



## Investigating Causes of Medical Errors in Intensive Care Units in Iran: A Cross-sectional Study

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### Abstract

**Background:** Medical errors cause disability and mortality in intensive care units (ICUs). We aimed to determine the occurrence and causes of medical errors in the ICUs of Iran.

**Methods:** In this cross-sectional study, data from the family complaint files referred to The disciplinary authority of Iran Medical Council was retrospectively reviewed to explore the causes of medical errors. Statistical analysis was performed in SPSS Version 26.0.

**Results:** A total of 293 complaint files were referred to the disciplinary commission from 2014 to 2019, of which 95 files were related to medical errors in ICUs. The median age of patients was 62 years (46-74 years) and 52 (54.7%) patients were men. Also, 37 (38.9%) patients had decreased levels of consciousness and 42 (42.2%) patients had cardiovascular disease. A total of 40 (42.1%) patients experienced a single medical error and 55 (57.9%) patients experienced more than 1. Causes of medical errors in patients were physician's or nurse's negligence in 53 (55.8%) patients, weak interaction of physician and nurse with the patient and family members in 11 (11.6%) patients, weak interprofessional interaction among physicians in 7 (7.4%) patients, equipment and structure of ICUs in 7 (7.4%) patients, nature of ICUs and patients in 6 (6.3%) patients, weak physician-nurse interprofessional interaction in 5 (5.2%) patients, low attention of the physician and the nurse to medication safety in 6 (6.3%) patients.

**Conclusion:** Patient safety is impacted by a variety of medical mistakes. Interprofessional strategies can be developed and put into action to mitigate medical errors in ICUs.

**Keywords:** Intensive Care Units, Medical Errors, Patient Safety, Treatment Outcome

**Conflicts of Interest:** None declared

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### Introduction

Patient safety is one of the principal features of the quality of health care systems, attempting to assure that a medical treatment plan will proceed properly and provide the optimum quality of care to achieve the best outcome (1). Intensive care units (ICUs) have emerged to bring together well-trained medical teams to provide care for patients

with life-threatening diseases (2). However, patients in ICUs are most vulnerable to being exposed to events because of high complexity in treatment, serious illness, underlying conditions, and providing life-sustaining care (3).

Medical errors account for important clinical and eco-

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#### ↑What is “already known” in this topic:

Medical errors account for important clinical and economic concerns worldwide and are among the biggest challenges for both patients and health care systems.

#### →What this article adds:

Development and implementation of interprofessional programs for health care providers can play an important role in the prevention and reduction of medical errors in ICUs.

nomic concerns worldwide and are among the biggest challenges for both patients and health care systems (4, 5). The estimated occurrence of medical errors with adverse events is 3.7% to 16.6% of hospital admissions. Moreover, about 1 in 10 patients are damaged by health care providers and the rate of medical errors in ICUs patients is 1.7 per day (6). Recently, the significance of medical errors as a key contributor to adverse events has been the main focus of several reviews and initiatives. The Institute of Medicine released an extensive report assessing the prevalence of medical errors and evaluating potential causes of medical mistakes (7). Furthermore, the American Heart Association (AHA) Scientific Statement has acknowledged the prevalence and scope of medical errors in acute cardiac care settings and has provided an overview of the main categories of medical error events (8).

Investigating the occurrence of the most common type of medical errors in ICUs and trying to find their causes is a valuable effort to reduce failure in treatment and improve patient's safety. Hence, we performed this study to describe the frequency and types of medical errors occurring in the ICUs and explore potential solutions.

## Methods

### Study Design and Ethics

In this retrospective cross-sectional study, which covered the years 2014 to 2019, the family complaint files of harmed patients in ICUs who were reported to the Islamic Republic of Iran Medical Council's (IRIMC) disciplinary authority were evaluated. The protocol of the study was approved by the Medical Research Ethics Committee (IR.IUMS.REC.1397.624). Written informed consent was obtained from all who participated in the study.

The aim of the study was to explore the main cause of medical errors in the ICUs resulting in harm to patients or death. Medical documents of damaged patients were reviewed by the disciplinary authority of IRMC to determine the causes of medical errors and the degree of negligence or innocence of the physicians and/or nurses. Age, gender, length of hospitalization, and patient indications for ICU admission were compared as predictors between study groups with different causes of medical errors.

### Data Collection

The Acute Physiology and Chronic Health Evaluation score (APACHE II), the causes of the complaint, and the causes of death, disability, and injury due to medical errors were all taken into consideration when extracting and screening the available data for each complaint. These questions inquired about the patient's age, gender, underlying disease, APACHE II score, and the causes of the complaint were also included.

### Statistical Analysis

All statistical analyses were performed using IBM SPSS Version 26.0 (IBM). Continuous variables are presented as mean  $\pm$  standard deviation and categorical variables as frequency (%). For analysing continuous data, the Krus-

kal-Wallis test was used to assess differences among the groups, whereas categorical variables were compared using the chi-square ( $\chi^2$ ) analysis. Statistical significance was set at  $P < 0.05$ .

## Results

Out of a total of 293 complaint files referred and assessed in the disciplinary commission, 95 files were related to medical errors in patients hospitalized in ICUs. The majority of complaints were against physicians in 64 cases (67.4%) and 27 complaints (28.4%) were against nurses. Four complaints (4.2%) were against both physicians and nurses. Also, 48 medical errors (50.5%) occurred during the day shift and 47 medical errors (49.5%) during the night shift.

Table 1 represents demographic and clinical data of patients. The median age of patients was 62 years (46-74 years) and 54.7% of them were men. The main reason for transferring patients to ICUs was decreased level of consciousness (38.9%), and cardiovascular disease was the most prevalent underlying disease (42.2%). Regarding surgical intervention, neurosurgery (23.08%) and laparotomy (21.54%) were more prevalent than other procedures.

Table 1. Demographic and clinical outcomes of intensive care unit patients

Variable	Level	
Median age (years)		62 (46-74)
Mean APACHE II score		11.25 $\pm$ 8.23
Median length of ICU stay (days)		10 (5-24)
Median length of hospitalization (days)		9 (5-23)
Gender (n, %)		
	Male	52 (54.7)
	Female	43 (45.3)
Types of complain file (n, %)		
	Death	81 (85.3)
	Disability	14 (14.7)
Indications for ICU admission (n, %)		
	Decrease in LOC	37 (38.9)
	Postoperative care	25 (26.3)
	Respiratory distress	18 (18.9)
	Hemodynamic compromise	15 (15.8)
Type of comorbidities (n, %)		
	Cardiovascular disease	42 (42.2)
	Diabetes mellitus	9 (9.5)
	Kidney disease	20 (21.2)
	Cancer	8 (9.4%)
	Stroke	7 (7.4)
	Pulmonary disease	
Type of surgical intervention (n, %)		
	Neurosurgery	15 (23.08)
	Laparotomy	14 (21.54)
	Orthopedic surgery	9 (13.58)
	Thoracic surgery	9 (13.58)
	Cardiac surgery	5 (7.69)
	ENT surgery	4 (6.15)
	Gynecology surgery	7 (10.77)

ICU, intensive care unit; APACHE, Acute Physiology and Chronic Health Evaluation; LOC, level of consciousness.

Medical errors in the ICUs resulted in disability and death in 14 and 81 patients, respectively. According to the verdict of disciplinary authority, 40 patients (42.1%) experienced a single medical error, whereas 55 patients (57.9%) were subjected to more than 1 medical error. The main causes of medical errors reported by the disciplinary authority are provided in Figure 1. The most common medical errors were physician or nurse's negligence (55.8%), followed by weak interaction of the physician and nurse with the patient and family members (11.6%). As represented in Table 2, a total of 53 patients were harmed due to the physician or nurse's negligence. The major contributing factors to negligence were misdiagnosis or delayed diagnosis of a medical condition, failure to monitor and report a change in patient status, and docu-

menting incorrect or incomplete information. Also, equipment and structure of the ICUs were responsible for 7.4% of medical errors that were identified by untidy drug shelves due to a large number of medicines and lack of light in ICUs. Furthermore, the nature of ICUs and patients, defined by fatigue, heavy workload, stress, patient's complex conditions, and giving the medication at the wrong time, accounted for 6.3% of medical errors that occurred in ICUs. There was no statistically significant difference between causes of medical errors and length of ICU stay ( $P = 0.662$ ), age ( $P = 0.258$ ), and gender ( $P = 0.840$ ). Descriptive analysis of medical error causes in terms of patient's indication for ICU admission is provided in Table 3.

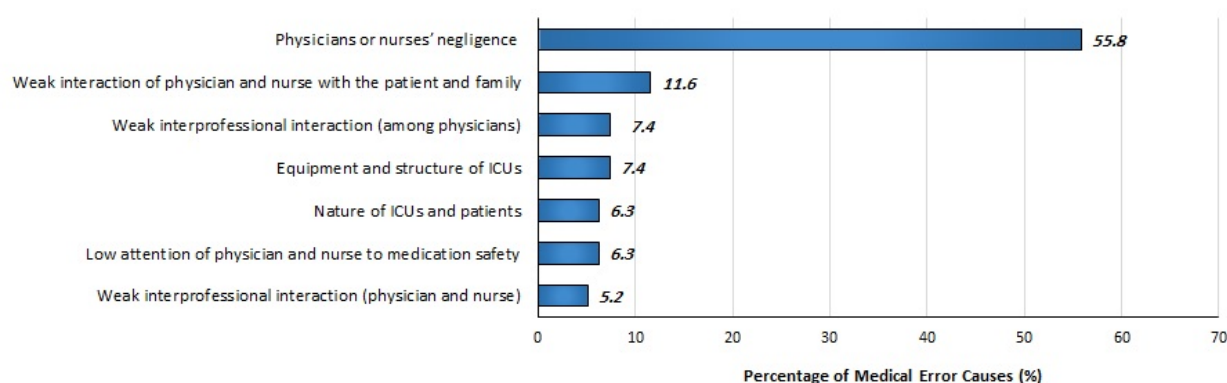


Figure 1. Patterns of medical error causes in ICUs.

Table 2. Summary of causes of medical errors and patient characteristics

Causes of Medical Errors	Patients (n=95)	Length of ICU Stay	Mean Age	Gender	
				Male (43)	Female (52)
Physicians or nurses' negligence	53 (55.8%)	19.25±23.67	60.77±19.69	21 (48.84)	32 (61.54)
Weak interaction of physician and nurse with the patient and family	11 (11.6%)	15.27±9.05	51.18±21.07	6 (13.95)	5 (9.62)
Weak interprofessional interaction (among physicians)	7 (7.4%)	15.71±20.52	62.29±20.94	4 (9.30)	3 (5.77)
Weak interprofessional interaction (physician and nurse)	5 (5.2%)	28.01±36.72	61.80±21.20	3 (6.98)	2 (3.85)
Equipment and structure of ICUs	7 (7.4%)	8.0±8.15	60.0±19.83	4 (9.30)	3 (5.77)
Low attention of physician and nurse to medication safety	6 (6.3%)	8.83±9.21	57.50±18.66	2 (4.65)	4 (7.69)
Nature of ICUs and patients	6 (6.3%)	26.17±46.1	39.83±18.30	3 (6.98)	3 (5.77)
P-value	-	0.662	0.258	0.84	

ICU, intensive care unit. Continuous data (mean ± standard deviation) are analyzed using nonparametric Kruskal- Wallis test and categorical data (%) are analyzed using  $\chi^2$  test.

Table 3. Summary of causes of medical errors and patient indications for ICU admission

Causes of Medical Errors	Number of Patients	Decrease in LOC	Postoperative Care	Respiratory Distress	Hemodynamic Compromise
Physicians or nurses' negligence	53	17 (45.94)	14 (56.0)	12 (66.67)	10 (66.67)
Weak interaction of physician and nurse with the patient and family	11	3 (8.11)	4 (16.0)	3 (16.67)	1 (6.67)
Weak interprofessional interaction (among physicians)	7	6 (16.22)	1 (4.0)	0 (0.0)	0 (0)
Weak interprofessional interaction (physician and nurse)	5	2 (5.41)	3 (12.0)	0 (0.0)	2 (13.33)
Equipment and structure of ICUs	7	2 (5.41)	1 (4.0)	2 (11.10)	2 (13.33)
Low attention of physician and nurse to medication safety	6	2 (5.41)	2 (8.0)	0 (0)	0 (0)
Nature of ICUs and patients	6	5 (13.50)	0 (0)	1 (5.56)	0 (0)
Sum	95	37 (100)	25 (100)	18 (100)	15 (100)

LOC, level of consciousness; ICU: intensive care unit. Categorical data are presented as number and percentage (%).

## Discussion

The findings of the present study have provided a clear understanding of the type of medical errors that occurred in the hospital's ICUs and resulted in direct harm to patients. We found that the physician or nurse's negligence accounted for 55.8% of medical errors in ICUs and approximately 11.6% of the medical errors resulted from weak interaction of the physician and nurse with the patient and family. Our findings highlight the patterns of common medical errors that occur in the ICU wards, resulting in death, disability, and injury. Identifying medical errors in ICUs offers the potential for enhancing patient safety and improving intensive care by modifying medical practices to decrease the number of medical errors in ICUs (7, 9).

Critically ill patients in ICUs are most vulnerable to medical errors owing to having both underlying conditions and acute organ dysfunctions. Also, life-sustaining treatment and highly technical routine care utilized in ICUs provide many opportunities for medical errors (10). Furthermore, long work shifts, heavy workload, and ICU team member's stress contribute to medicine-related errors (11). Because of this complexity, the ICUs are breeding ground for potentially dangerous events that increase the likelihood of hazardous medical errors (12, 13). Many studies and consensus reports have focused on how crucial medical mistakes are to unfavourable patient outcomes. In this regard, medical errors in ICUs tend to be errors of commission, and when errors of omission are added to errors of commission, the estimates of preventable harm significantly rise. Graf et al reported the occurrence of medical errors in 15% of ICU patients reported by physicians (71%) and nurses and physical therapists (29%) through completing a structured Incident Report Form (14). Also, Osmon et al investigation reported 232 medical errors in 728 ICU patients, and 130 (56.2%) of them were commissions or omissions that occurred within the physical location of the ICUs. In their study, most of the medical errors were reported by nurses using SAFE cards (59.1%), and also ICU attending physicians were responsible for 2.6% of medical errors (9, 15, 16). Our research revealed that medical errors in the ICU accounted for 55.8% of all errors, making physician or nurse carelessness the most common. Although negligence of the physician's orders by the patient is one of the main causes of errors related to the patients, active participation of patients is an effective way to preserve patient's safety and avoid medical errors (17, 18).

Moreover, a previous study has demonstrated that preventable in-ICU deaths occur in 14.1% of all deaths observed in the ICU that would be preventable through detection, reduction, and prevention of medical errors via training, supervision, and implementation of protocols (19). Osmon et al in their research reported that 9.9% of medical errors result in the need for additional life-sustaining treatment and 3% of medical errors may have contributed to patient deaths. Lack of purposeful collaboration among health care professionals, inactive communication between physicians and nurses with patients and their families, and obtaining a faulty medical and nursing

history lead to a broad range of medical errors in health care systems. In our study, weak interaction of physicians and nurses with the patients and families was responsible for 11.6% of medical errors, and also 7.4% of medical errors occurred because of weak interprofessional interaction among physicians. It has been reported that failure of communication among the health care team members is responsible for 60% of medical errors, with potentially adverse effects on clinical outcomes (20). Therefore, increasing collaboration between health care professionals and their relations can improve patient safety and clinical outcomes (21). In addition, environmental determinants, including the nature of the ICUs, the patient's condition, and ICU equipment, influence patient outcomes and occurrence of medical errors (22). Heavy workload, fatigue, stress, and insufficient light in the ICUs have been reported by several studies as factors affecting the occurrence of medical errors (23-25).

The present study has potential limitations. Our descriptive retrospective study was limited to the hospitals in the country and causes of medical errors reported by the disciplinary authority were taken into account. Therefore, it may not be appropriate to generalize the findings to all hospitals. The reasons for medical errors can also vary, therefore there must be other elements involved that weren't considered in our study. Thus, more research examining the factors that lead to medical errors in ICUs from the viewpoints of nurses and physicians may be useful to shed light on all facets of this problem.

## Conclusion

The results from this study illustrate that medical errors vary in their type and influence on patient safety and clinical outcomes. Therefore, development and implementation of interprofessional programs for health care providers can play an important role in the prevention and reduction of medical errors in ICUs.

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## Authors' Contributions

O.M.M.: conceptualization, investigation, methodology, project administration, and supervision. A.K.: conceptualization, investigation, methodology, and project administration. M.S.: conceptualization, data curation, formal analysis, investigation, methodology, writing, review, and editing. A.A.: conceptualization, investigation, methodology, software, and validation. K.A.: conceptualization, investigation, methodology, and project administration. A.F.B.: conceptualization, investigation, methodology, and project administration. M.N.L.: conceptualization, investigation, project administration, data curation, methodology, writing, review, and editing.

## Compliance With Ethical Standards

The study was completed according to the standards es-



established in the 1964 Helsinki Declaration and its later amendments. Written informed consent was obtained from all participants.

### Ethical Considerations

The protocol of the study was approved by the Medical Research Ethics Committee (IR.IUMS.REC.1397.624).

### Conflict of Interests

The authors declare that they have no competing interests.

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