A Task Analysis of Emergency Physician Activities in Academic and Community Settings

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Study objective: We characterize and compare the work activities, including peak patient loads, associated with the workplace in the academic and community emergency department (ED) settings. This allows assessment of the effect of future ED system operational changes and identifies potential sources contributing to medical error.

Methods: This was an observational, time-motion study. Trained observers shadowed physicians, recording activities. Data included total interactions, distances walked, time sitting, patients concurrently treated, interruptions, break in tasks, physical contact with patients, hand washing, diagnostic tests ordered, and therapies rendered. Activities were classified as direct patient care, indirect patient care, or personal time with a priori definitions.

Results: There were 203 2-hour observation periods of 85 physicians at 2 academic EDs with 100,000 visits per year at each (N=160) and 2 community EDs with annual visits of 19,000 and 21,000 (N=43). Reported data present the median and minimum-maximum values per 2-hour period. Emergency physicians spent the majority of time on indirect care activities (academic 64 minutes, 29 to 91 minutes; community 55 min, 25 to 95 minutes), followed by direct care activities (academic 36 minutes, 6 to 79 minutes; community 41 minutes, 5 to 60 minutes). Personal time differed by location type (academic 6 minutes, 0 to 66 minutes; community 13 minutes, 0 to 69 minutes). All physicians simultaneously cared for multiple patients, with a median number of patients greater than 5 (academic 7 patients, 2 to 16 patients; community 6 patients, 2 to 12 patients).

Conclusion: Emergency physicians spend the majority of their time involved in indirect patient care activities. They are frequently interrupted and interact with a large number of individuals. They care for a wide range of patients simultaneously, with surges in multiple patient care responsibilities. Physicians working in academic settings are interrupted at twice the rate of their community counterparts. [Ann Emerg Med. 2011;58:117-122.]

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INTRODUCTION

Since the 2000 Institute of Medicine report *To Err Is Human*,[1] there has been tremendous interest in examining how physicians interact with their work environments, with specific attention paid to identifying system items that may contribute to the potential for medical error. There have been few attempts to examine systems interventions that may assist potential error reduction. One reason is that the physician work environment is poorly characterized, making comparisons with baseline difficult when system operational interventions are contemplated or initiated (eg, computerized physician order entry).

For more than a decade, we have conducted observational studies examining components of the emergency department (ED) workplace.[2-4] This study was designed to weave several components together, to perform a task analysis of several ED workplaces. This allows a comparison with historical controls for some components (eg, introduction of computerized patient medical records, point-of-care testing, waterless hand cleansers widely dispersed throughout the ED, portable telephones). It also allows the most comprehensive description of the ED workplace, allowing us and others to measure future interventional strategies that may reduce error-producing conditions (eg, interruptions or reliance on memory for patient status tracking).

The goal of the study was to characterize and compare the activities of physicians practicing in academic and community EDs.

MATERIALS AND METHODS

We performed an observational, time-motion study. The observations occurred from June through August 2006 at 2

Editor's Capsule Summary

What is already known on this topic

Direct observation to characterize emergency physicians' work activities has rarely been done.

What questions this study addressed

In this time-motion study, trained observers shadowed emergency physicians in academic and community settings to record types of activities, such as interactions, interruptions, and direct and indirect patient care.

What this study adds to our knowledge

Physicians spent most of their time on indirect patient care activities, eg, charting, reviewing records and diagnostic tests, or interacting with consultants. They were frequently interrupted; in academic settings, interruptions were about twice as common as in community practices.

How this is relevant to clinical practice

This study is unlikely to change practice direct, but a grounded, empirical understanding of how emergency care is actually performed should be useful in implementing improvements to the care system while minimizing unexpected adverse consequences.

academic EDs, each with more than 100,000 annual visits per year, and at 2 community EDs with annual visits of 19,000 and 21,000. At the time of the study, ED patient records were handwritten at all sites, and all sites used computerized electronic medical record and laboratory/radiology results.

Trained observers shadowed physicians (all American Board of Emergency Medicine certified/prepared) for 2-hour observation periods, recording activities. Two-hour periods were chosen as the maximal time that observers could reliably collect data without fatiguing and also permitted them meal and bathroom breaks. Data included interpersonal interactions, distances walked, time sitting, patients concurrently treated, interruptions, breaks in tasks, physical contact with patients, hand washing, diagnostic tests ordered, and therapies rendered. Activities were classified as direct patient care, indirect patient care, or personal time with a priori definitions.[2-4] The observer followed subjects to all locations except the bathroom or when privacy was specifically requested by either the physician or patient. To minimize the Hawthorne effect, the investigator stood in the corner of the patient care room or at a distance of at least 5 feet from the subject in non–patient care areas and held a clipboard to obscure the data sheet. Different tasks such as charting, ordering medications, and ordering diagnostic tests are performed on different forms in the EDs so the observers can easily differentiate tasks from the 5-foot distance. Recorded data were encrypted so that observational subjects were unaware of the specific nature of the study. The investigator did not initiate conversation with the subject during the study period.

Using a standardized data collection form, the observer recorded the tasks being performed in 1-minute increments, interruptions during these tasks, number of interpersonal interactions, patients touched, distance walked, and the number of patients simultaneously under the care of the subject. Events taking less than 30 seconds were observed (eg, handwashing) while being recorded under the applicable task category for that minute (eg, direct patient care). Three task categories, defined a priori, were evaluated: direct patient care, indirect patient care, and personal activities. Data categorized under direct patient care included lifting patients, bedside history and physical examination, or any activity involving direct interaction with the patient, diagnostic tests ordered, medication ordering, bedside ECG interpretation, and procedures performed. Ordering diagnostic tests and therapies was classified as direct patient care because the order sheets were maintained at the bedside and were easily distinguishable to the observer. The indirect patient care category included charting, review of medical records, interacting with consultants or learners, and interpretation of diagnostic tests. We also included interaction with the family or friend of a patient, nurses, paramedics, consultants, social workers, translators, laboratory or radiology technician, secretaries, colleagues, law enforcement, and the teaching of learners. Personal activities included waiting, eating, social conversation with a colleague, and "other" (eg, reading the newspaper, "surfing the net"). Hand washing was a category of its own. We defined "interruption" as any event that briefly required the attention of the subject but did not result in switching to a new task. Examples included listening to an announcement on the public address system, a nursing inquiry about another patient, or a quick patient update from a learner. A "break in task" was defined as an interruption that subsequently resulted in changing tasks. Examples included answering incoming telephone calls or interrupting a wound repair to care for an arriving patient in cardiac arrest.

Investigators wore a pedometer calibrated to their gait to estimate the total distances walked during each observation period.

Participation in the study was voluntary, and we obtained verbal consent from participants. The investigator informed the physician subjects that we were conducting an observational study to better understand the ED work environment and that all data about them would remain both individually anonymous and confidential. The Indiana University institutional review board approved the project.

Observation periods included a nonrandomized sampling of all shifts, including weekends and nights. Nonparametric summary statistics were estimated during the 2-hour observation period. Descriptive statistics reported are the

Table 1. Main results of the study by academic and community sites.*

	Venue	Minimum	Quartile 1	Median	Quartile 3	Maximum
Diagnostic tests ordered	Academic	0	2	7	13	88
	Community	1	4	8	12	24
Data reviewed	Academic	0	6	10	14	27
	Community	3	6	10	14	25
Treatment ordered	Academic	0	2	4	6	15
	Community	0	3	5	7	19
Interruptions	Academic	1	6	12	17	32
	Community	0	3	6	15	19
Breaks in task	Academic	0	3	5	8	17
	Community	0	1	2	4	8
Total interactions	Academic	25	57	70	83	132
	Community	26	47	65	78	101
New interactions	Academic	14	30	35	43	70
	Community	8	19	23	32	44
Patients touched	Academic	1	4	6	7	13
	Community	0	6	7	10	20
Hand washes	Academic	0	1	2	3	9
	Community	0	0	2	3	7
Distance walked, miles	Academic	0.08	0.21	0.30	0.41	0.68
	Community	0.06	0.12	0.17	0.22	0.29
Time sitting, min	Academic	0	26	43	58	86
	Community	20	52	68	80	101
Indirect care, min	Academic	29	53	64	72	91
	Community	25	48	55	67	95
Direct care, min	Academic	6	27	36	47	79
	Community	5	28	41	52	60
Personal time, min	Academic	0	2	6	12	66
	Community	0	3	13	27	69
Maximum number of patients under care†	Academic	2	5	7	9	16
	Community	2	4	6	8	12

*N=160 (academic), N=43 (community). All values are during a 2-hour observation period.
†N=137 (academic), N=43 (community).

median, range (minimum, maximum), and interquartile range (quartile 1, quartile 3).

RESULTS

We conducted 203 2-hour observation periods. Eighty-five physicians at the 2 academic EDs (N=160) and 2 community EDs (N=43) were observed. Table 1 presents the main results of the study by academic and community sites.

Emergency physicians spent the majority of time on indirect care activities. Physicians at the academic sites spent a median of 64 minutes per 2-hour observation on this category (range 29 to 91 minutes) compared with a median of 55 minutes for community emergency physicians (range 25 to 95 minutes). Direct care activities represented the next most frequent use of time. Academic emergency physicians participated in direct care a median of 36 minutes per 2-hour observation period, with a range of 6 to 79 minutes compared with their community counterparts doing so for a median of 41 minutes, with a range of 5 to 60 minutes. The majority of time in direct patient care did not involve directly touching the patients; academic median 6 (range 1 to 13) and community median 7 (range 0 to 20). Personal time differed by location type. Physicians practicing in the academic environment experienced a median of 6 minutes per 2-hour observation period as personal time (range 0 to 66 minutes) compared with a median of 13 minutes (range 0 to 69 minutes) by the physicians at the community sites. All physicians simultaneously cared for multiple patients, with a median number of patients greater than 5 for all sites. The median number of simultaneous patients at the academic sites was 7 (range 2 to 16 patients) and 6 at the community sites (range 2 to 12 patients).

Academic emergency physicians had a median of 70 interpersonal interactions per period (range 25 to 132 interactions), and community emergency physicians had 65 interactions (range 26 to 101 interactions). The median number of different individuals interacted with were academic 35 individuals (range 14 to 70 individuals) and community 23 individuals (8 to 44 individuals).

Handwashing (sink and water based at all sites) occurred a median of 2 times (range 0 to 9 times) at academic centers and 2 times at community sites (range 0 to 7 times).

Physicians walked a median of 0.3 miles (range 0.08 to 0.68 miles) per 2-hour observation period at the academic sites and 0.17 miles (range 0.06 to 0.29 miles) at the community EDs.

At academic sites, there were a median of 12 interruptions (range 1 to 32 interruptions), with 5 interruptions (range 0 to

Table 2. Historical comparisons of the interruption rates in various ED settings.

Study	Interruptions/Hour	Setting	Date	Journal
Chisholm[2]	10	Rural, suburban, and urban teaching	2000	*Acad Emerg Med*
Chisholm[3]	10	Community	2001	*Ann Emerg Med*
Coiera[11]	11.5	Australian rural and urban	2002	*Med J Aust*
Spencer[13]	15, 23.5	Australian teaching	2004	*Ann Emerg Med*
Westbrook[7]	6.6	Australia teaching	2010	*Qual Saf Health Care*

17 interruptions) resulting in a break in task compared with 6 interruptions (range 0 to 19 interruptions) with 2 breaks (range 0 to 8 breaks) in task at community sites. Table 2 provides historical comparisons of the interruption rates in various ED settings.

Agreement between the 2 research associates was excellent. The intraclass correlation coefficient for interobserver agreement of task categorization and times was 0.82.

LIMITATIONS

The results of our study must be interpreted in light of several limitations and sources of potential error. First, although our study included as many different shifts as was possible, our shift sampling may not have been completely random. Second, "a major risk in any monitoring system is that its very presence might change the activity patterns of the observed events."[5] As described in the "Materials and Methods" section, we undertook several measures to minimize the influence of having an investigator observe subjects' activities (Hawthorne effect). Third, because we are unaware of a generally accepted methodology for categorizing work tasks in the health care environment, we developed our own categorization scheme. This system worked well in previous studies. Fourth, because the observers were not physicians, they may have misinterpreted or incorrectly classified some of the tasks, although interobserver agreement was good. Nonphysician investigators were chosen to allay concerns among the physician subjects that they would be observed by a peer. Fifth, although our study included 4 EDs in urban, suburban, and rural settings, the study sites may not be representative of EDs throughout the United States.

The obvious future investigational question centers around the effect of widespread implementation of fully electronic medical records in EDs. Additionally, emphasis and monitoring of hand hygiene practices as mandated by The Joint Commission (TJC) resulted in nearly universal use of waterless hand cleansers in EDs since this study. Local direct observation checks suggest vastly improved physician hand hygiene since then. Measures to protect emergency physicians from interruptions have progressed little since our initial work a decade ago. Recent work observes a correlation of interruptions with nursing medication errors.[6] Although technically feasible, to our knowledge little implementation has been accomplished in developing electronic "virtual patient records" accessible to multiple nurses and consultants for review and data entry simultaneously allowing asynchronous information transmission and interaction without interruptions. Similar use of an electronic message board could allow communication with consultants without the currently built-in telephone call interruptions. Paradoxically, such an electronic whiteboard may create a degradation in some features of communication (eg, inability to know, or misunderstanding of, the emotional valance of the sender's message). Implementation of such a system would create the need to carefully examine for unintended consequences.

DISCUSSION

Our study represents the most comprehensive attempt to characterize physician activity in the ED workplace. Academic and community workplaces share many similar facets that are likely consistent in emergency medicine practice. Physicians spend the most time on indirect care activities, followed by direct care, with limited personal time. They interact with many individuals, and interruptions create breaks in task. ED providers experience profound variability in peak patient loads. Such periods of peak patient loads are commonly referred to as surge. Peaks in simultaneous active patient care responsibilities of 16 (academic) and 12 (community) reflect ED surge phenomena. Operational systems should address ED surge volumes (as opposed to medians) to maximize efficiency and patient and provider safety and wellness.

The amounts of time spent in direct and indirect patient care activities have changed little during the decade since Hollingsworth et al[4] published their initial report in 1998. The introduction of electronic medical record, computer-based radiology image review and point-of-care testing appears to have not significantly affected these time allocations. These therefore may be somewhat consistent in the practice of emergency medicine. Direct patient care activities in particular were remarkably similar in both settings and very similar to that reported in a recent study conducted at an Australian teaching hospital.[7] These results are also similar to data examining hospitalists activities that found that 26% and 21% of their time was spent on direct patient care activities.[8] The slightly larger amount of time spent in indirect patient care activities at the academic sites may reflect the higher complexity of some of those patients, as well as the need for a larger number of calls to coordinate multiple consulting physicians.

We were surprised by the relatively low numbers of times that emergency physicians in each venue touched a patient,

suggesting that repetitive physical examinations of the same patient rarely occur. Perhaps emergency physicians rely on nursing assessments, monitoring vital signs, or use of "doorway gestalt" in an effort to obtain time efficiency. This likely also reflects the focused rather than general examination approach appropriate for many ED patients, as well as the use of observational components of the examination.

Academic emergency physicians have more interruptions, and more of these result in breaks in task than their community counterparts. The presence of learners and higher overall acuity of illness (perhaps necessitating larger numbers of consultant discussions) likely contribute to this. It is interesting that the total number of interruptions per hour has remained so consistent in numerous publications, again suggesting this as a feature of the ED workplace.[2,3,6] Although a recent study of hospitalists observed that 1 in every 10 minutes is spent in simultaneous activity, the data gathering instrument did not specifically record interruptions or breaks in task.[8] The Australian teaching hospital study observed that physicians failed to return to an interrupted task nearly 20% of the time.[6] There is evidence supporting the negative effect of interruptions on task performance and subject perception of stress,[9,10] and we agree with the speculation by Westbrook et al[6] that interruptions likely cause emergency medicine providers to compensate through task short cuts or failure to reengage in the task. This suggests that teaching cognitive forcing strategies to reorient after an interruption, and especially after a break in task, may be beneficial to ED providers.[2,3,11] In addition, ED systems design should incorporate methods to reduce undesired interruptions.

Hand hygiene remained poor in both venues (approximately one third of patient contacts). This number likewise reflects little improvement from historical data.[4,12] Our data collection preceded the widespread use of alcohol-based hand cleansers that tend to be geographically more conveniently located than traditional sinks. Anecdotally, direct observation of physicians at one of the academic center study sites in 2009 revealed consistent hand cleansing compliance for emergency physicians more than 70%, using strict TJC definitions.

We did find a significant decrease in the distances walked by academic physicians compared with our historical data (0.3 versus 0.6/2-hour period).[4] This likely reflects a reorganization of work area responsibilities since that publication, resulting in improved ergonomic efficiency.

We chose to document human interactions, and each interaction required acknowledgment and cognitive decisions about the content of the conversation (these were all more than a simple "hello"). We were surprised by the large number of human interactions (>30/hour in each venue), as well of the number of new interactions (which include introductions and quickly "sizing each other up"). This reinforces the attention given to efficient communication skills by emergency physicians. Many of these interactions likely factor directly into patient satisfaction surveys and a decision to seek legal counsel in the setting of a poor patient outcome.

These objective workplace measures permit future assessment of ED system changes. This may assist a system to change in ways that result in the intended improvement without creating adverse unintended consequences. In particular, workplace changes should be carefully examined for the effect of ED provider interruption and efficiency of communication.

We found many similarities between the academic and community ED practice environment, suggesting that many features are consistent to the practice of emergency medicine. Indirect patient care activities occupy the majority of time. Direct patient care activities are remarkably similar in both venues. Academic emergency physicians sustain more interruptions per hour than their community counterparts. There is limited personal time. Emergency physicians interact with more than 30 individuals per hour. Future ED operational system design should promote direct patient interaction, limit or not increase indirect patient care responsibilities, minimize undesired interruptions, promote efficiency in communication, and be cognizant of the large number of individuals emergency physicians must interact with each hour.

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