STRESSORS IN THE PHARMACY: AN OBSERVATIONAL STUDY OF INTERRUPTIONS

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Errors in the healthcare field are a significant problem. Interruptions leading to distractions have been identified as an important cause of errors. Within the pharmacy, interruptions leading to medication errors have received particular attention. Both external and internal sources can cause interruptions, which can distract the pharmacists and the technicians from their tasks. Hence it is important to study interruptions, their types, how they are caused, where and when they come from, how long they last, and how pharmacists and technicians feel about them. The objectives of this observational and survey study were to: 1) classify interruptions based on the type of interruption and cause, time, location, and duration, 2) identify differences in interruption types, duration and frequency across days of the week or time of day, and 3) quantify pharmacist perceptions related to workload and stressors (e.g. interruptions) in their work environment, through an employee survey. Results indicate that 64% of interruptions were classified as incoming phone calls, and the mean duration of interruptions is 1.14 minutes. Further, pharmacists and technicians differ in their perceptions of workload and reported top stressors. Analyzing stressors, including interruptions and their causes, can aid in improving the processes and increasing safety within the pharmacy.

INTRODUCTION

There have been numerous advancements in medical and information technology in recent years, yet error rates remain high in health care delivery systems. These errors lead to serious consequences for patients (Knudsen, Herborg, Mortensen, Knudsen, & Hellebek, 2007). The 1999 Institute of Medicine report, *To Err is Human*, draws attention to the extent of preventable errors within the healthcare sector (Institute of Medicine, 2000). The report highlights the number of preventable deaths in the range of 44,000 to 98,000 per year. Though these estimates are based on extrapolations, even going by the conservative estimate, these rates are alarming. Medication-related deaths are approximately 9,000 per year (Phillips, Christenfeld, & Glynn, 1998).

In addition to implications for patient safety, medication errors have also been associated with increased costs due to increased lengths of stay and other costs. Pharmacy operations constitute a major component in the hospital revenue cycle (Albert, 2001) and account for approximately 15 percent of the typical US hospital budget (Gupta, Wojtynek, & al., 2006). Thus, costs associated with medical errors in the pharmacy have direct implications for hospitals, and further understanding these errors and their causes may contribute valuable information to the ongoing discussion related to rising costs in the healthcare system.

Determining root causes of errors and estimating error rates are ongoing challenges within the healthcare sector. An error is defined as failure of a planned action to be completed as intended and includes errors of commission and omission (Reason, 2000). There are multiple factors, such as facility layout, workload, interruptions, patient's condition, interface, etc. that contribute to the failure of a planned action (Ash, Berg, Colera, & al., 2004). Human errors are inherently attributable to characteristics of human cognition and system design (Nolan, 2000) – largely because of the human component, but also the often complex and dynamic context in which many humans operate (Rasmussen, 1997).

In many high-risk industries human error is a fundamental contributor to organizational errors, and workflow interruptions have been observed to be a main source of human errors (Yates, Hochman, Sayles, & Stockmeier, 2004). Within healthcare systems, and in particular the pharmacy, interruptions have also been identified as a contributing factor to human error, and ultimately to patient safety. Numerous studies have shown that the understanding of interruptions is vital to design, implement and evaluate work processes and information systems to prevent errors within the health care system (Brixey et al., 2005; Brixey, Walji, Zhang, Johnson, & Turley, 2004).

Although interruptions and the ensuing distractions have been identified as major causes of errors, and despite

the many medical advances in the past 20 years, interruptions and distractions continue to cause problems for inpatient pharmacies. These disruptions can be a concerning issue when analyzing the work of pharmacists and technicians who are working on visual tasks (Sobek & Jimmerson, 2003). These disruptions add to the already high activity environment and act as stressors for the pharmacists and technicians. Stressors may also include extraneous noises caused by ringing phones, door bells, fax or printing machines, tube systems, etc. In addition, the large number of employees confined to a restricted space can cause a loud ambient environment. Together, these interruptions and other stressors within the pharmacy setting may prevent a pharmacist or technician from thoroughly and accurately completing the task at hand. This may lead to medical errors. Thus, there is a need to better understand and ultimately to decrease interruptions and stressors within hospital pharmacies.

Objectives

Therefore, the objectives of this study were to: quantify and classify interruptions occurring in a hospital inpatient pharmacy; identify differences in interruption types, durations, or frequencies across days of the week or times of day; and measure worker perceptions of workload, stressors and interruptions in the pharmacy work environment.

METHODS

Study Design

There are two phases to this study. First, an observational study was conducted to quantify and classify interruptions across work days and shifts. This study built on the work conducted in a previous observational study in this pharmacy (Silver, Zhang, & Pasupathy, 2010). Second, a survey was conducted to determine pharmacy worker perceptions of workload and stress. Prior to any sessions and data collection, approval for the study was obtained from the local Institutional Review Board.

Phase 1 - Observational Study. A team of three observers recorded the time, duration, location and description of interruptions and distractions in a central pharmacy within a large academic hospital. For the purposes of this study, an interruption was classified as a noticeable diversion of attention from the task at hand. An interruption was marked when the participant successfully returned to complete their initial task, as well as when their attention was further diverted. The observer used behavioral cues to identify a distracted employee. These included answering phone calls, an employee leaving desk to tend the window, or other noticeable sign of distraction. Stopwatches were used to measure the duration of each interruption. Observation sessions were scheduled for up to two hours and occurred during three different day of the week combinations (Monday-Thursday, Friday, and Saturday-Sunday) based on results from previous work (Zhang & Pasupathy, 2009), and three different times of day periods, for a total of nine observation intervals. The time periods were classified as morning (8 a.m. – 11 a.m.), afternoon (11 a.m. – 5 p.m.) and evening (5 p.m. – 9 p.m.). During sessions, the observer stood or sat in pre-determined locations close to the pharmacist or technician. Upon observing an interruption, they first used contextual cues to determine the root cause and classify the interruption. If the observer was not able to determine the cause of the interruption, they asked the pharmacist/technician to provide a brief summary of the situation. One or two observers were present during each of the observation sessions, and. all pharmacists and technicians working at the given time periods in the pharmacy agreed to be observers in the project. Two observation sessions were conducted for observer calibration and to ensure consistency and inter-observer reliability in data collection. During these two calibration sessions all three observers were present and recorded the same set of interruptions. Upon completion of the second session, 100% consensus on interruption data was achieved.

Phase 2 – Survey of Worker Perceptions. A survey to measure worker perceptions of workload, stressors and technology was administered to pharmacists and technicians in order to quantify worker perceptions and identify differences between worker groups with regard to perceived workload and stress in the workplace. The survey consisted of questions from the Physicians Workload Instrument (D.A. Bertram, Hershey, Opila, & Quirin, 1990; D. A. Bertram et al., 1992), along with additional items to quantify perceptions of technology use, and ratings of stressors (noise, interruptions) and their impact on the work environment. The surveys were handed out and returned anonymously. The first ten questions asked the employee to respond to aspects of workload on a 0 to 10 scale (with zero being none, and ten being an extreme amount) (Bertram, Hershey et al., 1990; Bertram, Opila et al., 1992). Specifically, these questions measured the amount of: mental effort, physical effort, sufficient help, sufficient time, modify standards, spare time, utilize technology, comfort in learning new technology, technology increasing efficiency, and ease of daily processes. The next 5 questions allowed the employee to respond on a 0 to 5 scale (zero being none and five being to a great extent) to rate: their levels of stress, how interruptions affect productivity, how noise affects accuracy, the frequency of multiple tasks, and the frequency of interruptions. After the survey was administered the responses were separated by work title (pharmacists and technicians) and the differences between responses from pharmacists and technicians were evaluated.

Setting

Participants for the observations and surveys were all staff members in the Inpatient Central Pharmacy located in a 274-bed University Hospital in a large academic health system.

Data Analysis

Data from the observational study, including the duration, type, job title, time, location, and description of each interruption, were recorded onto a prepared table in a spreadsheet and input into Microsoft Excel for further statistical analysis. Descriptive statistics were then computed to quantify frequencies and durations of interruptions.

Analysis of observational interruptions data was also performed using Chi-Square Automatic Interaction Detection (CHAID). CHAID was used to identify differences between interruption types, when they occurred (time of day and day of the week), and their frequency and duration. CHAID is an exploratory technique based on a tree-based classification of relationships between a dependent variable and a series of predictor variables (Kass, 1980). CHAID provides partitions in the data set based on the independent variables. These partitions help build profiles and formulate categorization rules. All relationships were significant at least at the p=0.05 level. All variables were coded as nominal type except for the duration of the interruption, which was coded as a scale type. Duration results are shown as mean (SD).

The data collected through the survey were complied into a Microsoft Excel sheet in order to separate the responses based on job title. Descriptive statistics (mean, standard deviation) were also calculated for each question. The mean responses found for each question were categorized as Pharmacist Response Average, Technician Response Average, and Overall Average. Differences in the means from the Pharmacist and Technician responses were analyzed using a using a two-sided t-test (α =.05) in Mini-tab.

RESULTS

Descriptive Statistics

During this study a total of 20.5 hours were observed, and the research team recorded a total number of 227 interruptions. The average number of interruptions per hour was 11.04 and the average length of interruption was 1.14 minutes. The numbers of interruptions per work shift time period are shown in Figure 1 for morning, afternoon, and evening time shifts. The time of day with the highest number of average interruptions is the Afternoon. Table 1 summarizes all of the classifications of interruptions with the descriptive statistics on their means and standard deviations for duration, frequencies, and relative frequency.

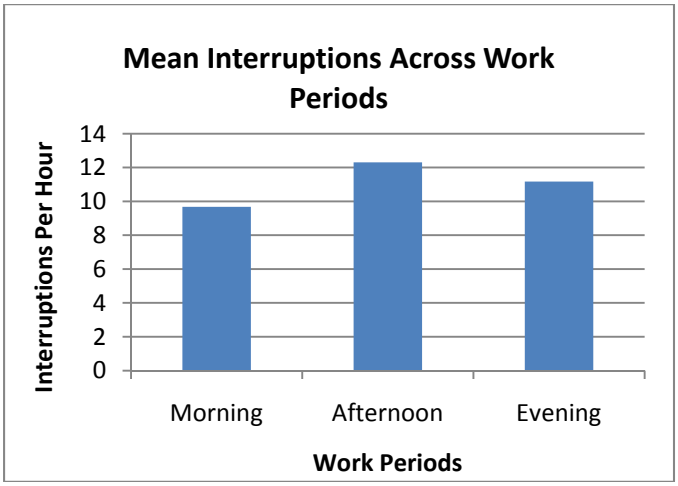

Figure 1: Mean number of interruptions across time periods.

Table 1: Descriptive statistics for Interruption Types across observation sessions.

Type	Mean (SD) Duration (Min.)	Overall Frequency	Relative Frequency (%)
In. Phone/Clarify Meds	1.31 (1.08)	33	15%
In. Phone/Transfer Call	0.97 (1.45)	18	8%
In. Phone/Missing Info	0.78 (.52)	10	4%
In. Phone/Confirm Order	0.62 (.49)	16	7%
In. Phone/Check up Order	1.64 (1.30)	22	10%
In. Phone/Change Medication	0.98 (.79)	20	9%
In. Phone/Personal	2.88 (3.27)	2	1%
In. Phone/Hurry up Calls	1.59 (1.28)	13	6%
In. Phone/Unknown	0.62 (.38)	12	5%
Outgoing Phone	1.03 (.44)	11	5%
Outgong/Confirm Orders	0.58 (.24)	3	1%
Outgoing/Check up Orders	0.98 (.40)	2	1%
Outgoing/Change Medication	2.02 (1.53)	2	1%
Outgoing/Personal	0.59 (.00)	1	0%
Outgoing/Hurry Up Calls	1.25 (.00)	1	0%
Outgoing/Unknown	0.97 (.63)	8	4%
Discussion	0.85 (.76)	30	13%
Window	2.31 (2.48)	12	5%
Door	0.33 (.15)	5	2%
Hands on Task	1.07 (.99)	6	3%

Differences in Interruptions across Days of Week and Time of Day

When the types of interruptions were analyzed, time of day was the most significant predictor. The types of interruptions that occur at different time during the day were significantly different. Mornings are likely to have general discussions and check up on specific orders. Whereas, afternoons are likely to have clarifying medications and transfer calls. Evenings have clarifying medications and "hurry up" calls. Among evening interruptions, there is a significant difference between those that occur on Mondays through Thursdays and those that occur on Fridays through Sundays. Evenings on Mondays through Thursdays are very likely to have window interruptions and hands on task interruptions. Friday,

Saturday and Sunday evenings are likely to have clarifying medications and "hurry up" calls.

When duration was analyzed, there were four significant classifications. Those interruptions at the window and related to personnel were the highest at 2.3 (2.33) minutes. Interruptions at the door and confirming orders were the shortest and lasted for 0.6 (0.4) minutes. Clarifying medications, check-up orders and "hurry up" calls lasted 1.5 (1.2) minutes. The rest lasted 0.9 (0.7) minutes.

Interruptions are likely to be on Friday afternoons (48%) compared to mornings and evenings (26%), while interruptions on other days are likely to be during mornings and evenings (46%) compared to afternoons (12%).

Worker Perceptions of Workload and Stressors

Ten pharmacists and eight technicians completed the survey. Pharmacists rated their mental effort as significantly higher than Technicians (t =3.46, p = .005). In contrast, technicians rated their physical effort significantly higher than pharmacists (t = -3.24, p = .006). Pharmacists also responded whether they have sufficient time to complete tasks as significantly higher than technicians (t = 2.38, p =.032). Technicians rated that they have significantly more spare time than pharmacists do (t = -2.31, p = .039). Pharmacists rate a significantly higher frequency of multiple tasks at one time than technicians (t = 2.19, p = .045). Pharmacists also rate significantly higher frequency of interruptions than the technicians (t = 2.43, p = .038). Survey respondents were also asked to indicate the top stressors in their work environment. For pharmacists the top three stressors were phone calls (9/10 respondents), lack of staff, specifically saying that there is a lack of technician staff (4 respondents), and issues related to health information systems (e.g., CPOE and EMAR) implementation (4 respondents). The technicians had the top three responses of too many phone calls (7/8 respondents), inadequate staff (5 respondents) and all things regarding the Pyxis machine, including filling it (2 respondents).

DISCUSSION

Observation results indicate that there are a number of sources of interruptions in a hospital pharmacy. In this study, incoming phone calls to clarify orders were the most frequent interruptions (15%), and incoming phone calls in general comprised 65% of all observed interruptions. While these were the most frequent interruptions, they were not always longest in duration. Outgoing phone calls to change medications, and interruptions via the pharmacy window were longer in duration than most of the incoming phone call interruptions, the exception being incoming personal phone calls. Classification of interruptions may be split into two different realms, internally driven and externally driven (Gonzalez & Mark, 2005). With internally driven interruptions, such as outgoing phone calls, it is easier for the participant to choose a more optimal time to interrupt a task. However, this may not always be true for externally driven interruptions (e.g. incoming phone calls), as they are unpredictable (McFarlane & Latorella, 2002). Thus, higher rates of incoming phone calls as externally driven interruptions may be especially critical with regards to disruption of pharmacy tasks and potential implications for errors.

The prevalence of interruptions coming in the form of incoming phone calls points to the importance of a systemic view in understanding performance in pharmacy processes. Human factors research has long established that interruptions, particularly those that disrupt the primary task and require divided attention, are a root-cause of human error, including error in healthcare environments (Brixey, et al., 2005; Flynn et al., 1999; Subramoney, 2009; Yates, et al., 2004). Previous researchers have also identified taxonomies of interruptions (Brixey, et al., 2004), however these taxonomies have not analyzed data to identify patterns between the types of interruptions, when they occur (time of day and day of week) and how long they last (duration). This study collected preliminary data based on existing interruptions taxonomy and identified patterns for the hospital pharmacy. These are being presented to the practitioners to understand stressors to help better design/change work systems.

Results of the survey indicated differences between pharmacists and technicians with regard to stressors, workload, and interruptions. Both the pharmacists and the technicians agreed on one of their top 3 stressors, that the pharmacy requires more workers. The pharmacists specified that there is a need to increase staff numbers, specifically hiring more technicians. This is interesting because technicians report that they have significantly more spare time than the pharmacists. Workers were also asked to report suggestions for improvement, pharmacist responses consistently suggested that more staff is needed; this was very similar to their responses for their top 3 stressors. Technicians, in contrast, had fewer overall suggestions for change (10 suggestions to the Pharmacists 20 suggestions), and overall their suggestions focused on decreasing the number of phone calls by decreasing the amount of phone lines. Agreeing with the Pharmacists, the Technicians also suggested an increase in the number of Technicians in the pharmacy. Overall, these data on worker perceptions enable further understanding of the causes and implications of interruptions and other stressors in order to better target process improvement and work system redesign efforts and improve quality. In summary, interruptions, especially externally driven interruptions, are prevalent within the pharmacy. Additional work is needed to further describe these interruptions and their implications for task

performance. Specifically, future studies should consider to what extent interruptions are similar or dissimilar from the current task. Future work should also focus on the time usage of the technicians, and interruptions that they face. From the results of this study the technicians report having more spare time than pharmacists, but both pharmacists and technicians agree that hiring more technicians could improve overall work flow within the pharmacy. Future work could also investigate the time utilization of the technicians to identify potential waste and determine whether additional hiring is actually needed.

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