

Medication Administration Errors and Contributing Factors from Critical Care Nurses' Perspective

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Abstract:

Background: In critical care units, the utilization of medications is the cornerstone of patient care. Millions of lives can be improved and saved by using medications properly. Errors in the administration of medication in critical care units can have fatal consequences. **Objective:** To identify medication administration errors and their contributing factors from critical care nurses' perspective. **Design:** A descriptive research design. **Settings:** Six intensive care units at the Alexandria Main University Hospital. **Subjects:** A convenient sample of 176 critical care nurses with a range of educational backgrounds and at least six months of ICU experience. **Tools:** Two tools were used in this study. **Tool one** was the Medication Administration Errors Assessment. Part I: Nurses' sociodemographic and work-related data: Part II: Medication Administration Errors Assessment. **Tool Two:** Medication Administration Errors Contributing Factors assessment. **Method:** A structured interview was employed to collect data. **Results and Conclusion:** The study revealed that critical care nurses sometimes make medication administration errors, these errors include wrong rate, wrong interval, wrong dose, incorrect administration technique and other errors. These errors are attributed to various factors such as shortage of staff, lack of resources, and lack of reporting. Other contributing factors include years of experience, shift work, distractions, and inadequate knowledge. Factors like fatigue, psychological issues, and incomplete medical record information also contribute to errors. The study indicated a significant relationship between medication administration errors and nurses' age, sex, work experience, nurse-patient ratio. **Recommendations suggestions:** Implement medication administration training, follow policies, evaluate ICU nurse expertise, use technology, recruit professional staff, and ensure efficient medication administration to prevent errors.

Keywords: Medication administration errors, contributing factors, Critical Care Unit, Nurse Perspective, Patient safety.

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Introduction

Critical care nurses play a pivotal role in delivering high-quality care for the critically ill and vulnerable patients in the hospitals. Medication safety is a crucial aspect of patient safety, it involves preventing or correcting adverse drug events resulting from medication use, and ensuring freedom from accidental injury. (Wondmieneh et al., 2020). Ensuring safe care is particularly important in the complex and dynamic environment of the Intensive Care Unit (ICU), where medications administration serve as the most common intervention for such critically ill.

Medication errors are defined by the National Coordinating Council for Medication Error and Reporting and Prevention (NCCMERP) as avoidable incidents that could result in incorrect medication administration or patient injury while the medication is in the patient's, healthcare provider's, or consumer's control. Numerous factors, such as professional practice, protocols, and systems, may be connected to these incidents. Examples of such factors include prescribing, order communication, product labeling, packaging, and nomenclature, compounding, dispensing, distribution, administration, education, as well as usage and monitoring (National Coordinating Council for Medication Error Reporting and Prevention [NCC-MERP], 2020).

A recent meta-analysis study indicated a prevalence of medication errors ranging from 32.1% (Sutherland et al., 2020) to 94% (Assiri et al., 2018). Additionally, statistics highlight that 39% of medication errors were attributed to general practitioners, 38% to nurses, and 23% to

pharmacies (Al-Worafi, 2020). Despite the lack of accurate statistics in the treatment system, studies suggest that many intentional and accidental medication errors go undisclosed, often identified only through complaints to courts about doctors and nurses (Yang et al., 2020). Phases of medication administration are prescription, dispensing, administration, and monitoring The World Health Organization [WHO], 2020b). Medication errors (MEs) are prevalent and significantly contribute to adverse outcomes among critically ill in the ICUs. Patients experience morbidity, adverse drug events, increase in the duration of hospitalization, disability and death in up to 6.5% of hospital admissions. (Abukhader & Abukhader, 2020). MEs extend hospital stays by 2 days and increase the costs by \$2000–\$2500 per each patient (Alrabadi et al., 2020). with global estimates suggesting an annual cost of \$42 billion for medication errors (Abukhader & Abukhader, 2020).

The NCC-MERP classifies medication errors in health centers into **four categories**: potential or non-error; error, no harm; error, harm; and error, death. Potential errors occur when a mistake occurs but doesn't cause harm, while harm occurs when a mistake requires medical intervention and results in short-term or long-term patient injury, hospital stay, long-term damage, or death (National Coordinating Council for Medication Error Reporting and Prevention [NCC-MERP], 2020, 2022).

Significance of the study:

Patients in the ICUs, due to their critical illness and multiple organ

dysfunction, are especially vulnerable to ME-related adverse events, impacting their medication handling. (Hanks et al., 2022).

Studies indicate that MEs most commonly occur during the administration phase. This phase is responsible for the highest number of physical disabilities and deaths worldwide (Abukhader & Abukhader, 2020). Adverse events caused by medication errors rank among the top ten global causes of disability and mortality (World Health Organization [WHO], 2023b), causing the death of one person every day and injuring approximately 1.3 million people annually in the United States alone (World Health Organization [WHO], 2020b).

Aims of the study

The aim of the study is to:

Identify medication administration errors and their contributing factors from critical care nurses' perspective.

Research questions:

1. What are the medication administration errors from critical care nurses' perspective?
2. What are the contributing factors of medication administration errors from critical care nurses' perspective?

Materials and Method

Materials:

Research design:

Descriptive research design was used in this study.

Settings:

Six intensive care units (ICUs) at Alexandria Main University Hospital, namely unit II, unit III, unit IV, unit V, unit VI, and unit VII. These ICUs receive

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medical and trauma patients in their acute stage directly from the emergency department or transfer from other hospital departments.

Subjects:

A convenience sample of 176 critical care nurses were included in the current study. The criteria for inclusion in the research were nurses who had at least 6 months of practical work experience in the ICU, and voluntary agree to take part in the study.

Tools:

Two developed tools were used to the study.

Tool one: "Medication Administration Errors Assessment". It was developed by the researcher after reviewing the relevant literature (Bişkin Çetin & Cebeci, 2021; Brabcová et al. 2023; Mirzaei et al. 2013). To identify medication administration errors from critical care nurses' perspective. Part I is "Nurses' sociodemographic and work-related data", and part II is "Medication administration errors assessment" which consists of 11 items. The test-retest reliability of the scale was 0.878 with Cronbach's alpha for Tool one. Scoring system is a 3-point Likert-type scale ranging from 1 to 3, with 1 being never, 2 sometimes, and 3 being often. The total score on the scale ranges from 11-33.

Tool two: "Medication Administration Errors Contributing Factors assessment". It was developed by the researcher after reviewing the relevant literature Bişkin Çetin & Cebeci, 2021; Brabcová et al. (2023); Mirzaei et al. (2013). To identify the contributing factors for medication administration errors from critical care nurses' perspective. It consists

of 5 categories: managerial process (8 items), Nursing job (11 items), Social and psychological conditions of the nurses (5 items), medicine and physicians (8 items), and patient and environment of the unit conditions (4 items). The 36-item of the scale have a reasonable level of internal consistency reliability 0.913. The scoring system by a 3-point Likert-type scale ranging from 1 to 3, with 1 is never, 2 sometimes, and 3 is often. The total score on the scale ranges from 36 to 110.

Method

- Approval was obtained from Research Ethics Committee Faculty of Nursing, Alexandria University before the study conduction.
- Approval was obtained from Faculty of Nursing, Alexandria University to the Administrative Authorities of Alexandria Main University Hospital before the study conduction.
- Approval of data collection was taken from the Administrative Authorities of the Alexandria Main University Hospital to the selected settings before data collection.
- The two tools of the study were developed, content validity and reliability were done.
- A pilot study was carried out on 10% of the subjects (18 nurses), and they excluded from the study subjects.
- Data were collected over approximately a period of three consecutive months starting from the beginning of September 2023 to the end of November 2023.
- A structured interview was employed to collect the socio-demographic, and work-

related data of the nurses, then assessment of MAEs and contributing factors from the nurses' perspective.

- The individual questionnaire was completed in 30 minutes.
- At the end of the interview, each nurse was asked to describe at least one medication administration error she encountered.

Statistical analysis

Data collected from the studied sample were revised, coded, entered using a personal computer (PC) and analyzed it using SPSS version 22. Descriptive statistics were used, with Chi-square and correlation coefficients used for relationship testing. Data visualization included bar graphs and pie charts.

Ethical considerations:

- Informed consent was the first part of the questionnaire.
- Privacy and anonymity of the participants, voluntary participation in the study was emphasized at the beginning of the data collection.
- Confidentiality of the collected data was maintained.

Limitation of the study:

- This study was conducted on a small sample size and in one setting; therefore, the results cannot be generalized.

Results:

Table I: shows distribution of the studied critical care nurses according to their characteristics. Concerning the studied nurses' age, it ranges from 21.0 to 55.0 years with a mean of 34.07 ± 8.859 years.

The majority were female (66.5%). The majority had a secondary school of nursing diploma (46.6%), 21.6% had technical institute diploma and 31.8% had a bachelor degree .

The study reveals that 45.5% of the studied nurses work in the general intensive care units, 13.6% in trauma emergency care units, 18.8% in medical and surgical emergency care units, and 81.1% are staff nurses. The majority have 1.0 to 35.0 years of experience, with 48.3% have less than 10.0 years. 84.7% have fixed work shifts, and 15.3% of them had rotating work shift. while 44.9% of them are working by one nurse to two patients and 39.8% are working by one nurse to three and more patients.

Table II: represents rank of the medication administration errors by mean score percent of the studied nurses' responses. The first error was wrong rate (62.33%), followed by wrong dose interval, wrong dose, and incorrect administration technique (53.6%).

Table III: illustrates the relationship between the occurrence of medication administration errors and the studied nurses' characteristics. It was noticed that there is a statistically significant relationship between the medication administration errors and nurses' characteristics, with major errors (26.6%) occurring among nurses under 30 years old, 17.1% among female nurses, and 28.0% among those with a secondary school diploma. Major errors (27.1%) occurred among nurses with less than 10 years of experience, particularly in rotation shifts. The major errors (28.6%) occur when increased patient-ratio especially when assigned to more than two patients.

Table IV: reveals Rank of the Contributing Factors of the Medication administration Errors according to the mean score percent of the studied nurses' responses. The first factor was nursing staff shortage (81.33%), followed by years of experience (72.0%). Then fatigue from long work hours (66.67%), followed by presence of various number of medications in the unit (66.1%), and increased patient numbers (64.33%).

Discussion

The medication administration errors (MAEs) according to the mean scores percent of the current study findings revealed that the first medication administration error reported by the studied nurses was the wrong rate, followed by wrong dose, dose interval, and other errors. Fewer nurses reported previous MAEs according to their work experience, except for omission errors and unauthorized drug use.

The current study finding was in agreement with Brabcová et al. (2021), Jessurun et al. (2023). It was documented that medication administration errors can cause serious side effects, prolonged hospital stays, delayed recovery, severe harm, and even patient death (Abukhader & Abukhader, 2020).

According to the **managerial process**, the study found that the most common cause of MAEs among nurses is the **shortage of nursing staff**, influenced by inadequate nursing schools, unavailability of resources, and economic concerns (Oleribe et al., 2019). This finding was aligned with Rae et al. (2021), who stated that staff shortages are a significant global issue affecting patient care standards,

leading to exhaustion and burnout among enrolled nurses.

The present study presents a **lack of resources**, including computerized orders and essential equipment, leading to medication administration errors through time consumption, distraction, tension, and inaccurate drug dose estimates. This finding is consistent with previous studies that highlighting the importance of appropriate equipment for medication safety and the effectiveness of automated infusion machines and electronic health records in reducing errors (Manias et al. 2020).

The current study indicates that a **lack of recording and reporting** of medication administration errors (MAEs) is a significant issue in healthcare. Nurses often avoid reporting medication administration errors due to fear of peer, manager punishment, and negative attitudes. Accurate reporting, reducing time between errors, and reports are crucial for patient wellbeing (Tchijevitch et al., 2023). This emphasized the significance of in-service training for nurses on reporting medication administration errors. (Mourid et al., 2020).

Regarding the contributing **factors connected to nursing jobs**, the study demonstrated that nurses' **distractions and interruptions** during medication administration can lead to MAEs, often resulting from self-distraction, losing focus, and other healthcare providers (Alteren et al., 2021). These interruptions are often the most frequent sources, and have been linked to clinical errors and procedural failures, all lead to medication errors (Eid et al., 2022).

The study demonstrates that **long shift hours** (long and night shift), make the nurses more likely to experience MAEs due to fatigue, sleep deprivation, poor working memory, slower mental processing speed, and increased risk of workplace injury (Books et al., 2020). This finding is in line with the result of Montgomery et al. (2021), who identified that night shifts, exhaustion, tension, a higher workload, a higher patients to nurses ratio, and disruptions to workflow are important predictors of MAEs.

The current study finding presents that over half of the nurses reported **inadequate knowledge about medication, patient diagnosis, and infusion devices** as the primary cause of medication-associated errors (MAEs). Escrivá-Gracia et al., (2019) warn that patients may be at risk due to a lack of drug information and awareness of certain side effects. This aligns with previous research suggesting that improving nurses' medication knowledge can reduce errors (Rodziewicz and Hipskind's 2020). However, El-Sayed et al. (2015) found no significant correlation between nurses' knowledge and their practice.

Regarding the **physiological, psychological, and social** aspects of the nursing staff as contributing factors to the MAEs. The current study findings demonstrated that fatigue because of excessive work hours, psychological and emotional problems constitute a major factor in MAEs. The nursing profession is distinguished by a heavy workload, strict work schedules, high information, cognitive intensity, and regular information updates. This finding is supported with Montgomery et al. (2021), who clarified that there is

strong evidence linking psychological aspects of nursing, such as compassion fatigue and burnout, to medication errors.

Concerning medicine and physicians as causes of MAEs, the current study showed that the studied nurses mentioned medicine and physicians as factors in medication administration errors and related this to **look-alike medications**. World Health Organization [WHO], (2023a) have estimated that confusion caused by Look-Alike, Sound-Alike (LASA) medications can contribute to medication errors. Appropriate training and education on look-alike, sound-alike medications and their major risks are recommended in order to decrease their contribution to medication errors.

Findings of the present study revealed that the studied nurses reported that **inappropriate labeling of medications** would sometimes cause MAEs. This finding was supported by Alrabadi et al. (2020), who stated that improper infusion device settings, distractions from other patients or staff members, or any incident, as well as issues with labeling and packaging, were the primary causes of MAE. The labels should be completed, and validated to make sure they are free from any errors (Institute for Safe Medication Practices (ISMP), 2024).

Moreover, the current study indicated that **incomplete medical record information** can lead to MAEs. Documenting inaccurate or insufficient patient information can put the patient at risk for harm, especially if the documentation is related to medication administration (Faubion, 2024). Negligence in recording medication and following documentation policies can

threaten patient safety and cause MAEs (Shitu et al., 2020). Comprehensive training for the healthcare team, regular audits, and reviews of medical records are preventive strategies for identifying and correcting incomplete documentation (Billed Right, 2023).

According to result of the current study, the **increase in patients'** numbers was significant environmental factor contributing to medication errors from the nurses' point of view. Patients in the ICUs, due to their critical illness and multiple organ dysfunction, are especially vulnerable to ME-related adverse events. Additionally, sedation and delirium may render patients incapable of contributing to their own care (Hanks et al., 2022). standardization of nursing requires a ratio per patient that must be maintained in order to prevent work stress and overload that contribute to medication error prevention (Semicyuc, 2022).

Regarding the relationship between medication administration errors and the studied critical care nurses' characteristics, the result of the current study showed a statistically significant association between the **age of the nurses and medication administration errors**. Where, the younger nurses were more likely to make major errors. This finding is consistent with Thomas et al. (2017), who demonstrated that younger nurses have higher MAEs than older nurses. This may be related to a lack of knowledge and experience.

Furthermore, there was a statistically significant association between **medication errors and the gender**, with female nurses being more likely to make medication errors. This finding was consistent with the findings of Asefa et al. (2021), a study done in Ethiopia that found

female nurses are more likely to report medication administration errors than male nurses. On the other hand, Izadpanah et al. (2018), showed that medication errors were more prevalent among men.

As well, result of the present study described a correlation between the frequency of **medication administration errors and nurses with low work experience**. This finding aligned with the conclusions of Wondmieneh et al., (2020). Fewer years of experience have been linked to a higher rate of medication errors due to less RN confidence, gaps in pharmaceutical knowledge, and deviations from medication policies.

The present study findings demonstrated a significant relationship between the **levels of education and the medication administration errors**, where the second school diploma nurses self-reported major occurrence of medication administration errors. This result is confirmed by Kerari and Innab (2021), who reported that there was significant evidence that the level of education of the nurses, their length of work experience, and their training are directly linked to the occurrence of medication administration errors. On the other hand, Samundeeswari & Muthamilselvi (2018) found no significant difference between the different levels of the nurses' educational backgrounds.

Conclusion:

Based on the current study findings:

The studied critical care nurses reported the following medication administration errors from their perspectives, ranked in descending order: wrong rate, wrong interval, wrong dose, wrong administration technique, wrong

preparation, and error of omission of the drug, administration of the drug after stop order on chart, wrong drug, wrong route, wrong patient, and unauthorized drug error.

These errors are attributed to various factors such as shortage of staff, lack of resources, and lack of reporting, years of experience, work shift, distractions, and inadequate knowledge. Other Factors like fatigue, psychological issues, and incomplete medical record information also contribute to medication errors from the studied nurses' perspectives.

The study indicated a significant relationship between medication administration errors and nurses' age, sex, level of education, work experience, and nurse-patient ratio.

Recommendations:

The following recommendations are suggested.

- **For clinical practice:** Integrate policy and regulations for medication administration safety and documentation in daily care practice.
- Furthermore, develop a training program for nurses about types, the adverse event of MAEs, causes, high-risk and new medication.
- Create an environment to support the staff for medication administration and error reporting and develop strategies to prevent further errors.
- **For hospital administration:** Implement information technology in the drug administration process.
- Recruit appropriate number of professional nursing staff.
- **For educational:** Add drug-related Knowledge and skills for safe medication administration in the nursing curriculum.

- **For further studies:** Replicate this study on larger sample size of nurses and different geographically location.

Table I: Distribution of the Studied Nurses According to their Characteristics.

Nurses' Characteristics	Total N=176	
	No.	%
Age (years)		
20-	64	36.4
30-	61	34.7
40-	38	21.6
50-<60	13	7.4
Mean ± SD 34.07 ± 8.859		Min- Max 21.0-55.0
Sex		
Male	59	33.5
Female	117	66.5
Level of education		
Secondary school diploma	82	46.6
Technical institute diploma	38	21.6
Bachelor degree	56	31.8
Work unit		
General	80	45.5
Trauma emergency	24	13.6
Medical emergency	33	18.8
Surgical emergency	39	22.2
Current work position		
Staff nurse	141	80.1
Head nurse	35	19.9
Years of experience in nursing		
<10	85	48.3
10-	33	18.8
20-	48	27.3
≥30	10	5.7
Mean ± SD 12.80 ± 10.22		Min- Max 1.0-35.0
Work shift		
Fixed (Morning- Evening)	149	84.7
Rotation	27	15.3
Nurse-Patient ratio		
One/ One	27	15.3
One/Two	79	44.9
One/Three and more	70	39.8
Mean ± SD 2.970 ± 2.295		Min- Max 1.0-10.0

Table II: Rank of the Medication Administration Errors by Mean Score Percent of the Studied Nurses' Responses.

Medication administration Errors	Min – Max	Mean ± SD	Mean Score Percent	Rank
Wrong rate	1.0 – 3.0	1.87±0.684	62.33%	1
Wrong dosing interval	1.0 – 3.0	1.81±0.657	60.33%	2
Wrong dose (overdose, low dose)	1.0 – 3.0	1.75±0.705	58.33%	3
Incorrect administration technique	1.0 – 3.0	1.61±0.508	53.6%	4
Wrong preparation error	1.0 – 3.0	1.43±0.566	47.73%	5
Prescribed drug not administered (omission error)	1.0 – 3.0	1.41±0.659	47.0%	6
Drug administered after stop order on chart	1.0 – 3.0	1.42±0.523	47.33%	7
Wrong drugs	1.0 – 3.0	1.40±0.522	46.59%	8

Wrong route	1.0 – 3.0	1.37±0.561	45.64%	9
Wrong patient	1.0 – 3.0	1.37±0.539	45.64%	10
Unauthorized drug error (without physician order)	1.0 – 3.0	1.27±0.472	42.33%	11

Table III: Relationship between Medication Administration Errors and the Studied Nurses' Characteristics.

Nurses' characteristics	Medication Errors						Total N=176		Test of Significance
	Minor (N= 99)		Moderate (N= 75)		Major (N= 2)		No.	%	
	No.	%	No.	%	No.	%			
Age (years)									
20-	14	21.9	33	51.6	17	26.6	64	36.4	$\chi^2= 57.007^*$ $p<0.001^*$
30-	21	34.4	30	49.2	10	16.4	61	34.7	
40-	35	92.1	2	5.3	1	2.6	38	21.6	
50-<60	10	76.9	2	15.4	1	7.7	13	7.4	
Sex									
Male	39	66.1	11	18.6	9	15.3	59	33.5	$\chi^2=17.201^*$ $p<0.001^*$
Female	41	35.0	56	47.9	20	17.1	117	66.5	
Level of education									
Secondary school diploma	12	14.6	47	57.3	23	28.0	82	46.6	$\chi^2=75.581^*$ $p<0.001^*$
Technical institute diploma	18	47.4	15	39.5	5	13.2	38	21.6	
Bachelor degree	50	89.3	5	8.9	1	1.8	56	31.8	
Years of experience in nursing									
<10	14	16.5	48	56.5	23	27.1	85	48.3	$\chi^2=94.623^*$ $p<0.001^*$
10-	11	33.3	17	51.5	5	15.2	33	18.8	
20-	45	93.8	2	4.2	1	2.1	48	27.3	
≥30	10	100.0	0	0.0	0	0.0	10	5.7	
Nurse- Patient ratio									
One/ One	22	81.5	4	14.8	1	3.7	27	15.3	$\chi^2=75.539^*$ $p<0.001^*$
One/Two	54	68.4	17	21.5	8	10.1	79	44.9	
One/Three and more	4	5.7	46	65.7	20	28.6	70	39.8	

X² Chi Square Test

* statistically significant at p ≤ 0.05

Table IV : Rank of the Contributing Factors of the Medication Errors according the mean score percent of the studied nurses' responses.

Contributing Factors of the Medication Administration Errors	Min-Max	Mean ± SD	Mean score Percent	Rank
Managerial process				
Shortages of nursing staff (disproportionate nurse-patient ratio).	1.0-3.0	2.44±0.630	81.33%	1
Lack of resources (computerized order, infusion pump, etc.)	1.0-3.0	2.14±0.840	71.33%	2
Lack of recording and reporting mechanism for MAEs.	1.0-3.0	1.88±0.681	62.67%	3
Unmotivated nurses because of discrimination in the workplace.	1.0-3.0	1.84±0.723	61.33%	4
Nursing job				
Number of nurses' years of experience.	1.0-3.0	2.16±0.762	72.00%	1
Distractions, and interruptions.	1.0-3.0	2.02±0.650	67.33%	2
Time of shift work (night & long shift).	1.0-3.0	1.89±0.554	63.00%	3
Inadequate knowledge and skills about medication, patient diagnosis, infusion devices.	1.0-3.0	1.83±0.627	61.00%	4

Contributing Factors of the Medication Administration Errors	Min-Max	Mean \pm SD	Mean score Percent	Rank
Social, and psychological conditions of nurses				
Fatigue caused by excessive work hours.	1.0-3.0	2.09 \pm 0.640	69.67%	1
Psychological and emotional problems.	1.0-3.0	1.77 \pm 0.759	59.00%	2
Medicine and physicians				
Availability of a variety of medications in wards.	1.0-3.0	1.98 \pm 0.701	66.00%	1
Look-alike medications.	1.0-3.0	1.86 \pm 0.599	62.00%	2
Inappropriate labeling of medications.	1.0-3.0	1.73 \pm 0.618	57.67%	3
Incomplete medical record information	1.0-3.0	1.70 \pm 0.516	56.67%	4
Patient and environment of the unit				
Increased number of patients with severe illnesses in critical care unit.	1.0-3.0	1.93 \pm 0.698	64.33%	1

High= \geq 66.6%

Moderate = 33.3% -<66.6%

Low = <33.3%

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