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Impact of workflow interruptions on baseline activities of the doctors working in the emergency department

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ABSTRACT

Background Workflow interruptions are common in the emergency department (ED) of the hospitals for physicians, leading to an increased risk of errors.

Purpose This study aims to understand the baseline activities of the ED doctors and how these are affected by workflow interruptions.

Methods The study was conducted in two phases to collect the doctor's perspective (through questionnaire survey) and observer's perspective (through workflow observation study) about ED doctors' baseline activities and workflow interruptions. Two different perspectives were obtained to make the insights clearer and more valuable. The point of view of the 223 doctors working in ED of the hospitals was recorded through a questionnaire survey. In the second phase, the observer's point of view (authors) was obtained through a workflow observation study, and 13 doctors were observed for 160 hours.

Results Direct communication with patients (37.1%) and 'documentation and prescription' (22.7%) were found to be the most frequent activities. The most common interruptions were visual and auditory distractions, rumination (mind-wandering) and intrusion (by co-workers). Also, the time consumed on indirect patient care (6.6%) was higher than direct patient care (4. 2%). Interruptions increase the chances of errors by making it hard for a doctor to resume a primary task after facing interruptions.

Conclusion Interruptions increase the chances of errors and make it difficult for the doctors to resume primary tasks (after facing such incidents).

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Observational studies were conducted to study baseline activities and workflow interruptions faced by the physicians in the hospitals' emergency departments (EDs).

WHAT THIS STUDY ADDS

⇒ This study investigated workflow interruptions and baseline activities of ED doctors in the perspective of the observer (through observation study) and doctors (through questionnaire survey).

⇒ Furthermore, it includes region-wise analysis of baseline activities and workflow interruptions in urban and suburban hospitals.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Occupational application of this study includes improving the overall performance of ED doctors that are often affected by workflow interruptions.

INTRODUCTION

Emergency departments (EDs) are challenging and complex work systems[1] because of unpredictable demand.[2] A worldwide spread of COVID-19[3] is a contemporary example of unpredictable workload in EDs of hospitals. Workflow interruptions are common in the working environment of EDs.[4] Interruption is when the current (primary) task is suspended for performing secondary tasks.[5] Workflow interruptions are assumed to hurt the working memory of clinicians. That is why these interruptions lead to an increase in the risk of errors,[6] breaks in tasks,[2] cognitive effect (eg, less accurate recall of information and memory loss), breaks in concentration[7] and workload.[8] Therefore, healthcare environments need to reduce workflow interruptions to efficiently and safely improve clinical outcomes.[8 9]

Different methodologies have been adopted to study interruption for medical staff working in EDs. For instance, interruptions and multitasking for the doctors working in EDs of the hospitals were examined using a workflow time study.[10] Multitasking performed by clinicians in two Swedish EDs was observed through an observational study by employing two observers simultaneously to determine the accuracy of observations. The most common activity was information exchange.[11] Interviews were also used to observe the physician's perspective on workflow interruptions at Swedish EDs.[12] A mixed-method study (involving observational and interview studies) monitored the interruptions in two Swedish ED works.[13] Direct observation, semi-structured interviews and hospital surveys were used

to explore US hospital nurses' work environment and interruptions.[14]

In the extant body of literature, observational workflow time studies[10 11 15] and semi-structured interview survey studies[13] have been employed to study workflow interruptions in EDs of hospitals. However, this study aims to understand the baseline activities of ED doctors and how these are affected by workflow interruptions through the observer's perspective (observational study) and doctors' perspectives (using questionnaire survey method) to make the insights clear and valuable. Furthermore, workflow interruptions in clinical work across different settings, that is, urban versus suburban/rural hospitals, have been observed. The study is first in nature to explore and compare doctors' perspectives with observations. In addition, the study also compares the baseline activities and workflow interruptions of ED doctors from urban and suburban hospitals to know if the types and frequencies of occurrences are different. Based on outcomes, a framework is proposed to improve the doctors' performance by effectively managing interruptions.

The following research questions are developed for this study:

RQ1. What type of activities do the doctors have to perform during working hours?

RQ2. What types and frequency of interruptions are faced by the doctors working in EDs?

RQ3. To what extent do the findings of the survey differ from observations?

RQ4. Do the answers to the above three RQs vary for the doctors working in EDs of the urban and suburban hospitals?

RQ5. What factors (reduced working hours, relevant patients, etc) affect the overall performance of the doctors?

DATA AND METHODS

Data collection

As per the research requirement, as mentioned above, data for this study were collected using both questionnaire survey and observation study approaches. And participants in the questionnaire survey participated voluntarily. The data were collected through a questionnaire requiring the respondents to record their responses on a Likert scale in a questionnaire survey. Two hundred twenty-three responses were recorded through random sampling technique, including 118 from the doctors working in urban hospitals and 105 from the doctors working in the suburban region. Thirteen respondents (seven from urban and six from suburban) were the doctors under observation for an observational study. Consent was obtained from doctors for an observational study. Six doctors working in the ED of a suburban hospital were observed for 80.5 hours. Similarly, seven doctors working in the ED of an urban hospital were followed for 79.5 hours.

Based on previous studies, baseline activities were divided into 10 categories to ease the observation study.[16 17] These 10 activities included social and personal activity, indirect patient care, direct patient care, documentation and prescribing, direct communication with patients, patient data analysis, professional communication, breaks, walking and waiting for patients' diagnosis results or colleagues'[16 17] were observed during the observational study.

The questionnaire was divided into two parts. The first part of the questionnaire consists of 13 factors, including interruptions (IN), patient care, multitasking (MT), personal/social activities in night shifts versus day shifts, task switching, task break-in, resumption of primary task (RT), professional communication, waiting, breaks, information exchange, social and personal task and overtime. The details are presented in the appendix (see online supplemental appendix A). Part 2 of the questionnaire consists of the doctors' opinions about the effects of the number of patients, relevant patients, working hours, frequent breaks, visual and auditory distractions, multitasking and interruptions on the overall performance of doctors (see online supplemental appendix B).

Figure 1 presents the scheme of this study.

Methods for data analyses

The obtained data (discussed in detail under the subheading 'Data collection') is collected from urban and suburban hospitals. Therefore, the analyses section is divided into two parts to analyse the data in a better and clear way, including the (1) overall model (regardless of hospital's location at urban and suburban hospitals) and (2) region-wise analysis (urban and suburban hospitals).

The data obtained from the observation study is analysed through descriptive statistics.[16–18] The analyses of the data obtained from the questionnaire survey are made using SmartPLS to find significant interruptions in doctors' work patterns and examine the relationship of interruptions to different factors.[19] To compare urban and suburban hospitals, Kruskal-Wallis, pairwise Wilcoxon rank-sum and Spearman's rank correlations tests were used in extant studies to compare interruptions in EDs of rural areas, urban and suburban hospitals.[2] Wilcoxon rank-sum test has been used for comparison between two samples, whereas the Kruskal-Wallis test is for comparison among more than two samples.[20] Therefore, in this study, the Wilcoxon rank-sum test compares the results of urban and suburban hospitals.

Patient and public involvement

This study investigates the baseline activities and interruptions faced by the doctors working in EDs of the hospitals by incorporating the doctor's and observer's perspectives. Research questions were developed based on the gap in the literature, that is, discussed earlier in the 'Introduction' section. The study was designed in a way that it will cover the doctor's perspective through a questionnaire survey. Patients and public were not involved, however,

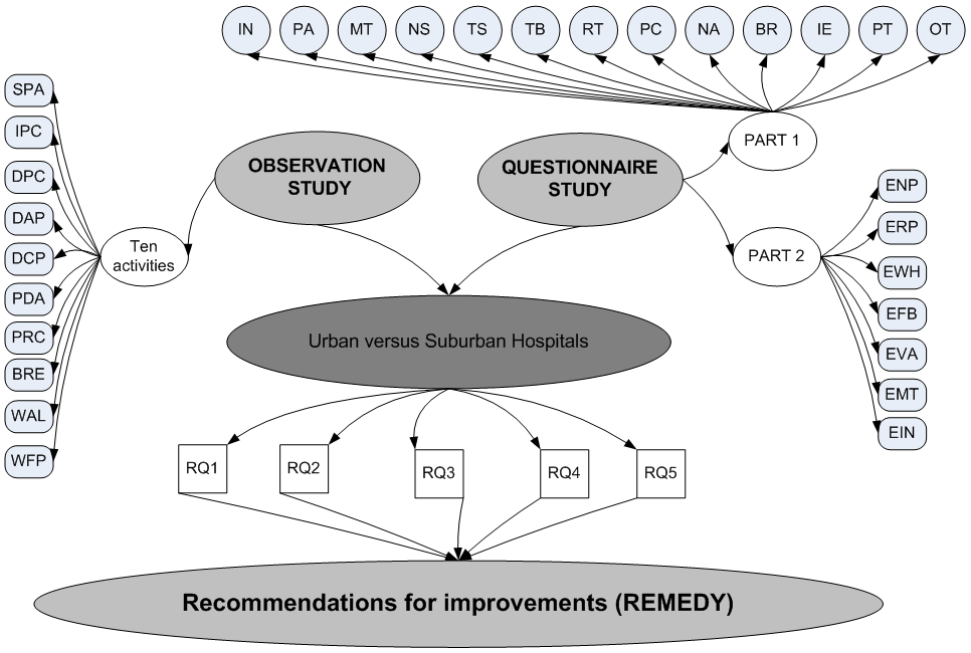

Figure 1 Scheme of study. BR, breaks; BRE, breaks; DPC, direct patient care; DAP, documentation and prescribing; DCP, direct communication with patients; ENP, effect of number of patients; ERP, effect of relevant patients; EWH, effect of working hours; EFB, effect of frequent breaks; EVA, effect of visual and auditory distractions; EMT, effect of multitasking; EIN, effect of interruptions; IN, interruptions; IE, information exchange; IPC, indirect patient care; MT, multitasking; NS, personal/social activities in night shifts; OT, overtime; PA, patient care; PC, professional communication; PT, social and personal task; PDA, patient data analysis; PRC, professional communication; RT, resumption of primary task; S, task switching; SPA, social and personal activity; TPC, professional communication; TB, task break-in; WAL, walking; WFP, waiting for patients' diagnosis results or colleagues.

perspectives of the doctors were recorded through a questionaire survey. The consent of the doctors was taken before participation.

RESULTS

Survey results and analysis

The demographic detail of the respondent doctors from EDs of hospitals is provided in table 1. The values of Cronbach's alpha for comprehensive data (regardless of hospitals located at urban or suburban sites) for the urban region and suburban region (0.787, 0.798 and 0.798) are within the acceptable range of 0.70–0.95,[21] confirming the reliability of the data.

Overall model

For an overall model (regardless of hospital location at urban or suburban sites), the effect of interruptions on different factors using relative path coefficients is shown in figure 2. All path coefficients are positive, showing a direct impact of interruptions on other factors. Among all path coefficients, *interruptions* to *personal/social activities in the night shift* (IN-NS) have the highest path coefficient value. It represents that the rate of personal activities, including cell phone usage, is higher in night shifts than in day shifts. These findings confirmed the results of the previous study in different countries and settings.[18] The next highest path coefficient is the effect of interruptions on the resumption of tasks (IN-RT). It represents that resuming the primary task after distraction or interruption is difficult for the doctors. The path coefficient of interruptions on multitasking (IN-MT) shows that interruptions and distractions result in multitasking, for

Table 1 Demographic detail of respondent emergency department doctors

Variable	Description	Frequency	Percentage (%)
Gender	Male	127	57.0
	Female	96	43.0
Age (years)	20–25	48	21.5
	26–30	78	35.0
	31–35	56	25.1
	35+	41	18.4
Experience (years)	0–5	86	38.6
	6–10	70	31.4
	11–15	51	22.9
	15+	16	7.2
Area of hospital	Urban	118	52.9
	Suburban/ Rural	105	47.1
Department	Emergency	223	100.0
	Other	0	0.0

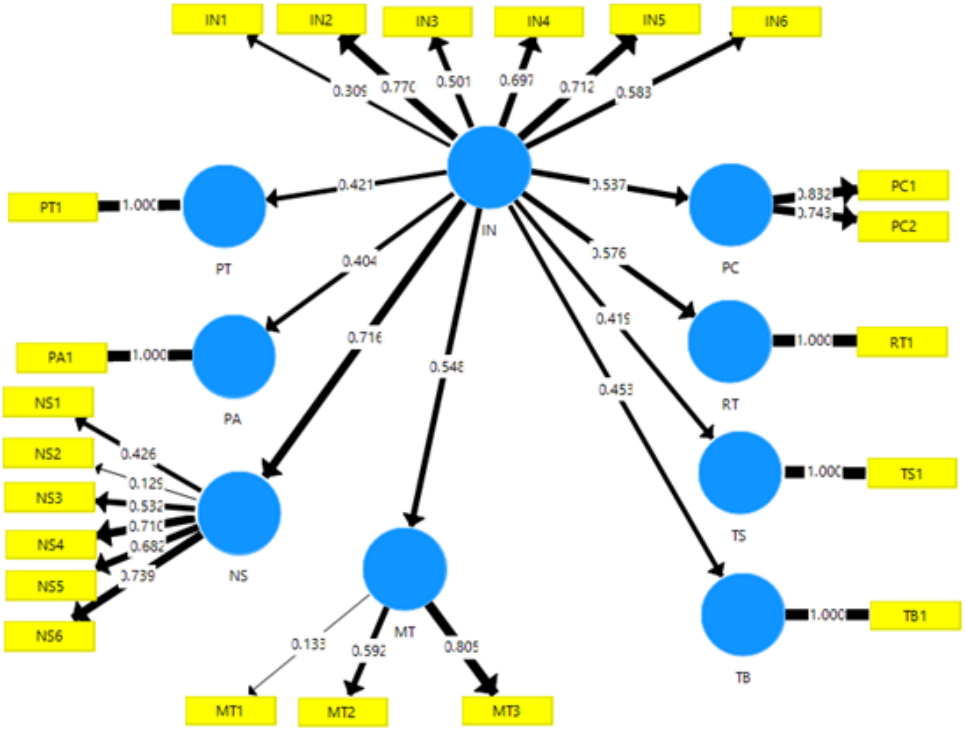

Figure 2 Overall model. IN, interruptions; MT, multitasking; NS, personal/social activities in night shifts; PA, patient care; RT, resumption of primary task; TS, task switching; TB, task break-in.

example, a doctor is busy prescribing while listening to his colleagues. Among IN, visual and auditory distractions (IN2), rate of rumination such as mind-wandering (IN5) and rate of intrusions such as co-workers asking for something or emails that demand attention (IN4) are found to be significant interruptions (*RQ2*).

According to doctors' opinion (obtained through part 2 of the questionnaire), the effect of visual and auditory distractions (1.794±0.779), multitasking (1.670±0.594) and interruptions (1.499±0.524) is negative on the overall performance of ED doctors because mean value of doctor's responses for these variables is closer to '1' in a 5-point Likert scale questionnaire. Whereas the effect of the relevant patient (4.236±0.513) and reduced number of patients (4.272±0.483), decreased working hours (4.264±0.538) and frequent breaks (3.998±0.798) are positive on the overall performance of doctors because the mean value of doctor's responses is closer to '5' for these variables.

Region-wise analysis: comparison between urban and suburban hospitals

Significance values from the Wilcoxon rank-sum test representing a difference in mean values for urban and suburban sites are presented in table 2. A p value ≤0.05 means that the difference in the mean value for urban and suburban sites is significant. The differences in mean values for interruptions, multitasking, personal activities in night shifts, task break-in, professional communication, waiting, breaks, social/personal tasks and overtime are significant. According to the results of the Wilcoxon rank-sum test, there is no significant difference in the opinion of the doctors working in EDs of urban and suburban hospitals regarding the effect of the number of patients, relevant patients, working hours, frequent breaks, visual and auditory distractions, multitasking and interruptions on performances of doctors (*RQ4*).

The factors with a significant difference are further investigated to know whether the mean value is higher for the urban or suburban site. Based on the above results (shown in table 2) and discussion, *RQ4* concludes that multitasking and overtime are higher for urban hospitals than in suburban hospitals. In contrast, interruptions, personal activities during night shifts, task break-ins, professional communication, waiting, breaks and social/personal tasks are higher for suburban hospitals than urban hospitals. Table 3 details the type of interruptions faced by the doctors working in EDs of urban and suburban hospitals (*RQ4*).

Results and analysis of the observational study

Overall model

Table 4 and figure 3, the doctors spend most of their time in direct communication with patients (37.1%, 11.89±2.577), and documentation and prescribing (22.7%, 7.27±2.324) are found to be significant activities (*RQ1*).

Region-wise analysis: comparison between urban and suburban hospitals

From table 4, it is evident that the frequency of direct communication with patients, waiting, social and personal activities, professional communication and walking are higher for the doctors working in suburban hospitals

Table 2 Results of Wilcoxon rank-sum test and descriptive statistics

Factors	Urban versus suburban	Urban	Suburban
	Wilcoxon rank-sum test (p value)	Mean±SD	Mean±SD
Interruptions	0	4.069±0.802	3.267±0.690
Patient care	0.327	3.822±1.059	3.962±0.820
Multitasking	0	4.091±0.729	3.670±0.542
Personal/social activities in night shifts	0	3.197±0.598	3.685±0.516
Task switching	0.188	4.137±1.074	4.295±0.929
Task break-in	0.004	3.632±1.111	4.029±0.853
Resumption of task	0.623	3.906±1.122	3.971±0.975
Professional communication	0	3.280±0.885	3.776±0.759
Waiting	0	3.521±1.171	4.152±0.830
Breaks	0.013	3.675±1.279	3.981±1.126
Information exchange	0.452	4.127±1.034	4.229±0.846
Social/Personal tasks	0.019	2.559±1.034	3.000±1.359
Overtime	0	3.511±0.657	3.867±0.595
Effect of number of patients	0.169	4.328±0.463	4.210±0.499
Effect of relevant patients	0.43	4.269±0.503	4.200±0.524
Effect of working hours	0.114	4.319±0.573	4.202±0.493
Effect of frequent breaks	0.143	4.088±0.763	3.897±0.826
Effect of visual and auditory distractions	0.995	1.806±0.850	1.781±0.697
Effect of multitasking	0.925	1.682±0.666	1.656±0.503
Effect of interruptions	0.691	1.485±0.521	1.514±0.5229

than in urban hospitals. In contrast, the frequency of documentation and prescription, patient data analysis, indirect patient care (including washing hands or sanitising before direct care), direct patient care (care that includes touching the patient) and breaks are higher for the doctors working in urban hospitals than in suburban hospitals (*RQ4*).

DISCUSSION

Our results showed that the doctors spend most of their time in direct communication with patients (37.1%, 11.89±2.577) and documentation and prescribing (22.7%, 7.27±2.324) activities (*RQ1*). These findings confirmed previous studies in other countries and settings.[5] Comparing the percentage of most frequent activities, that is, direct communication with patients, was even higher in a previous study (45.7%) than in the current study (37.1%). We separately analysed professional communication with colleagues (4.6%) and direct communication with patients (37.1%). And if we see the total percentage of communication activities, it becomes 41.7%, which is close to 45.7% of the previous study discussed above.[5]

Table 3 Types of interruptions in urban and suburban hospitals

		Urban	Suburban
Interruptions (IN)	Variable	Mean±SD	Mean±SD
Visual and auditory	IN2	4.04±1.025	4.19±0.751
Phone calls	IN3	2.85±1.311	3.65±1.038
Intrusions	IN4	3.50±1.222	3.99±0.778
Rumination	IN5	3.01±1.221	4.07±0.943

Communication plays a fundamental role in the work environment of healthcare.[17] It helps to perform teamwork to improve patient safety and outcomes,[22] but at the same time, it can be an area of a critical issue when disruptive interruptions occur.[17] This study found that resuming primary tasks after interruption was highly difficult for the doctors. These results confirmed the findings of previous studies.[9 10 23] In ED work environments, visual and auditory distractions, ruminations and intrusions were frequent interruptions. The study found that the percentage of indirect care activities in the daily work pattern of ED doctors is higher than the direct care activities. Furthermore, the study found that the percentage of indirect care activities in the daily work pattern of ED doctors is higher than the direct care activities, confirming the findings of the previous studies.[17]

Based on the findings and results of this study, the results of the observation study are in line with the questionnaire survey. In both methods, direct communication with patients or information exchange was significant in the work pattern of the doctors working in EDs of

Table 4 Descriptive statistics of activities performed by doctors every 30 min

Activities	Overall model Mean±SD	Overall model Percentage (%)	Urban hospital Mean±SD	Suburban hospital Mean±SD
Direct communication with patients	11.89±2.577	37.10	11.27±1.951	12.50±2.954
Documentation and prescribing	7.27±2.324	22.70	8.33±1.840	6.23±2287
Patient data analysis	3.08±1.865	9.60	3.18±2.448	2.98±0.997
Indirect patient care	2.13±1.037	6.60	2.80±0.718	1.46±0.859
Waiting for patient, result, colleague	1.82±1.845	5.70	0.35±0.477	3.27±1.508
Social and personal activity	1.56±1.154	4.90	0.68±0.532	2.43±0.920
Professional communication (with colleagues)	1.48±0.947	4.60	1.31±0.893	1.66±0.969
Direct patient care	1.36±0.618	4.20	1.61±0.573	1.11±0.559
Walking	1.21±0.916	3.80	1.07±0.789	1.35±1.009
Breaks	0.21±0.493	0.243	0.22±0.535	0.20±0.449

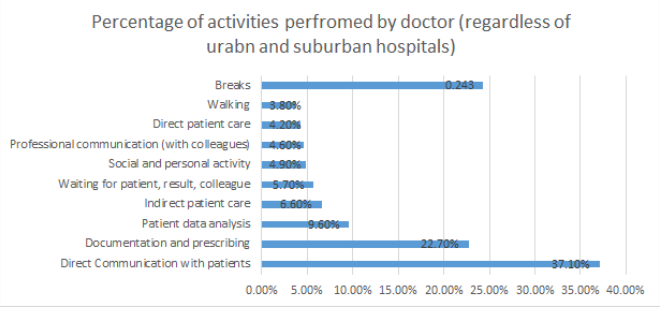

Figure 3 Percentage of activities performed by doctors (regardless of urban and suburban hospitals).

hospitals. The comparison of indirect and direct care, and activities like professional communication, waiting and social and personal engagements among urban and suburban hospitals were also aligned (*RQ3*).

Recommendations for improvements in performance of the doctors

Multitasking and interruptions increase the risk of errors and significantly reduce the performance of doctors in EDs of hospitals.[16] Based on the results of this study, a framework is proposed comprising recommendations to enhance the performance of ED doctors, as shown in figure 4.

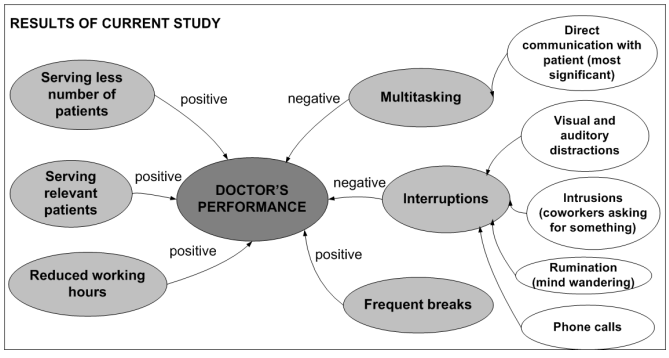

Figure 4 A proposed framework to improve doctors' performances.

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Patient consent for publication Not applicable.

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