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Original Article

Assessment of Transcription Errors and their Effects on Medical Approach, Hospitalization Duration, and Financial Costs of Traumatic Patients: How Can We Prevent Them?

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Abstract

Background and aims: Transcription errors pose significant risks to patient well-being, potentially leading to morbidity, mortality, and financial burdens on healthcare systems and society. This study assessed the prevalence of transcription errors and their impacts on medical treatment approaches, hospitalization duration, and associated costs.

Methods: Direct observation was used to evaluate and compare all patients' medical records, identifying errors, costs, and hospitalization duration. Physician orders and patient applications were checked, with intervention and control groups categorized based on the presence or absence of errors, respectively. Data were analyzed using descriptive and quantitative methods such as the chi-square, student's t-test, Mann-Whitney test, and ANCOVA, to assess statistical significance.

Results: No significant differences were observed in gender ($P=0.73$) and age ($P=0.89$) between patients. Omission errors and incorrect dosage forms were the most common. Errors were more frequent in patients with underlying diseases ($P<0.001$), with nurses frequently involved ($P<0.001$). Errors were more prevalent in intensive care units (ICUs) ($P=0.002$) and during morning and night shifts ($P<0.001$). A significant association was found between trauma severity and medication error occurrence ($P<0.001$). Moreover, patients with transcription errors had higher medical expenses and extended hospital stays ($P<0.001$).

Conclusion: Effective preventive measures are crucial to avoid transcription errors and their adverse consequences. Recommendations include minimizing abbreviations, ensuring complete and explicit orders, rigorous training, double-checking, using technology such as Electronic Prescription and Physician Orders, maintaining a distraction-free, ergonomic work environment, and fostering open communication among healthcare providers and patients to enhance medication safety.

Keywords: Transcription errors, Hospitalized patients, Root cause analysis, Patient's quality of life, Medical expenses

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Introduction

While offering numerous benefits, medical care also reveals significant harms. A study in 1995 highlighted a high frequency of medical errors in the United States, with some leading to morbidity and mortality in hospital admissions. Shocking reports prompted action, including the publication of a seminar by the National Academy of Medicine in 1999 to address the rate of harm in the healthcare system. Since then, numerous studies worldwide have evaluated medication errors and their consequences.[1,2]

Recognizing the severity of medical errors, the World Health Organization (WHO) initiated programs to control and eliminate them. For instance, the WHO launched the 'Medication without Harm' global patient safety challenge in 2017, focusing on reducing medication-related harm by 50% over five years. However, despite these efforts, patients in low- and middle-income countries continue to face higher risks of preventable harm.[3,4]

Medication errors, particularly transcription errors, are common and occur during various stages of healthcare delivery, threatening patient safety. Factors such as inadequate knowledge, illegible prescriptions, and stressful

environments contribute to these errors, especially in emergencies where quick decisions are crucial.[5,6] Studies have identified ward-related and managerial factors as barriers to reporting medication errors.

Transcription errors occur when information is inaccurately transferred, often due to poor handwriting, cognitive issues, or human mistakes. In healthcare, such errors can lead to serious consequences such as incorrect treatments or medication mistakes, highlighting the importance of accuracy for reliable records. Common errors include omission, faulty timing, wrong medication, and drug interaction. Medication errors remain a significant concern despite global progress, resulting in patient harm and increased healthcare costs.[3,7] Drugs often linked to transcription errors include benzodiazepines, opioids, sedative antidepressants, antipsychotics, first-generation antihistamines, antibiotics, muscle relaxants, and stimulants.

Medication errors must be viewed as systemic rather than individual mistakes. Enhanced medical education and systematic approaches to identifying and preventing errors are essential to reducing their occurrence. In countries like Iran, where outdated methods persist, research is needed to address medication errors, particularly transcription errors, and their impact on patient care and healthcare systems. This study aimed to investigate transcription errors in trauma patients, given their potential implications for medical care, patient outcomes, and healthcare costs. Understanding the causes and consequences of transcription errors can help develop effective prevention strategies and ultimately improve patient safety.

Materials and Methods

Transcription errors were identified through direct observation of medical records, patient charts, and nursing reports for trauma patients. Physician orders are scrutinized with the patient's charts and nursing reports in this context. To this end, patients were categorized into two groups: the control group (those without transcription errors in their treatment process) and the intervention group (those experiencing transcription errors). Both groups were assessed based on the Injury Severity Score (ISS) criteria, and each patient's score was calculated accordingly. The ISS is commonly used for evaluating injured patients, where injuries are ranked from 0 (no injury) to 75 (unsurvivable).[8-10] Ultimately, the accumulated statistics of discrepancies in the intervention group were aggregated and presented in a descriptive and quantitative report. Additionally, treatment costs and hospitalization durations were compared between the two groups and quantitatively reported. Furthermore, global studies in this field propose solutions to reduce and prevent transcription errors.

Statistical Analysis of Data and Comparative Indices

Data were reported using means and standard deviations in Microsoft Excel 2016. Statistical analysis was performed using SPSS version 25. The relevant data were examined descriptively and quantitatively within the specified timeframe by analyzing medical records employing chi-square and student's t-tests. The Mann-Whitney test served as a non-parametric alternative to the independent sample t-test. Analysis of covariance (ANCOVA) was used to adjust for the impact of confounding variables. A P value of less than 0.05 indicated statistical significance.

Results

Evaluation of Transcription Errors and Demographic Characteristics in the Study Population

A total of 312 subjects were examined, with transcription errors identified in 204 subjects (65.4%), forming the case group. The remaining 108 subjects (34.6%) without transcription errors were the control group ($P<0.001$). In the group with transcription errors, 27 individuals (13.2%) were female, while the remainder were male. In the group without transcription errors, 16 individuals (14.8%) were female, and the rest were male. The average ages in both groups (mean ± standard deviation) with and without transcription errors were 39.24 ± 18.53 years and 37.43 ± 15.67 years, respectively. Statistically, the patients' ages and genders did not affect the incidence of errors and showed no significant differences. However, errors were more frequent in patients with underlying diseases, likely due to more drug treatments ($P<0.001$), as depicted in Table 1.

Rate of Each Type of Transcription Error

Table 2 presents the occurrence of various types of transcription errors and their average occurrences by error type. Omission error was the most common (29.3%), followed by wrong dosage and wrong treatment.

Evaluation of Transcription Error Based on Hospital Ward, Shift of Work, and Healthcare Provider

Regarding the hospital ward, the percentage of hospitalized patients in the intensive care unit (ICU) and surgical unit was significantly higher in the group with transcription errors. Some patients were in different wards, and transcription errors occurred across all wards ($P=0.002$), as illustrated in Table 3. A statistically significant difference was observed in shift work times between those with and without transcription errors ($P<0.001$).

Table 1. Transcription Errors and Demographic Characteristics

Qualitative Variable		Case Group (n = 204)	Control Group (n = 108)	*P* Value
Transcription errors		204 (65.4)	108 (34.6)	0.001
Underlying diseases status	Presence	124 (60.8%)	43 (39.8%)	0.001
	Absence	80 (39.2%)	65 (60.2%)	
Gender	Male	177 (86.8%)	92 (85.2%)	0.731
	Female	27 (13.2%)	16 (14.8%)	
Age (y)		39.24 ± 18.53	37.43 ± 15.67	0.890

Specifically, morning and night shifts displayed a higher prevalence in the group with transcription errors, while the evening shift exhibited a lower prevalence compared to the group without transcription errors (Table 3). Notably, transcription errors by nurses were predominant, accounting for 63 medical records (30.88%) and 643 errors (63.2%), in the investigated drug-related errors. Physicians ranked second, with 19 medical records and 374 errors (36%). Furthermore, both physicians and nurses were involved in 122 medical records ($P<0.001$), as depicted in Table 3.

Evaluation of Trauma Severity in the Incidence of Errors

As outlined in Table 4 and Figure 1, there is a statistically significant association between trauma severity and the prevalence of transcription errors. An increase in trauma severity correlates with an increase in transcription errors ($P<0.001$).

Comparison of the Duration and Cost of Hospitalization in the Case and Control Groups

Tables 5 and 6 illustrate the relationship between hospitalization cost and admission duration, regarding the absence or presence of transcription errors using an ANCOVA analytical test model. After adjusting for the effect of contextual covariates such as age, gender, and underlying diseases before the occurrence of traumatic injuries and hospitalization of patients, it was evident that both hospitalization costs and duration were significantly higher in the group with transcription errors ($P<0.001$). This suggests that an increase in errors can lead to longer hospital stays, probably due to the lack of proper and timely treatment, and result in higher costs imposed on both medical centers and patients.

Discussion

The WHO defines medication safety as "the science and activities related to the diagnosis, assessment,

Table 2. Rate and Mean Number of Errors in Each Type of Transcription Errors

Type of Transcription Errors	Number	Percentage	Mean Number of Errors
Wrong dosage	144	24.5%	1.92±1.081
Illegible hand-writing (prescription)	25	4.3%	1.16±0.374
Drug interactions	25	4.3%	1.44±0.768
Improper transfer to medication card	42	7.1%	1.31±0.604
Similarities in drug names	29	4.9%	1.24±0.435
Omission error	172	29.3%	2.37±1.626
Wrong dosage form	65	11.1%	1.29±0.579
Wrong treatment	86	14.6%	1.34±0.713

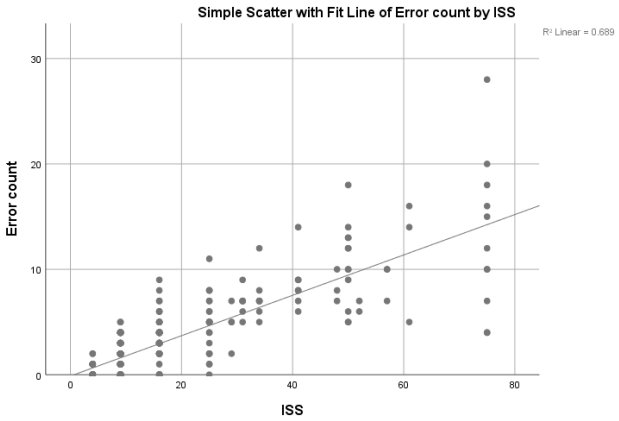

Figure 1. Scatter Plot of the Number of Errors and ISS in All Patients. *Note.* ISS: Injury Severity Score

Table 3. Determination of Transcription Errors Based on Hospital Ward, Shift of Work, and Healthcare Provider

Qualitative Variable		Case Group (n=204)	Control Group (n=108)	*P*-value
Hospital Ward	Emergency (% within hospital ward)	39 (60.0%)	26 (40.0%)	0.002
	Surgical (% within hospital ward)	157 (65.7%)	82 (34.3%)	
	Intensive care (% within hospital ward)	46 (86.8%)	7 (13.2%)	
Shift Work	Morning	151 (33.60%)	2 (1.80%)	<0.001
	Evening	140 (31.20%)	106 (96.40%)	
	Night	158 (35.20%)	2 (1.80%)	
		Physicians	**Nurses**	**Physicians and Nurses**
Healthcare provider in case group		19 (9.31%)	63 (30.88%)	122 (59.80%)	<0.001

Table 4. Contrast of Trauma Severity in the Case and Control Groups

Qualitative Variable		Case Group (n=204)	Control Group (n=108)	Chi-square (*P* value)	Pearson Correlation Statistics (*P* Value)
Trauma severity (based on ISS)	1-15	75 (36.8%)	98 (90.7%)	<0.001	0.830 (<0.001)
	16-30	74 (36.3%)	10 (9.3%)		
	31-45	21 (10.3%)	0 (0.0%)		
	46-60	20 (9.8%)	0 (0.0%)		
	61-75	14 (6.9%)	0 (0.0%)		

Note. ISS: Injury severity score.

Table 5. ANCOVA of the Admission Duration and Hospitalization Cost in the Case and Control Groups

Quantitative Variable	Group	Estimated Marginal Mean	SE	95% CI		F	*P* Value
				Lower Bound	Upper Bound		
Hospitalization cost (million toman)	Case group (n = 204)	32.61	3.1	26.58	38.80	20.69	< 0.001
	Control group (n = 108)	8.32	4.2	0	16.76		
Admission duration (in days)	Case group (n = 204)	6.839	0.53	5.79	7.89	12.42	< 0.001
	Control group (n = 108)	3.582	0.74	2.13	5.04		

Note. SE: Standard error; CI: Confidence interval.

Table 6. Descriptive Statistics on the Hospitalization Costs in the Case and Control Groups

Qualitative Variable		Hospitalization Costs (Million Toman)				
		Sum	SE of Sum	Median	Mean	SD
Transcription Errors	Control group	714.64	120.93	3.75	6.61	11.63
	Case group	6819.83	767.06	15.29	33.59	53.83

Note. SE: Standard error; SD: Standard deviation.

understanding, and prevention of adverse effects or any other drug-related problems". According to a survey of admitted patients in hospitals, only 27.9% knew the name of their discharge medicine, and even fewer could understand the purpose of their drugs.[11] When categorizing errors, considering their consequences such as patient harm is beneficial. The National Coordinating Council for Medication Error Reporting and Preventing (NCCMERP) classifies the relationship between errors and harm into categories such as error without harm (conditions with the capacity for error), error with no harm, error with harm, and error with patient death.[12]

Transcription errors are a preventable part of the medication safety chain. However, most parts of society and specialists underestimate their dangerous and even life-threatening consequences. Transcription errors are also highly prevalent in other developing countries such as Pakistan. Shawahna and colleagues' study reported transcription error rates of 16.9% and 13.8% in inpatient and discharge patient charts, respectively.[13] However, our study indicated a higher rate of 77% for patients with transcription errors, and it aligns with previous studies in Iran and other countries.[6,14] For example, a study in Morocco found that 60% of 492 transcription errors occurred at the transcription stage in ICU patients. Another study from Sri Lanka reported that 88.6% of charts include transcription errors, with a statistically significant association ($P < 0.001$) between the number of prescribed drugs and the presence of at least one medication transcription error (MTE).[15] Ghorbanzadeh and colleagues' study in Iran showed that omission errors have the highest transcription error rate, followed by improper transfer to medication cards and illegible handwriting.[6] In Ratnapala and colleagues' study in Sri Lanka, medication name transcription errors were most prevalent, followed by route and frequency errors.[16] According to a study by Jennane et al from Morocco, the wrong route of administration was 73%, which is much higher than ours, and 11% was the wrong dose, which is similar to our findings.[17] Sangha reported that the most frequent MTEs were the omission of new and stop medication orders, comprising 28.9% and 26% of all MTEs, respectively. The contributing factors to these transcription errors were illegible prescriptions (90.7%) followed by distractions (87.0%), according to the nurses' opinions. Antibacterials for systemic use were involved in the majority of MTEs, accounting for 55.3%.[3] In our study, omission errors had the highest rate of transcription errors, followed by wrong dosage, wrong treatment, and wrong medications.

Regarding hospital wards, the incidence of transcription errors was significantly higher among hospitalized traumatological patients in surgical and ICU settings ($P < 0.001$). A statistically significant association was also observed between trauma severity and the prevalence of transcription errors ($P < 0.001$), which is consistent with the findings of Ghorbanzadeh et al in Iran.[6] Ward-related factors were identified as the most significant causes of transcription errors.[6] In another European study, a high prevalence of transcription error occurred in traumatological patients (64.2%) in their emergency room and other wards, though no association was noted between these errors and the specific wards where the patients were admitted. Additionally, our results indicated no significant differences between the absence and presence of transcription errors based on patient age, gender, or underlying diseases.[16]

Our study found that nurses were more responsible for committing transcription errors than physicians. There was also a significant correlation between the time and duration of medical health providers' shifts and the occurrence of transcription errors. A direct observation study in 58 nursing homes reported an MTE rate of 12.2%.[3] The results of a study from a hospital in Cameroon indicated that 87% of the nurses attribute transcription errors to distractions, 74.8% to increased workload, and 74.1% to staff negligence.[3] Likewise, a study in Sri Lanka identified a higher workload (77.8%) as a major cause of MTEs. Topcu et al reported 'personal neglect' (86.1%), 'heavy workload' (37.5%), and 'new staff' (37.5%) as

the three main factors involved in transcription errors.[18] Transcription errors associated with these underlying causes can be eliminated by controlling health workers' shifts, reducing their heavy workload via specific job timelines and enough rest between shifts, scheduling new staff during morning shifts under the supervision of other skilled and expert co-workers, and double-checking what they have done. A study from Turkey, which evaluated medical errors of healthcare providers through a questionnaire, reported that nurses' errors were 32.6% in surgical wards and 13% in emergencies, while their physicians' errors were 42.2 % and 9.2%, respectively. Although a literature review by Shea et al reported that pharmacists had the highest knowledge of medication interactions, followed by doctors and nurses, and our results show a difference in the number of nurses and doctors involved in transcription error.[19] This comparison indicates that doctors and nurses cannot be sufficient to address these errors in different situations, highlighting the need for pharmacists.[20]

Multiple solutions are needed to prevent transcription errors. The US Food and Drug Administration (FDA) has worked on examining confusing drug names, improving packaging, advocating for identification barcodes, and providing patient education. A report from an interventional study carried out at a trauma center in Pennsylvania, US, evaluated transcription errors and addressed them with the help of a pharmacist among trauma patients.[21] This study evaluated the accuracy of the first medication history-taking of patients by the trauma team and nurse, revealing numerous ordering and transcription errors. However, many of these errors were corrected with the help of a pharmacist. Admissions nurses were found to be more accurate in history-taking than the trauma team. Nevertheless, there was no significant difference in accuracy between the trauma team and nurses when Glasgow Coma Scale (GCS) scores decreased, and the ISSs increased. Their transcription error rate (10/234) was lower compared to other reports from the USA at that time, largely due to the reconciliation process by their pharmacist, which prevented potentially dangerous transcription errors.[20] Pharmacists play a crucial role in checking the dosage and intervals of specific drugs that are more prone to errors, including insulin, opioid-containing analgesics, anticoagulants, antibiotics, and antihistamines/cold medications. Transcription errors in medication records occur when incorrect drug names are documented, posing serious health risks. Medications prone to these errors often have similar names, spellings, or therapeutic uses. Commonly confused drugs include hydroxyzine (an antihistamine) vs. hydralazine (an antihypertensive), acetaminophen (a pain reliever) vs. acetazolamide (a diuretic), morphine (an opioid analgesic) vs. hydromorphone (a more potent opioid), prednisone (a corticosteroid) vs. prednisolone (its active form), and clonidine (for hypertension and ADHD) vs clonazepam, (known as Klonopin, an anti-anxiety medication). Other frequently confused drugs include Celebrex (an NSAID) vs. Celexa (an antidepressant), Adderall (a stimulant for ADHD) vs. Inderal (a beta-blocker), Zantac (for reducing stomach acid) vs. Zyrtec (an antihistamine), Lamictal (an anticonvulsant) vs. Lamisil (an antifungal), alprazolam (Xanax, for anxiety) vs. lorazepam (Ativan, for anxiety and insomnia), Topamax (an anticonvulsant) vs. Toprol-XL (a beta-blocker), Plavix (an antiplatelet agent) vs. Paxil (an antidepressant), Prozac (an antidepressant) vs. Prilosec (a proton pump inhibitor), metformin (a diabetes medication) vs. metronidazole (an antibiotic), and Avinza (an extended-release opioid) vs. Evista (for osteoporosis). Moreover, commonly confused antibiotics include amoxicillin vs. ampicillin, which have similar names and therapeutic uses, cephalexin (Keflex) vs. cefalexin (an alternative spelling); Doxycycline vs. minocycline (both tetracyclines with similar suffixes), erythromycin vs. clarithromycin (Biaxin), which are used for similar infections, and levofloxacin (Levaquin) vs. Ciprofloxacin (Cipro), both fluoroquinolones used for various infections.[22-24] These errors are mitigated using such strategies as Tall Man Lettering (e.g., hydrALAZINE vs. hydrOXYzine), electronic prescribing systems, double-checking protocols, patient education, and barcoding systems. Each category of drug can be identified by its primary therapeutic use. For example, antihistamines such as hydroxyzine treat allergies, whereas antihypertensives such as Hydralazine are used to lower blood pressure.[22,25] This distinction is crucial. Although the trauma team, consisting of both nurses and doctors, should focus on the survival of traumatized patients and provide critical initial help for them, they should also pay attention to transcribed medicines more accurately to prevent life-threatening consequences of wrong medications. The current study indicated that the cost and duration of hospitalization are significantly higher in the group with transcription errors. This trend is also observed in developed countries where prolonged hospital admissions were reported in multiple studies due to such errors.[26]

Transcription errors indicate a systemic breakdown; hence, only systematic supervision and reconciliation can effectively reduce the rate of these errors. Clinical pharmacists play a crucial role in supervising and intervening throughout the medication process to identify and prevent transcription errors during the reconciliation process. In addition to healthcare providers responsible for reconciliation, information technology is a fundamental component in reducing transcription errors. Computer systems can eliminate illegible and unclear handwriting, decipher confusing medical abbreviations, and utilize drug databases to identify potential drug interactions. Computerized Physician Order Entry (CPOE) systems can reduce transcription errors by more than 50%. However, not all errors result in adverse outcomes. Simple recommendations can be followed by healthcare providers to prevent transcription errors, including minimizing the use of error-prone abbreviations, determining the

exact completion of orders, clarifying orders before the prescriber leaves the ward, and conducting the transcription process when the involved staff is fresh and in a quiet place free from distractions.[9] Moreover, open and direct communication between the healthcare team (nurses, physicians, and pharmacists) and with patients is another key point in the medication safety chain.[8]

Conclusion

The results of this study show that transcription errors can happen with high prevalence. These errors can also lead to significantly higher costs, prolonged hospitalization, and threats to patient safety. These results highlight the need for serious and careful preventive planning, monitoring of the treatment process, and continuous training of the treatment staff to prevent these errors and their consequences, ultimately improving patients' quality of life and health.

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Authors' Contribution

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Competing Interests

The authors declare that there is no conflict of interests.

Ethical Approval

Ethical considerations in this study included obtaining permission from the Ethics Committee of Shahid Beheshti University of Medical Sciences (IR.SBMU.TEB.POLICE.REC.1402.055). This article does not involve studies with human participants or animals.

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