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Original Contributions

PHYSICIAN, INTERRUPTED: WORKFLOW INTERRUPTIONS AND PATIENT CARE IN THE EMERGENCY DEPARTMENT

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□ **Abstract—Background: It is unclear how workflow interruptions impact emergency physicians at the point of care. Objectives: Our study aimed to evaluate interruption characteristics experienced by academic emergency physicians. Methods: This prospective, observational study collected interruptions during attending physician shifts. An interruption is defined as any break in performance of a human activity that briefly requires attention. One observer captured interruptions using a validated tablet PC-based tool that time stamped and categorized the data. Data collected included: 1) type, 2) priority of interruption to original task, and 3) physical location of the interruption. A Kruskal-Wallis H test compared interruption priority and duration. A chi-squared analysis examined the priority of interruptions in and outside of the patient rooms. Results: A total of 2355 interruptions were identified across 210 clinical hours and 28 shifts (means = 84.1 interruptions per shift, standard deviation = 14.5; means = 11.21 interruptions per hour, standard deviation = 4.45). Physicians experienced face-to-face physician interruptions most frequently (26.0%), followed by face-to-face nurse communication (21.7%), and environment (20.8%). There was a statistically significant difference in interruption duration based on the interruption priority, $\chi^2(2) = 643.98$, $p < 0.001$, where durations increased as priority increased. Whereas medium/normal interruptions accounted for 53.6% of the total interruptions, 53% of the interruptions that occurred in the patient room (n = 162/308) were considered low priority (χ^2 [2, n = 2355] = 78.43, $p < 0.001$). Conclusions: Our study examined interruptions over entire provider shifts and identified patient rooms as high risk for low-priority interruptions. Targeting provider-centered interventions to patient rooms may aid in mitigating the impacts of interruptions on patient safety and enhancing clinical care.** © **2017 Elsevier Inc. All rights reserved.**

□ **Keywords—interruptions; workflow; patient safety; human factors**

INTRODUCTION

Emergency medicine is a dynamic environment characterized by unpredictable workloads, time-critical activities, medically complex cases, and the concurrent management of multiple patients. To meet the demands of the emergency department (ED), physicians must actively engage with a number of team members, including other clinicians, nurses, residents, and technicians. Although interaction with ED staff members is absolutely necessary for patient care and management, at many times these interactions can interrupt physicians

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from their current task. In an already challenging environment, frequent interruptions can add to the demands placed on clinicians in the ED.

Emergency physicians are interrupted six to 11 times per hour—nearly three times more than primary care providers (1–4). Interruptions are commonly characterized as having negative implications for patient safety. They can delay clinician responses to patients and increase the risk for errors by disrupting clinicians' thought processes and increasing cognitive demands (5,6). Yet, interruptions in the clinical work process can also be beneficial by providing critical, time-sensitive information that relates to patient care (7). In the moment, interruptions can provide a "fresh set of eyes" on the task, giving the clinician an opportunity to evaluate the current task and change accordingly. Pausing the current task—as a result of an interruption—and subsequently performing a task assessment can prevent error occurrences due to performance degradation.

Relatively few studies examined interruptions in the ED to understand their impact on cognitive workload and workflow at the point of care (8–11). As a result, development of practical solutions to improve information transmission and reduce interruptions in this high-risk environment is limited. Interruptions studies related to patient safety in the ED are traditionally performed over short time periods, which provide only a superficial understanding of the nature of interruptions occurring (7,8). Our study aimed to examine interruptions experienced by emergency physicians over the duration of entire shifts. Using observations and surveys, our study quantified interruptions based on frequency, duration, type, priority, and location of interrupted physicians to further develop opportunities to intervene in avoiding interruptions of low value.

METHODS

Setting and Participants

We conducted an observation-based, prospective study in an academic ED located in the Midwest. The ED was fitted with 72 rooms, including seven dedicated resuscitation bays and 11 pediatric rooms. Annually, the ED receives 73,000 patient visits, with 35% of adult patients admitted to inpatient care. The Institutional Review Board approved this study.

We approached attending physicians during a monthly meeting to discuss the study goals. Participation was voluntary and physicians could opt out at any time. Based on those who provided consent and researcher availability, we utilized a convenience sampling in selecting which attending physician shifts to observe.

Research Protocol

One experienced health-care systems engineering researcher (HJH) shadowed emergency medicine attending physicians during their regularly scheduled work shifts. At the beginning of a shift, the researcher introduced himself to the participating attending. During the shift, the researcher collected data on interruptions using a tablet data collection tool and observed the physician workflow—including patient care. If at any point a patient did not want to be observed, the researcher stepped outside the patient room and continued observation when the physician exited the patient room. For the purposes of this study, we defined an interruption as "any break in the performance of a human activity initiated by a source internal or external to the recipient, that very briefly requires the attention of the participant and does not inherently necessitate the clinician change tasks" (2).

We captured interruptions using a validated tablet PC-based tool that time stamped and categorized interruptions in real time according to 1) type, 2) priority (i.e., low, normal/medium, high/critical), and 3) the physical location where the interruption occurred (12). A description of the interruption types can be found in Table 1. The researcher determined interruption priority by comparing the interruption in relation to the current task. For instance, if a current task involved checking patient blood pressure and the physician is interrupted with a trauma page, the interruption would be recorded as "high/critical" priority in relation to the blood pressure task. Such examples were confirmed with ED staff prior to the study. Interruption location included in Patient Room, Outside Patient Door, Hallway, Staff Station, or Dictation Room/Area.

Data Analysis

We analyzed the observation data using the statistical software RStudio (Version 0.99.489, Boston, MA), and Microsoft Excel (Microsoft Corporation, Redmond, WA). Interruption duration was calculated from the time stamps. Descriptive statistics included means (M), medians (Mdn), and standard deviations (SD). A Kruskal-Wallis H test analyzed the effect of interruption priority on duration, and a chi-squared test examined interruption priority in and outside of the patient rooms. We designated the interruption locations outside patient door, hallway, staff station, and dictation room/area as "Out of Patient Room."

RESULTS

Of the 46 attending physicians working at this institution, 28 (n = 28/46, 60.9%) participated in our study. Our study