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Type of Medical Errors, and Related Factors in Kermanshah Province in 2020

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Abstract

Background: Medical errors are considered inevitable events in healthcare systems and represent a major challenge in global health, particularly in developing countries. This study aimed to investigate the types of medical errors and their associated factors in Kermanshah Province, western Iran, in 2020.

Methods: A cross-sectional study was conducted using data from all patients referred to public and private healthcare centers with complaints related to clinical or medical errors. Complaints were filed with the Kermanshah Medical System Organization in 2020. Data were collected using a checklist and medical error registry software.

Results: The operating room ward accounted for the highest proportion of reported errors (44.09%), followed by the delivery ward (20.43%) and the emergency ward (6.45%). Poisson regression analysis revealed that age group, type of service center, and the interaction between medical negligence and type of shift were significantly associated with the number of errors.

Conclusion: Greater attention should be paid to hospital performance, and medical protocols should be revised to prevent errors and their associated financial and human consequences. Our findings suggest that healthcare organizations should prioritize conditions during night shifts, particularly when additional medical staff are involved. Implementing enhanced safety protocols or support systems during these periods may mitigate the elevated risk of errors and improve overall patient safety.

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Introduction

An error is defined as a defect in practice that occurs due to an inappropriate plan for achieving a goal.[1] Patient safety is regarded as one of the most important concerns in healthcare systems and is critical from economic, humanitarian, and ethical perspectives.[2] Researchers generally categorize medical errors into two groups: structural errors (technical and systematic) and human errors (such as registry errors, medication errors, and treatment errors). Each of these errors can cause significant harm to both patients and the healthcare system.[3]

Medical errors are recognized as inevitable events in healthcare systems[3-5] and represent a major challenge to global health systems, particularly in developing countries. They rank as the eighth leading cause of death worldwide and the fifth leading cause of death in the United States.[6] According to research, the probability of errors occurring across different sectors of healthcare systems is estimated to be between 5% and 10%, of which approximately 50% are preventable.[5, 7] Similarly, findings from the Harvard study revealed that 58% of adverse events related to medical errors were preventable.[8] Reports from a U.S. health survey conducted between 2004 and 2005 indicated that 34% of medical errors resulted from incorrect prescriptions, diagnoses, or treatments. Comparable figures were reported internationally: 30% in Canada, 22% in Australia, 23% in Germany,

and 25% in New Zealand.[9]

Medical errors result in annual costs exceeding 17 to 19 billion dollars.[10] In developing countries, such as those in the Eastern Mediterranean region, approximately 1.4 million medical errors occur in healthcare centers annually.[11] Reports from Iran indicate that one in every 150 hospitalized patients dies due to medical errors.[3, 12, 13] According to a review study conducted in Iran, the majority of these errors are medication-related, with prevalence rates ranging from 10% to 80%.[14] Overall, the prevalence of medical errors in Iran has been reported at around 50%.[14] Furthermore, a systematic review and meta-analysis found that physicians and nurses committed errors at rates of 31% and 37%, respectively.[15]

Despite continuous efforts to reduce clinical errors, they remain frequent in practice, with physicians often referred to as the "second victims" of such errors.[16] Identifying the various types of medical errors is therefore essential for effective prevention planning. However, due to the absence of a standardized reference framework, the estimated prevalence of errors varies widely across studies. The considerable human and financial consequences of medical errors, combined with ongoing challenges in this field, highlight the urgent need for further research. The findings of this study aim to provide valuable insights for health policymakers and system managers to develop strategies that minimize clinical errors and enhance the safety of healthcare services.

The primary objective of this study was to examine the types of medical errors and the factors associated with their occurrence in Kermanshah Province, western Iran, in 2020.

Methods

Study Design

This cross-sectional study was conducted in Kermanshah Province, western Iran, in 2020. Data were obtained from the Kermanshah Medical System Organization and included 268 patients who had filed complaints regarding clinical or medical errors in public and private medical centers during the study period.

Kermanshah is one of the seven diagnostic and medical service hubs in Iran. It hosts 23 hospitals, including seven educational and medical centers, two hospitals affiliated with the Social Security Organization, two hospitals affiliated with the Armed Forces, and two private hospitals, with a total of approximately 2,600 active beds. In addition, the province provides training in two subspecialty fields—cardiac surgery and pediatric nephrology—as well as residency programs in 12 specialties, such as general surgery, internal medicine, obstetrics, pediatrics, anesthesia, infectious diseases, radiology and ultrasound, urology, cardiology, neurology, psychiatry, and pathology.

The study protocol was approved by the Research Ethics Board of the Deputy of Research at Kermanshah University of Medical Sciences (KUMS) (Approval Code: IR.KUMS.REC.1397.810). Written informed consent was obtained from all participants.

Data Collection

Data were collected using a checklist and medical error registry software. Additional information was obtained, depending on the type of error, from patients' medical records and hospital error reporting forms. The research instruments captured data on demographic characteristics, admission details, diagnosis, treatment actions, and specific information about the error, including medical negligence, type of error, contributing factors and causes, error outcomes, probability of recurrence, work history of the offender, incident shift, and the final verdict.

Medical errors were classified into six categories: (1) Clinical Decision-Making Errors (including diagnostic and treatment errors), (2) Procedural Errors (including medication and surgical errors), (3) Communication Errors, and (4) System Errors.[17]

After approval of the medical error registry by the Ethics Committee of Kermanshah University of Medical Sciences, the researcher contacted all cases referred to the Kermanshah Medical System Organization during the study period, invited them to participate in the registry, and obtained informed consent.

Statistical Analysis

Quantitative variables were summarized using the mean and standard deviation, while qualitative variables were described using frequencies and percentages. The chi-square test was applied to examine associations between categorical variables. Poisson regression with robust standard errors was conducted to evaluate both adjusted and unadjusted associations between related factors and the number of errors. All data were complete, with no missing values. Statistical analyses were performed using *Stata* version 12, and a significance level of 0.05 was considered.

Ethical Consideration

IR.KUMS.REC.1397.810

Results

Analysis of data from 268 reported clinical errors showed that the mean age of complainants was 34.99 years. Of these, 52.26% were women and 47.74% were men. Regarding marital status, 57% of complainants

were married, and 42.80% were single. The operating room accounted for the highest proportion of reported errors (44.09%), followed by the delivery ward (20.43%) and the emergency ward (6.45%). Regarding work shifts, most errors occurred during the morning shift (47.94%), followed by the evening shift (43.07%).

Approximately 60.45% of errors were reported by hospitalized patients, with 62% of cases involving individuals who were admitted voluntarily. Preventable errors accounted for 53.93% of all reported cases, while 46.07% were classified as non-preventable. Among error types, procedural errors were the most common (46.27%). Within surgical errors, events occurring during sedation and anesthesia were most frequent, comprising 51.20% of cases.

Physicians were responsible for the majority of errors (75.19%), with an average of 17.46 years of work experience among those who committed errors. Regarding institutional distribution, public hospitals reported the highest error rate at 3.94%, followed by military hospitals (14.55%), private hospitals (8.48%), and hospitals affiliated with the Social Security Organization (3.03%).

Analysis of contributing factors indicated that communication issues accounted for the largest proportion (30.65%), while systemic factors represented 4.98%. A summary of these findings is provided in Table 1.

Table 1: Frequency of clinical errors based on the error type, Surgical error, Contributing factors and causes, Medical negligent, Hospital ward, Type of admission, Type of shift (n=268).

Coding Category	Subcategories	N (%)
	Clinical Decision-Making Errors	111 (41.42%)
	Procedural Errors	124 (46.27%)
Error type	System Errors	31 (11.57%)
	Documentation Errors	1 (0.37%)
	Patient-Related Errors	1 (0.37%)
	Performing surgery in the wrong position or person	2 (1.60%)
	Performing unnecessary surgery	6 (4.80%)
	Performing the wrong surgical procedure	9 (7.20%)
Surgical error	Placing surgical instruments on the body	2 (1.60%)
	Postoperative infection	12 (9.60%)
	Accidental or anesthesia events	64 (51.20%)
	Burns during surgery	3 (2.40%)
	Other related items	27 (21.60%)
	Cognitive factors	43 (16.48%)
	Systemic factors	20 (7.46%)
Contributing factors & causes	Communication factors	80 (30.65%)
	Human Factors	56 (21.46%)
	Other Factors	69 (26.44%)
	Doctors	200 (74.63%)
Medical negligent	Other medical staff	68 (25.37%)
	Laboratory	1 (1.08%)
	Operating room	41 (44.09%)
	Surgery	6 (6.45%)
	ICU	4 (4.30%)
	Delivery	19 (20.43%)
	Women	1 (1.08%)
	Children	1 (1.08%)
Hospital ward	NICU	**5** (5.38%)
	PICU	1 (1.08%)
	Neurology	1 (1.08%)
	Neurosurgery	1 (1.08%)
	Emergency	6 (6.45%)
	Oncology	1 (1.08%)
	Orthopedics	1 (1.08%)
	Angiography	1 (1.08%)
	Other wards	3 (3.23%)
	Emergent	50 (19.16%)
Type of admission	Urgent	50 (19.16%)
	Elective	168 (62.69%)
	Morning	128 (47.94%)
Type of shift	Evening	115 (43.07%)
	Night	25 (9.32%)

CPR: Cardiopulmonary resuscitation; ICU: Intensive care unit; NICU: Neonatal intensive care unit; PICU: Paediatric Intensive Care Unit

Chi-square analysis indicated a significant association between medical negligence and work shifts (X^2=18.66; P<0.001). A significant relationship was also found between medical negligence and error type (X^2=29.88; P<0.001). Specifically, 88.71% of procedural errors were attributed to physicians, compared with 11.29% attributed to other personnel. In addition, there was a significant association between the type of admission and error type (X^2=21.75; P=0.005). Elective admissions were more likely to involve clinical decision-making errors (51.82%) compared with emergent admissions (19.09%).

The results of Poisson regression, assessing both adjusted and unadjusted associations between relevant factors and the number of reported errors, are presented in Table 2. Independent variables examined included the offender's work experience, average weekly hours in the center, average weekly hours in the operating room, incident shift, error cause, patients' age group, type of service provider center, patient status, interaction between work shift and error type, and contributing causes of errors.

The results of the adjusted Poisson regression analysis indicated that, compared to patients aged 0–20 years, the incidence rates of medical errors were significantly higher in the 20–40, 40–60, and 60–80 age groups, with values of 1.38, 1.50, and 1.49, respectively (P<0.05). Additionally, the incidence rate of reported medical errors among non-physician personnel was 32% lower than that of physicians (P<0.05). For individuals working the night shift in the presence of medical negligence, the incidence rate of medical errors was over three times higher compared to those on the morning shift without medical negligence. This finding suggests that the night shift exacerbates the impact of medical negligence on the likelihood of committing errors (Table 2).

Discussion

The results indicated that, of the 268 reported errors, 124 were attributable to procedural errors in hospitalized patients. This finding is consistent with studies conducted at Harvard and in Australia, which similarly identified procedural errors as a major contributor, accounting for approximately half of the reported errors.[17, 18] Notably, adverse events in hospitalized patients were frequently associated with surgical procedures, a critical subset of procedural errors.

These findings contrast with prior research, which identified medication errors as the most prevalent type of error.[19] For instance, Rezazadeh et al. (2013) and Shoja et al. (2007) reported that medication errors were the most frequent clinical errors,[20, 21] whereas in

Table 2: Poisson regression results to assess the adjusted & unadjusted association between related factors on the number of errors.

Variables	Unadjusted IRR [95% CI]	Adjusted IRR [95% CI]
Work experience of the wrongdoer	1.01 [1.00, 1.02]*	1.01 [0.99, 1.01]
Average hours in the operating room per week	1.02 [1.00, 1.04]*	1.00 [0.99, 1.01]
Average hours of attendance at the center per week	1.02 [1.00, 1.04]*	1.01 [0.98, 1.03]
Age categories:		
0-20	Reference	Reference
20-40	1.27 [0.99, 1.44]	1.38 [1.08, 1.77]*
40-60	1.41 [1.07, 1.87]*	1.50 [1.14, 1.98]*
60-80	1.44 [1.06, 1.98]*	1.49 [1.12, 1.97]*
80-100	0.30 [0.06, 1.54]	0.34 [0.07, 1.46]
Incident Shift:		
Morning	Reference	Reference
Evening	0.81 [0.67, 0.96]*	0.98 [0.76, 1.27]
Night	0.84 [0.63, 1.13]	0.81 [0.59, 1.10]
Type of service provider center:		
Hospital	Reference	Reference
Clinic	0.86 [0.66, 1.11]	0.86 [0.65, 1.12]*
Policlinic	0.86 [0.69, 1.07]	0.83 [0.61, 1.13]
Pharmacy & Laboratory	2.19e-06 [5.44e-07, 8.80e-06]*	1.35e-06 [3.07e-07, 5.91e-06]*
Patient status:		
Hospitalized	Reference	Reference
Not Hospitalized	0.85 [0.71, 1.01]	1.17 [0.88, 1.55]
Medical negligent:		
Doctors (Specialists)	Reference	Reference
Other medical staff	0.63 [0.51, 0.77]*	0.68 [0.48, 0.96]*
Incident Shift × Medical negligence:		
Morning × Doctor	Reference	Reference
Evening × Other personnel	1.15 [0.74, 1.80]	0.94 [0.61, 1.47]
Night × Other personnel	3.17 [1.62, 6.18]*	3.16 [1.55, 6.45]*

*P<0.05

the present study, they accounted for only 1.87% of the errors. This discrepancy is notable, particularly in light of a UK study reporting that 12% of primary care patients are affected annually by prescribing or monitoring errors.[22] and a study in Mexico where dose regimen errors comprised 27.6% of errors, with 58% of prescriptions containing mistakes.[23] The present study suggests that physicians and other healthcare personnel demonstrated higher accuracy in drug prescribing and monitoring compared to other types of errors.

According to the findings, physicians were responsible for the highest proportion of errors (75.19%), whereas previous studies reported a higher prevalence of errors among nurses, attributed to high workloads, insufficient sleep, and elevated stress levels.[24-26] Clinical errors are particularly common in surgical specialties due to the complexity of procedures and the visibility of complications, which may be more pronounced when clinicians are inexperienced or when new clinical methods are introduced;[26, 27] however, the average work experience of the offenders in this study was 17.46 years.

Regarding shift times, errors were more prevalent during morning shifts, consistent with findings by Chaharsooqi and Khamernia (2014).[6, 28, 29] Conversely, other studies by Mohsenzadeh and Darabi reported higher error rates during night and evening shifts, respectively,[30, 31] differences likely attributable to variations in hospital types and contexts. In an Australian study, approximately 17% of adverse events in outpatients resulted in disability or death, with researchers estimating that about half were preventable.[18] In contrast, the current study found that 60.45% of reported errors occurred in inpatients, and 53.93% of these errors were deemed preventable.

According to a review study in Iran, teaching hospitals were the most common setting for clinical errors in 75% of the studies, followed by private hospitals, social security hospitals, and military centers, respectively.[14] In the present study, 73.94% of errors were reported in educational hospitals, followed by military hospitals (14.55%), private hospitals (8.48%), and social security hospitals (3.03%). Differences in equipment and the availability of specialized staff among hospitals likely contribute to variations in patient satisfaction with care and services.

The study also revealed a significant relationship between medical negligence and the type of shift, as well as between medical negligence and the type of error. Notably, 88.71% of procedural errors were attributed to physicians, whereas only 11.29% were linked to other personnel. Given that physicians are directly involved in prescribing medications and performing surgeries, it is expected that they play a greater role in procedural errors. Moreover, a significant relationship was found between the type of admission and the type of error, with elective admissions (51.82%) being more likely than emergent admissions (19.09%) to result in clinical decision-making errors.

The significant interaction observed between night shifts and the presence of medical negligence suggests that the combined effect of these variables substantially increases the incidence of medical errors. This interaction may be attributed to increased fatigue and reduced vigilance among staff during night shifts, potentially exacerbated by negligent practices. Understanding these mechanisms is crucial for designing effective interventions that reduce errors during high-risk periods.

It is important to acknowledge that, due to the cross-sectional design of this study, causal relationships cannot be established. Additionally, because the clinical error registry includes only officially reported cases, the true incidence of medical errors is likely underestimated.

Conclusion

The results of this study indicate that the majority of medical errors occurred in the operating room, followed by the obstetrics and gynecology departments. The most common type of error was surgical, specifically events occurring during sedation and anesthesia, which are a subset of procedural errors. Notably, approximately half of these errors were preventable. These findings underscore the need for enhanced hospital performance monitoring and the revision of medical protocols to prevent both human and financial consequences of medical errors. Additionally, healthcare organizations should pay particular attention to conditions during night shifts, especially when multiple medical staff are involved. Implementing additional safety protocols or support systems during these periods may mitigate the elevated risk of errors and improve overall patient safety.

Authors' Contribution

All authors contributed to the study design. M.B.H. conducted data collection. P.B. and Y.S. contributed to the study concept and design. M.B.H., Y.S., and M.A. performed the analysis and interpretation of the data. P. B. and Y. S. drafted the manuscript. P. B. critically revised the manuscript for important intellectual content. M.B.H., Y.S., and M.A. conducted statistical analysis.

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Conflict of Interest

The authors declare no conflicts to disclose.

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