Original Contribution

Perceived vs. actual distractions in the emergency department

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Abstract

Introduction: The emergency department (ED) has been shown to be an interrupt-driven workplace fraught with potential for distractions and interruptions that increase the potential for medical error. Accuracy of provider perception of these distractions and interruptions has yet to be investigated.

Methods: An observational two-phase study was conducted over a 9-week period in the highest acuity zone of the ED at an urban, academic medical center with about 90,000 visits/year. Phase I, conducted over the initial 5-week period, consisted of observers recording the type and frequency of all overhead pages in the ED. In phase II, conducted over the final 4-week period, direct observation of faculty and residents was done to record all individual interruptions for different levels of training. Actual data was compared to provider perceptions, as determined by survey responses.

Results: 2438 overhead pages were recorded and occurred, on average, 23.2 times per shift. The perceived rate of overhead pages was 43.2 per shift. 333 individual interruptions occurred, on average, 4.26 times per shift. The perceived rate was 53.5 per shift. Attending providers perceived a significantly higher number of individual interruptions compared to all resident providers.

Conclusion: The perceived amount and rate of distractions and interruptions are significantly higher than the actual amount and rate of distractions and interruptions. Attending physicians both perceive and experience more distractions and interruptions. Further work should be done to evaluate the power of provider perception, and the potential contribution of inaccurate perception to medical error and provider burnout.

1. Introduction

The Emergency Department (ED) has been described as a “natural laboratory for error” and emergency medicine (EM) has been known as “a practice prone to error” [1,2]. Wears and colleagues described several features that make the ED particularly complex, including the need to simultaneously evaluate patients with varying characteristics, high levels of uncertainty, and a lack of feedback regarding treatment success [3]. These are compounded by an “unbounded” potential for patients, severe time constraints, and multiple shift changes and handoffs [4,5]. These complexities all contribute to high error rates in the ED. A point of potential error is the overlap between multitasking and interruptions [5].

Interruptions are more common in the ED than in other specialties [6,7]. One study showed that ED physicians are interrupted three times as much as primary care physicians [8,9]. Academic EDs have also been shown to have twice the amount of interruptions as community EDs. High volume EDs are also subject to more interruptions, as both interruptions and the associated need to change tasks to deal with the interruption increase with the number of patients seen [8]. Not surprisingly, distractions and interruptions in the ED are most often initiated via telephone or face to face interactions, and physicians and nurses have been shown to be the most frequent receivers of interruptions [10].

Interruptions have been shown to occur in the ED as frequently as every 6–9 min [5,11]. This has been compared to rates of distractions for distracted drivers and distracted pedestrians, who are more prone to accidents that result in injury to themselves or others [11]. In medicine, as in life, the relationship between medical errors or adverse events and interruptions is complex [12]. Although difficult to prove, it is generally accepted that medical errors are likely to increase as the number of distractions or interruptions increases [13,14]. This study sought to compare the
perception of distractions and interruptions by EM physicians with actual occurrences in the ED.

2. Methods

2.1. Study design and setting

An observational two-phase study was conducted over an 9-week period in an urban, academic center with an annual volume of about 90,000 patients. Observations were recorded by 9 work-study research students, who were not involved in direct patient care, and worked shifts in parallel with ED physicians. All observations were made in the highest acuity zone of the ED, which is staffed by 2 attending physicians and 4 resident physicians. The residency program is a 3-year training program, and residents of all training levels rotate through the high acuity zone. In the study ED, attending physicians work 8-hour shifts, as do third year residents (R3) and second year residents (R2). First year residents (R1) work 10-hour shifts. Resident physicians all rotate through the same circadian clinical schedule. While some attendings do have set hours and potentially work certain shifts, most of the faculty work an equal number of day, evening and overnight shifts. Observations were made by the work-study research students 24 h per day for the 8-week study period, with one student on each 8-hour shift. The students were trained to recognize and appropriately categorize the distractions and interruptions prior to the study period. Approval from the institutional review board was obtained for the study.

2.2. Measurements and outcomes

For the purposes of this study, observations were recorded as ‘distractions’ if they were overhead pages and could potentially affect multiple providers at once, and ‘interruptions’ if they were experienced only by individual providers. Phase I focused on distractions and phase II focused on interruptions.

2.2.1. Phase I

In phase I of the study, which took place over the first 5-weeks of the study period, observers recorded the type and frequency of all overhead pages in the ED during all shifts. Overhead pages are heard by everyone present in the department at the time of the page, and therefore, could potentially distract all providers at the same time. The overhead pages recorded were those listed in Table 1.

2.2.2. Phase II

In Phase II, which took place over the latter 4 weeks of the study period, the work-study research students directly observed attendings and residents of different training levels. Each week of the 4-week period was dedicated to observing a physician of a different level of training. Attendings were observed during the first week, followed by R3s, R2s, and then R1s. Interruptions recorded during this phase were those that only affected the providers at whom they were directed, rather than all providers in the department. At the study institution, there is a graded increase in responsibility, in which additional tasks are taken on as the level of training progresses. There are certain tasks which are managed by R1s, R2s, R3s, and attendings. Those tasks are independent of both the transitions within the residency program and years of experience for attendings. Individual interruptions that were recorded are listed in Table 2.

2.2.3. Survey

Prior to the observation study period, a survey, developed by the study investigators, was sent to all EM faculty and resident physicians at the study hospital. Survey questions included an estimation of the number of distractions and interruptions on individual shifts, the impact of those distractions and interruptions on patient care, and a ranking of the frequency of different categories of both distractions and interruptions. Distractions and interruptions included in the survey reflected common overhead pages and individual tasks that were an established part of departmental operations. Specific questions asked on the survey are listed in the Appendix A. Survey responses were anonymized outside of level of training. No residents were individually identified, and no distinction was made between the number of years of experience of attending providers. This study did take place during a transition time within the residency and the beginning of a new academic year. Therefore, survey responses for distractions and interruptions were, for the latter part of the study period, compared to actual distractions and interruptions for different individuals. However, regardless of the individual provider, the same tasks are managed by residents of different levels of training, so survey responses from specific residency levels should accurately reflect the observations recorded for those same training levels. Likewise, the distinction amongst attending providers would not have impacted the recorded observations, as all attendings, regardless of their years of clinical experience, are expected to manage the same tasks during each shift.

2.3. Data analysis

Attending and resident survey responses for both Phase I and Phase II were compared using a one-way analysis of variance. Table 1 and Table 2 provide a list of actual individual interruptions recorded by work-study students during the Phase 2 of the study.

Table 1

<table>
<thead>
<tr>
<th>Overhead pages</th>
<th>Actual overhead pages recorded by work-study students during the Phase 1 of the study.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triage Alert</td>
<td>Rapid Head room “X”</td>
</tr>
<tr>
<td>Trauma in the Trauma Bay</td>
<td>X-ray to room “X”</td>
</tr>
<tr>
<td>Stroke Alert</td>
<td>Respiratory to room “X”</td>
</tr>
<tr>
<td>Trauma Evaluation*</td>
<td>Fire Rescue Haste</td>
</tr>
<tr>
<td>Neuro Evaluation*</td>
<td>Hospital-wide page</td>
</tr>
<tr>
<td>Nurse/PCA to room “X”</td>
<td></td>
</tr>
<tr>
<td>EKG room “X”</td>
<td></td>
</tr>
<tr>
<td>EMS coming to the back for charge nurse placement</td>
<td></td>
</tr>
<tr>
<td>Patient coming to the back for charge nurse placement</td>
<td></td>
</tr>
</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th>Individual interruptions</th>
<th>Actual individual interruptions recorded by work-study students during the Phase 2 of the study.</th>
</tr>
</thead>
<tbody>
<tr>
<td>EKG read</td>
<td>Call from Radiology</td>
</tr>
<tr>
<td>Trauma Evaluation*</td>
<td>Call from Outside Hospital</td>
</tr>
<tr>
<td>Neuro Evaluation*</td>
<td>Command Phone Call</td>
</tr>
<tr>
<td>Call from Lab</td>
<td>Other*</td>
</tr>
<tr>
<td>Call from Inpatient Provider</td>
<td></td>
</tr>
</tbody>
</table>

* Actual overhead pages recorded by work-study students during the Phase 1 of the study.

** Individual interruptions in the “Other” category were those that did not fall into a previously designated category.
ANOVA). Data were transformed using a log(10) function (or log(10 + 1) function if a value of zero needed to be accounted for) to assure normality and homogeneity of variance. Post hoc analysis was performed using a Tukey’s Honestly Significant Difference (HSD) test. Results from Phase I and Phase II were then compared to results from the survey using a Spearman’s rank order test, to differentiate between perceived and actual distractions. Distractions and interruptions that occurred the same number of times were assigned the same rank, as were those perceived to occur the same number of times. Significance was assessed at p < 0.05.

3. Results

3.1. Characteristics of study subjects

Out of 48 faculty members, 79% (38) responded to the survey. Out of 36 residents, 64% (23) responded. Of the resident responses, 8 were R3s, 6 were R2s, and 9 were R1s. Of all providers, 98.4% (61/62) felt they were distracted or interrupted during a shift, of whom 90.3% felt that being distracted or interrupted negatively impacted the care they provide to patients.

3.2. Main results

3.2.1. Phase I

During Phase I, 2438 overhead pages were recorded. The most commonly recorded overhead pages were “Triage Alert” and “Other”. In the “Other” category, 168 pages were referring to phone calls or pages to specific individuals or services. Of those pages, 59 pages were not able to be understood because of the poor sound quality of the overhead projection. These were still included in the analysis as the providers would have stopped their current task to listen to the page, even if it was ultimately unable to be understood. On average, 23.2 overhead pages were recorded per shift, which equates to 2.9 pages per hour. The actual number of all overhead pages is displayed graphically in Fig. 1.

The average perceived number of overhead pages per shift was 43.2, with a median of 32. This equates to an average of 5.4, and a median of 4, pages per hour. Attendings perceived an average of 47.76 overhead pages per shift, R3s perceived 27.6 overhead pages per shift, R2s perceived 47.6 overhead pages per shift, and R1s perceived 29.57 overhead pages per shift. The non-numerical responses of “too many to count”, which came from two providers, were excluded from analysis. This resulted in differing group sizes between phase I and phase II, even though the number of survey respondents remained constant. A comparison of the actual average number of overhead pages per shift and the perception of overhead pages per shift, by provider level of training, is shown in Fig. 2.

A one-way ANOVA revealed a significant difference between the perception of distractions amongst the attendings and all resident levels of training (F (3,40) = 4.779, p = 0.0061). Post hoc comparisons using Tukey’s HSD test indicated that the mean score for the attendings (x̄ = 1.608, SD = 0.346) was significantly different than the mean score for the R1s (x̄ = 1.084, SD = 0.318). The attending mean score did not differ significantly from that of the R2s (x̄ = 1.600, SD = 0.367) or R3s (x̄ = 1.446, SD = 0.258). There was also no significant difference amongst R1s, R2s and R3s.

The perception of the frequency of each type of overhead page differed from the actual frequency of each type of page (Fig. 3). The page perceived to be the most common was “Trauma Evaluation”, but the page that was most common was “Triage alert”.

Fig. 1. The actual number of recorded overhead pages during the study period.
Fig. 2. A comparison of perceived vs. actual average numbers of distractions, per shift.

Fig. 3. A comparison of rankings of actual overhead pages vs. the perceived rank of overhead pages by all providers.
Evaluating the two rank order lists in entirety using a Spearman’s rank order test revealed a moderate, positive correlation of 0.57. The difference in rank order lists was statistically significant (p = 0.036).

3.2.2. Phase II

333 individual interruptions were recorded over the 3-week period. Attendings were interrupted most often, a total of 124 times. The number of interruptions decreased as the level of training did, going from 119 to 70 to 20 from R3s to R2s to R1s. The average numbers of interruptions per shift were 2.95, 5.6, 3.3, and 1, for each respective level of training. A graphic representation of the actual interruptions per shift is shown in Fig. 4.

The average perceived number of interruptions per shift was 53.5 for all levels of training. Attendings perceived an average of 72.13 interruptions per shift. One non-numeric response of “too many to count” was excluded from analysis. R3s perceived an average of 9.42 interruptions per shift. R2s perceived an average of 23 interruptions per shift. One R2 also responded that there were “too many to count”, and this was also excluded from the analysis. R1s perceived 29.42 interruptions per shift, on average. A graphic representation comparing the average actual interruptions per shift to the average perceived interruptions per shift is shown in Fig. 5.

The perceived number of interruptions amongst different levels of training was statistically significant, based on a one-way ANOVA analysis (F (3,38) = 15.69, p = 8.50 × 10⁻⁷) Post hoc comparisons using Tukey’s HSD test indicated that the mean score for the attendings (x = 1.756, SD = 0.306) was significantly different than the mean score for the R1s (x = 0.873, SD = 0.407), and that of the R2s (x = 1.325, SD = 0.211). However, there was no significant difference between Attendings and R3s (x = 1.412, SD = 0.248). There was additionally a significant difference between R1s and R3s, but the difference between R1s and R2s, and R2s and R3s was not significant.

Attendings were most often interrupted by an EKG read, while R3s were most often interrupted by a call from an inpatient provider. R2s were interrupted most by both a call from an inpatient provider and doing a trauma evaluation. R1s were most often interrupted by a call from an inpatient provider.

A very weak, positive correlation of 0.08 was found between the perception of interruptions and actual interruptions, using a Spearman’s rank evaluation. The perception of the frequency of each type of interruption did not significantly differ from the actual frequency of each type of interruption (p = 0.665). This is shown graphically in Fig. 6.

4. Discussion

This study sought to determine if a difference existed between ED provider perception of distractions and interruptions and the actual occurrence of distractions and interruptions. The perception of overall number of overhead pages by all levels of training was significantly greater than the actual number of overhead pages. Moreover, a significant, moderate correlation was found between the rankings of types of overhead pages by providers and actual ranks of overhead pages. This implies that, not only did providers over-estimate the number of overhead pages per shift, they incorrectly estimated which pages were announced the most or least often.

Similarly, providers significantly overestimated the degree of individual interruptions per shift. In fact, providers estimated that interruptions occurred more than ten times as much as they did. There was also a large disconnect between the perception of the frequency of different types of interruptions. As would be expected, however, the perception of individual interruptions differed significantly amongst levels of training, with more experienced providers perceiving more interruptions than less experienced providers. The actual number of interruptions reflected this, and was, in fact, lower for less experienced providers. A similar pattern would likely be found at academic institu-
tions with a graded increase in assigned responsibilities that parallels advances in training, similar to the study hospital.

Provider response to distractions and interruptions is heavily influenced by their perception of those distractions and interruptions. Performance and select responses to stimuli, such as inter-

![Fig. 5. A comparison of perceived vs. actual average numbers of interruptions, per shift.](image1)

![Fig. 6. A comparison of rankings of actual interruptions vs. the perceived rank of interruptions by all providers.](image2)
ruptions, are heavily influenced by how those stimuli are perceived. Perception, shortly defined as "assigning meaning to an event or situation" directly affects how one responds emotionally, cognitively and behaviorally to certain stimuli [15,16]. Studies have shown that the same brain response occurred when people were exposed directly to certain stimuli and when they perceived they were being exposed to those same stimuli [17]. It has also been shown, through mood-as-input studies, that behavioral output can be manipulated by affective input. This implies that perceiving something to be true can lead to feeling a certain way, and that feeling will affect performance on a current task and preparation for a future task [18].

When translated to the ED setting, this suggests that the perception of distractions or interruptions could augment the existing consequences of being distracted or interrupted. Those consequences include commission of medical errors, an increase in which could have a substantial negative impact on patient safety, and increased cognitive fatigue, which could contribute to provider burnout.

4.1. Limitations

The distractions and interruptions recorded by the work study students may slightly underrepresent the actual number of distractions and interruptions in the ED. While working in the department, the students were also responsible for enrolling patients in other ongoing research studies. While the students were enrolling patients in other studies, interruptions and distractions may not have been recorded. Of the overhead pages recorded, many were indecipherable, due to poor sound quality, and could only be included in the "other" category as a result. Those pages may have been misallocated and skewed the overhead page data, either closer to or farther from the survey results.

Actual data collected had to be adjusted to perform an ordinal rank comparison with the survey data, as the categories of recorded data did not directly match the categories surveyed. To compare the data, actual data on "strobe alerts" was combined with "neuro evaluations" as both reflect acute neurological complaints, "One to one needed to room "X"" was combined with "Nurse/PCA to room "X"" as the PCAs are the staff responsible for close observation of patients, and the other category was eliminated as most pages were indecipherable and could not be adequately categorized.

Finally, although work-study students were trained in data collection prior to the onset of the study, no additional assessment of inter-rater reliability of the work-study students was performed.

5. Conclusion

This study shows that provider perception of not only the frequency, but also the type, of distractions and interruptions, differs from reality. In addition to reducing the number of distractions, more work should be done to target provider perception of distractions and interruptions, and their emotional and physical responses to those perceptions, which could potentially contribute to an increase in medical errors and provider burnout.

Appendix A

Survey

What level of training are you?
On an average shift, do you think you are distracted/interrupted?
Do you think being distracted/interrupted during a shift negatively impacts the care you provide to patients?
On an average shift, how many overhead pages do you hear?
Please rank the following overhead pages in the order you believe they most frequently occur:
EMS coming back for charge nurse placement
Fire Rescue Haste; Housekeeping to Room “X”
Neuro Evaluation; Trauma Evaluation
Trauma in the Trauma Bay
Hospital-wide Page; Triage Alert Room 'X'
Nurse/PCA to Room ‘X’
Rapid Head Room ‘X’
Respiratory to Room ‘X’
X-Ray to room ‘X’
Patient coming back for charge nurse placement
EKG room ‘X’

On an average shift, how many times are you interrupted?
Please rank the following interruptions in the order you believe they most frequently occur:
Call from the lab
Call from an inpatient provider
Call from radiology
Call from an outside hospital
Command Phone call
EKG read
Neuro Evaluation

References


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