Evaluation of Workload and Human Errors in Nurses

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Abstract

Background: Identification of human errors and their related factors in nurses dealing with the health of humans is important. Considering that much workload can increase the risk of human error, this study aimed to investigate the relationship between workload and human errors among nurses working in educational hospitals of Kerman University of Medical Sciences. **Methods:** This descriptive-analytical study was performed on 145 nurses from educational hospitals affiliated to Kerman University of Medical Sciences in 20. The workload was evaluated using the NASA-TLX questionnaire and human errors with SHERPA technique. The statistical test used was logistic regression model and the statistical significance level was considered <0.05 and the samples were selected randomly. The sample size was selected based on the percentage of functional errors reported by a study on human error assessment related to the duties of nurses in Semnan. **Results**: A total of 138 probable errors were detected in the nursing staff of these hospitals, 74% of nurses committed errors in seven main duties during their service. Patient medication with the highest frequency (34%) followed by the injection of the drug to the patient with a frequency of 23% were the most frequently committed errors by nurses. The findings of the research showed that workload in 53.1% of the nurses was very high and in 43.1% of the nurses was high, the results of the logistic regression model showed that there was no significant relationship between errors and workload in nurses. **Conclusion:** The results of the study showed that the average workload and human error in the nurses were high. Therefore, control strategies such as holding training sessions, implementation of clinical governance program in all wards, recruitment of adequate nurses, reduction of workload, reduction of work hours and the appropriate patient/nurse ratio should be given attention by the hospital managers depending on conditions; as well as the prevention of the two reported errors should be given top priority in corrective measures.

Keywords: Workload; NASA-TLX; Human error; Nurses; Kerman University of Medical Sciences

Introduction

One of the most important issues in the field of health care, especially in nurses, is human errors, which can affect the results of work and organizational outcomes, so identifying and seeking out control measures in order to reduce them is important.[1] Among the types of errors that may occur in a critical task, human errors are committed mainly by staff, and can sometimes lead to irreparable issues and affect patient safety in healthcare services delivery organizations.[2] Based on the results of various studies, human error is one of the main causes of accidents and most of the

accidents are attributed to human error.[3] Exposure to high workload can increase the risk of human error. The workload is a term used to describe how many cognitive and physical resources an operator uses to perform a task.[4] Workload is a multi-dimensional issue in a job or duty that can be combined with other factors such as the workplace, job demand, job type, and mental factors, organizational factors, and ultimately cognitive issues.[5] The focus of research on workload has been on determining the disparity between the work capacity of individuals and their job requirements.

Workload changes through changes in individual capacity or job requirements. It is very difficult to achieve optimal workload, especially in complex and dynamic work systems, where job requirements are constantly changing as job conditions change.[6] According to the Institute of Medicine (IOM), 4,000 to 9,800 people die from medical errors each year due to the mental and physical burden of the work imposed on the staff of various medical departments in the United States.[7] In reviewing the findings of human errors in the medical profession, nurses and paramedics in Iran, scant information is seen, and there is no accurate accessible figures.

However, due to the importance of patient safety issues and the accreditation of hospitalization, researchers have been increasingly investigating human errors.[8-11] About 30% of the workforce in developed countries and 70-50% in developing countries are exposed to high workload or inappropriate ergonomic conditions.[6]

The occurrence of human error in nurses, who hold a critical occupation, is important; given that high workload can increase the risk of human error, this study was aimed to investigate the relationship between workload and human error among nurses working in educational hospitals of a medical university.

Methods

This is a descriptive-analytical, cross-sectional study conducted in educational hospitals of Kerman University of Medical Sciences in 2013. In this study 145 nurses were selected randomly to be investigated. Before starting the study, they were asked to complete the questionnaire without mentioning their name in order to ensure that the nurses answered the items correctly. In this study, workload was measured by the NASA-TLX questionnaire and human errors based on the SHERPA guideline. Demographic information was also collected including the demographic and general characteristics such as age, work experience, gender, marital status, work shift, the department of service, education level, the number of patients per each nurse, and work hours per week.

The NASA-TLX questionnaire is widely used to evaluate workload and has acceptable credibility and reliability in scientific forums. The NASA-TLX questionnaire consists of two parts. In the first part, each task is subdivided into six subscales of mental, physical, and time requirements, the amount of effort, the level of performance and frustration level.

At this step, individuals will be scored from 0 to 100 on each of the six scales based on their working conditions. In the second part of the questionnaire, all scales are evaluated and selected in pairs and in 15 different situations by individuals based on the importance of their perception. Scoring the workload questionnaire is based on the sum of the scores that the respondent attains on each item is classified into four levels: low (0-25), moderate (26-50), high (51-75) and very high (76-100).[12] Researchers have reported reliability of this method 0.77.[13] The SHERPA technique has been used to identify and evaluate human errors.[4] This method consists of 8 steps, and starts with analyzing duties and sub-duties through hierarchical task analysis and then identifying errors, errors and types of errors using the checklist, assessing the risk taken and identifying critical errors, and finally presenting practical solutions for controlling and preventing errors. Questions were also asked about the demographic characteristics of the individuals (age, sex, marital status, work experience,

department of service, work shift, type of employment and number of patients) and data were collected. The collected data were analyzed using the SPSS version 22. For calculating and determining the status of the indexes, descriptive indicators, tables and charts were used and for data analysis, logistic regression model with random effects was used.

Results

A survey was conducted among 145 nurses from educational hospitals of Kerman University of Medical Sciences in 2015. The results of demographic data analysis showed that 93.8% of the nurses are female and 63.4% of them were married; 97.9% of participants had bachelor's

degree, 89.7% worked in night shift and 34.5% of the participants were transitional Table 1.

In total, in the nursing sectors of these hospitals, there were 41 main duties and 138 sub-duties in which the probability of errors was detected. The number and type of errors identified in the main tasks examined are shown in Table 2. Out of a total of 138 potential errors, 55.8% were functional, 22.47% visit-related, 15.21% selection-related, 62.3% recovery-related and 2.9% communication errors.

Besides that, 74% of nurses committed errors in 7 main duties. Patient medication with the highest frequency of 34% followed by the injection of the drug to the patient with a frequency of 23% were the most frequently committed errors by nurses.

Table 1. Participant demographic information

	Variable	Frequency	Percentage
Gender	Male	9	6.2
	Female	136	93.8
Education	Bachelor's degree	142	97.9
	Master's degree	3	2.1
Marital status	Married	92	63.4
	Single	53	36.6
Work shift	Day shift	15	10.3
	Work shift	130	89.7
Employment status	Registered	19	13.1
	Contractual	44	30.3
	Project-based	32	22.1
	Transitional	50	34.5

Table 2. Percentage of nurses' potential errors in different wards of hospitals affiliated to Kerman University of Medical Sciences

types of errors					
Total	Selection-related error	Communication error	Recovery-related error	Visit-related error	Functional error
100%	15.21%	2.9%	3.62%	22.47%	55.8%

Table 3. Workload in nurses in different departments of hospitals affiliated to Kerman University of Medical Sciences

workload	Minimum	Maximum	Mean (standard deviation)	Median (interquartile)
Mental requirement	40	100	85(12.2)	90(15)
Time requirement	15	100	76.7(17.4)	80(25)
Physical requirement	10	100	76.4(20)	80(25)
Attempt and assiduity	15	100	74.7(18.3)	80(25)
Frustration	10	95	63(25)	70(45)
Function	15	95	68(14.2)	70(20)
Total workload	30	91	74(12)	76(17/5)

Table 4. Relationship between error commit and workload and demographic variables using logistic regression model with random effects

Variable		error		Odds Ratio (CI:%95)	P-value
		yes	No		
Gender	Female	99(72.8)	37(27.2)	1	0.11
	Male	9(100)1	0(0)	3.8 (0.47- 30.7)	
Education	Master's degree	2(100)	0(0)	1	0.57
	Bachelor's degree	105(74)	37(26.1)	0.93 (0.09- 9.2)	
Marital status	Married	72(78.3)	20(21.7)	1	0.08
	Single	36(67.9)	17(32.1)	0.46 (0.19 -1.9)	
Work shift	Day shift	13(87)	2(13)	1	_
	Rotational work shift	95(73)	35(27)	0.25 (0.04 - 1.5)	0.13
Type of employment	Transitional	33(75)	11(25)	0.3(0.05 -1.68)	0.17
	Contractual	36(72)	14(28)	0.32(0.06- 1.66)	0.18
	Registered	16(84)	3(16)	1	_
	Project-based	23(72)	9(28)	0.17(0.02 - 1.33)	0.09
Workload		0.34(11.862)	76.11(11.6)	0.97(0.94 -1.10)	0.16
Age		31(6.4)	32.3(5.5)	0.9(0.78 -1.04)	0.16
Work experience		7.6(6.1)	8.3(5.3)	0.98(0.84- 1.14)	0.83
Number of patients		15(12)	17(14)	0.98 (0.96 -1.01)	0.48
Work hours		9(2)	9(2)	1.02 (0.82 -1.28)	0.80

1. Number (percentage)
2. Mean(±standard deviation)

As shown in Table 3, based on the questionnaire of workload, the highest scores were obtained for the two subscales mental requirements and time requirements, followed by the subscale physical requirements. On the other hand, the function scale had the lowest score. 53.1% of the nurses had very high workload, 43.4% had a high workload, and 3.4% had a moderate workload.

As Table 4 shows, the results of logistic regression model showed that there was no significant relationship between error commitment and workload in nurses (P=0.16). Also, there was no significant relationship between gender and age and committing error in nurses (P=0.09 and 0.06, respectively).There was no significant difference in error commitment with respect to the type of employment (transitional, contractual, registered, and project-based) (P=0. 49).

Nurses working on rotational work shift were more likely to commit error than those on day shift, but the difference was not statistically significant. There was no significant difference between the different wards of the hospital (P>0.05) Table 5.

Discussion

This study showed that the average workload among the nurses was high 74 (12), so that among the six subscales of the NASA workload index, the highest score was 85%, which is in agreement with the studies ot Malekpour et al. In nurses of Urmia University of Medical Sciences hospitals, Ghasemi et al. I Zagros Methanol Co., Taheri et al. in nurses of Alzahra Hospital in Isfahan, Mazloumi et al. in Air Traffic Control simulator (under high workload conditions) and Malekpour et al. among the teachers in the city of Hashtroud.[14-18] The subscale time requirements (76.7%), after the mental requirements subscalescale, obtained the second place, which is consistent with the research carried out by Taheri et al., Malekpour et al. [14-16] and the subscale frustration level (63%) accounted for the lowest percentage among the the six subscales, which is consistent with the research carried out by Habibi et al. on nurses of Alzahra Hospital in Isfahan, Sarsangi et al. in nurses in Kashan, Taheri et al., and Malekpour et al.[7,14,16,19]

Major errors identified in this study were of functional type with frequency of 55.8%, which is in line with the studies carried out by Dastaran et al. in endodontics department, Mohammadfam et al. in cataract surgery process, Kermani et al. in the emergency department of one of the hospitals in Semnan County, Habibi et al. in the Isfahan Oil

Refinery Company,[12,20,21] and visit-related errors with the frequency of 22.47% were the second leading errors after functional errors, which is consistent with the studies of et al. in the ophthalmological surgery department, Dastaran et al. and Kermani et al.[20,22,23] and communication errors had the least percentage of errors with 2.9%, which is consistent with the studies of Kermani et al. and Dastaran et al.[20,22] As the results of this study show, the increase in workload did not have a significant relationship with human error among nurses, which is due to the fact the workload of all nurses studied was high, which is similar to and is approved by the result of other studies.[18,19,24,25]

Patient medication was found to be the most frequently committed error (34%), followed by injection of the drug to the patient with a frequency of 23%. Nurses' drug-related errors are one of the most common medical errors related to patient safety in hospitals, which were investigated by Farz et al. in nurses of intensive care units, Ebrahimpour et al. in nurses of hospitals affiliated to Qazvin University of Medical Sciences, and Sadat Yousofi et al. in the internal and surgical wards of educational hospitals affiliated to Shahid Beheshti University of Medical Sciences.[26-28] Salavati et al., reported the most important reasons for drug-related errors: fatigue due to extra work, a shortage of nurses number per patient, and the presence of a large number of critically ill patients, long work hours.[29] Rahimian and Ghodrati also reported that high workload and inappropriate occupational conditions in nurses increased the likelihood of nursing errors.[30]

In this regard, Nikpeyma and Gholamnejad stated in their research that the three main causes of drug-related errors are high levels of workload, understaffing and mental and physical exhaustion, and also reported high workload as the second leading cause of job stress after lack of receiving reward and encouragement. All of these studies have somehow expressed the importance of directing attention to the workload of nurses.[31] The only unacceptable risk for the committed errors was patient triage, which is in agreement with the study of Kermani et al in the hospitals of Semnan city. It is suggested that male risk should be carefully considered in this study, and the necessary guidelines for reducing risk and strengthening the collaboration between employees to reduce risk should be addressed by the managers of healthcare organizations[22] Also, the results have shown that there is no statistically significant relationship between demographic variables, including age, work experience, gender and marital status, and incidence of human error; however, it seems that with increasing sample size and the number of people in the case and control groups, different results will be obtained. Therefore, the results will be better compared with the creation of sampling clusters with the same volumes. Conducting a cohort study can be also taken into consideration in future studies in this area to further examine the errors among subgroups. It is suggested that two nursing groups be investigated in a cohort study, with one group with low workload and one group with high workload be compared in terms of error commitment after several months of follow-up. Finally, it is suggested that two nursing groups be compared with respect to the number of committed errors in future studies with sufficient sample size.

Conclusion

Staff of healthcare centers, especially nurses, are always under the influence of various stresses, of which the most important are psychological problems, lack of time, physical disparities, and work shift issues. Based on the results of the present study, 138 human errors were identified in nurses' duties for 41 job duties; most of them were related to functional type errors followed by visit-related errors.

In addition, 74% of nurses committed errors during their term of service. Patient medication with the highest frequency and then administering the

drug to the patient was the second highest nurses' misconduct. It should be concluded that preventing these errors should be given top priority in corrective measures. The results on nurses' workload showed that over 90% of nurses had very high and high workload. Therefore, in order to reduce the occurrence of such errors and reduce labor costs, hospital managers need to take control measures such as holding training sessions, preparing visit checklist, codification of guidelines, implementation of the clinical governance program in all departments, employment of adequate nurses, logical patient/nurse ratio and reducing work hours to avoid excessive workload and reduce the risk of error commitment by nurses.

Conflict of interest

The authors did not report any contradiction of interests.

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