfeld AM, Nelson DR, *et al.* Work interrupted: a comparison of workplace interruptions in emergency departments and primary care offices. *Ann Emerg Med* 2001; 38 (2): 146–51.
32. McCarthy DM, Ellison EP, Venkatesh AK, *et al.* Emergency department team communication with the patient: the patient's perspective. *J Emerg Med* 2013; 45 (2): 262–70.
33. Weigl M, Müller A, Angerer P, *et al.* Workflow interruptions and mental workload in hospital pediatricians: an observational study. *BMC Health Serv Res* 2014; 14 (1): 433.
34. Carayon P, Wooldridge A, Hoonakker P, *et al.* SEIPS 3.0: Human-centered design of the patient journey for patient safety. *Appl Ergon* 2020; 84: 103033.
35. Valdez RS, Holden RJ, Novak LL, *et al.* Transforming consumer health informatics through a patient work framework: connecting patients to context. *J Am Med Inform Assoc* 2014; 22 (1): 2.
36. Steege LM, Rainbow JG. Fatigue in hospital nurses—'Supernurse' culture is a barrier to addressing problems: a qualitative interview study. *Int J Nurs Stud* 2017; 67: 20–8.
37. Thompson MJ, Reilly JD, Valdez RS. Work system barriers to patient, provider, and caregiver use of personal health records: a systematic review. *Appl. Ergon* 2016; 54: 218–42.
38. Schneider A, Wehler M, Weigl M. Effects of work conditions on provider mental well-being and quality of care: a mixed-methods intervention study in the emergency department. *BMC Emerg Med* 2019; 19 (1): 12.
39. Tomasi J, Warren C, Kolodzey L, *et al.* Convergent parallel mixed-methods study to understand information exchange in paediatric critical care and inform the development of safety-enhancing interventions: a protocol study. *BMJ Open* 2018; 8 (8): e023691.
40. Knoblauch H. Focused ethnography. *Forum Qual Soc Res* 2005; 6 (3): Art 44.
41. Cruz EV, Higginbottom G. The use of focused ethnography in nursing research. *Nurse Res* 2013; 20 (4): 36–43.
42. Fetterman DM. *Ethnography: Step by Step*. 2nd ed. Thousand Oaks, CA: Sage Publications; 1998.
43. Hughes J, King, V, Rodden T, *et al.* Moving out from the control room: ethnography in system design. In Proceedings of the 1994 ACM Conference on Computer Supported Cooperative Work (CSCW '94). New York: Association for Computing Machinery; 1994: 429–439.
44. Downing NL, Bates DW, Longhurst CA. Physician burnout in the electronic health record era: are we ignoring the real cause? *Ann Intern Med* 2018; 169 (1): 50.
45. Sarcevic A, Ferraro N. On the use of electronic documentation systems in fast-paced, time-critical medical settings. *Interact Comput* 2017; 29: 203–19.
46. Stanton NA. Hierarchical task analysis: developments, applications, and extensions. *Appl Ergon* 2006; 37 (1): 55–79.
47. Brixey JJ, Robinson DJ, Johnson CW, *et al.* A concept analysis of the phenomenon interruption. *ANS Adv Nurs Sci* 2007; 30 (1): E26–42.
48. Stiell A, Forster AJ, Stiell IG, Van Walraven C. Prevalence of information gaps in the emergency department and the effect on patient outcomes. *CMAJ* 2003; 169 (10): 1023–8.
49. Dawdy MR, Munter DW, Gilmore RA. Correlation of patient entry rates and physician documentation errors in dictated and handwritten emergency treatment records. *Am J Emerg Med* 1997; 15 (2): 115–7.
50. Arndt BG, Beasley JW, Watkinson MD, *et al.* Tethered to the EHR: primary care physician workload assessment using EHR event log data and time-motion observations. *Ann Fam Med* 2017; 15 (5): 419–26.
51. Reith TBI. United States healthcare professionals: a narrative review. *Cur-reus* 2018; 10 (12): e3681.
52. Robinson RD, Dib S, McLarty D, *et al.* Productivity, efficiency, and overall performance comparisons between attendings working solo versus attendings working with residents staffing models in an emergency department: a large-scale retrospective observational study. *PLoS One* 2020; 15 (2): e0228719.
53. Delaney M, Zimmerman KD, Strout TD, *et al.* The effect of medical students and residents on measures of efficiency and timeliness in an academic medical center emergency department. *Acad Med* 2013; 88: 1723–31.
54. Kennedy BP, Fitzmaurice L, Chan YR, *et al.* The love/hate relationship of tablets in electronic medical records: a usability study of a native EMR application for mobile devices. *Pediatrics* 2018; 141 (1): Meeting Abstract 11.
55. Spinell J. Emergency department 'teams' deliver results. 2014. <https://www.beckershospitalreview.com/hospital-physician-relationships/emergency-department-teams-deliver-results.html> Accessed 31 May, 2020
56. Bates DW, Landman AB. Use of medical scribes to reduce documentation burden: are they where we need to go with clinical documentation? *JAMA Intern Med* 2018; 178 (11): 1472–3.
57. Medstar Health National Center for Human Factors in Healthcare. Electronic Health Record (EHR) Safety and Usability, See What We Mean. 2019. <https://ehrseewhatwemean.org>
58. Beasley JW, Wetterneck TB, Temte J, *et al.* Information chaos in primary care: implications for physician performance and patient safety. *J Am Board Fam Med* 2011; 24 (6): 745–51.
59. Karsh BT, Weinger MB, Abbott PA, *et al.* Health information technology: fallacies and sober realities. *J Am Med Inform Assoc* 2010; 17 (6): 617–23.