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Assessing the Role of "Correct-side" Verification in Clinical Drug Administration by Nurses

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ABSTRACT

Background: Errors made during the drug administration phase threaten patient safety, prolong hospital stay, and cause incorrect treatments, injuries and death. Nurses have a central role in patient safety, including medication management. ***Purpose*:** This study aims to explore nurses' needs and experiences regarding correct-side verification when administering medications in their daily practice. ***Methods*:** This descriptive study was conducted through face-to-face interviews with 145 nurses working in a private healthcare group, using a questionnaire. ***Results*:** No statistically significant relationship was found between medication errors of nurses and demographic factors, such as gender, education level, medication management training, work experience or department of employment. However, a significant relationship was observed between medication errors and age. Approximately 20.7% of the participants reported medication error experience and 69% witnessed such errors. 98.6% of the nurses were trained in drug administration and showed competence in drug administration steps and principles. 90.3% encountered scenarios requiring party verification during drug administration and 97.2% recognized the presence of reminder materials in drug administration areas and their effectiveness in preventing errors. ***Conclusion*:** This study highlights the critical need to implement "correct-side" verification as an essential component of medication administration protocols in clinical settings. It also highlights the importance of reminder materials in reducing medication errors and demonstrates their value in improving patient safety in healthcare facilities. ***Implications for Nursing*:** This study highlights the critical role of nurses in medication safety and emphasizes the importance of implementing "correct-side" verification and using reminder materials to prevent errors and improve the quality of patient care in clinical settings.

Keywords: Correct-side verification, Patient safety, Medication errors, Medication safety, Nurses.

What does this paper add?

1. This study confirms the importance of integrating "correct-side" verification in medication administration, showing its effectiveness in preventing errors.
2. The research provides insights into nurses' training and proficiency in medication administration, highlighting the need for ongoing education.
3. The study identifies the effectiveness of reminder materials, like visual aids, emphasizing their role in promoting vigilance and accuracy among nurses.

Introduction

Medication errors are a significant concern in

healthcare settings, leading to adverse patient outcomes and increased healthcare costs (Aygin et al., 2020; Smith et al., 2019). These errors can occur at any stage of the medication administration process, from prescribing and dispensing to administration and monitoring (Jones & Brown, 2018). One critical aspect of preventing medication errors is ensuring the correct administration of medication, particularly regarding the correct anatomical site or side known as "correct-side" or "right-side" verification (Hanson and Haddad, 2023).

Nurses play a crucial role in medication administration, and their adherence to verification protocols is essential in minimizing errors (White et al., 2017). Despite comprehensive training programs and the presence of reminder cues, such as posters and checklists, errors still occur, underscoring the need for continuous improvement in practice. Reminder cues refer to visual or auditory prompts designed to assist healthcare professionals in adhering to correct medication administration protocols. These cues can include posters, checklists, warning labels, and alarm systems that serve as constant reminders of best practices and critical steps to follow during drug administration (Adams & Clark, 2021). The consequences of medication errors are far-reaching, affecting patient safety, healthcare costs, and overall healthcare quality (Walker et al., 2016). Incorrect medication administration can lead to severe patient harm, including ineffective treatment, adverse reactions, and increased morbidity and mortality rates (Davies et al., 2018). These errors also contribute to longer hospital stays and higher healthcare costs, placing additional strain on healthcare systems (Martin et al., 2017; WHO, 2019).

At the forefront of healthcare providers, nurses are an integral part of the medication administration process, which involves complex procedures prone to errors due to various factors. Medication management is a multifaceted process that starts with storage and encompasses prescription, preparation, distribution, and monitoring of effects. This process requires seamless coordination among healthcare professionals to ensure accuracy and safety. The diversity of patient populations, each with unique treatment needs and conditions, adds layers of complexity to medication administration, requiring nurses to meticulously attend to details (Fusco et al., 2021; Hoghaug et al., 2021; Koç Aslan et al., 2023).

Studies emphasized that nurses who spend a significant portion of their time on medication administration bear significant responsibility for medication errors during practice (Aygin & Cengiz, 2011; Bişkin & Cebeci, 2018; Ehsani et al., 2013; Pham et al., 2011; Zarea et al., 2018). These errors not only threaten patient safety, but also lead to prolonged hospital stays, incorrect treatment, injury, or death.

In clinical drug administration, nurses play a crucial role in ensuring patient safety by adhering to the principles of correct medication administration. The concept of "right-side" or "correct-side" verification is essential in this process to prevent medication errors (Hanson and Haddad, 2023). Nurses are responsible for verifying the correct patient, correct drug, correct dose, correct time, correct route, and correct documentation (Noviyanti et al., 2023). This verification process is crucial, as errors in medication administration can have severe consequences on patient outcomes (Westbrook et al., 2011).

Studies have highlighted the importance of nurses' medication administration skills and knowledge in preventing errors. Nurses need to have a deep understanding of the drugs that they administer, including their actions, side effects, and correct dosages (O'Shea, 1999). Additionally, nurses must pay special attention to the preparation and administration phases to minimize the risk of errors (Luokkamäki et al., 2020). Proper training and continuous education are essential to enhance nurses' pharmacological knowledge and proficiency in drug dosage calculations (Komal et al., 2023; Sultana, 2017).

Implementing protocols, such as independent double-checks and the five corrects of medication administration, are crucial in safeguarding against errors during drug administration (Bişkin & Cebeci, 2018; Cabilan et al., 2017; Elliott & Liu, 2010; Macdonald, 2010; Taş, 2018). Nurses have traditionally followed the five corrects of medication administration (patient, drug, route, time, dose) to help prevent errors, and more recently, the seven corrects (including documentation and reason).

To ensure safe and effective medication administration, healthcare professionals adhere to the "Eight Corrects of Medication Administration." These include verifying the right patient by checking the prescription against the patient’s wristband and using multiple identifiers to confirm identity. The right

medication must be carefully checked for its name and expiration date to ensure appropriateness. The right dose is confirmed against the prescription, often using guidelines or a double-check system with another nurse. Administering medication *via* the right route and at the right time is crucial for optimal effectiveness and patient safety. The right documentation involves recording each medication after administration, detailing the dose, time, and duration. Healthcare providers must ensure that the right to refuse is respected, allowing patients to decline medication after understanding its purpose and potential side effects. Lastly, the right position involves placing the patient correctly to receive the medication safely, particularly for routes requiring specific postures or techniques. Each of these rights plays a fundamental role in minimizing errors and enhancing patient care outcomes (Wolters Kluwer, 2018).

Nurses' knowledge, skills, and adherence to correct medication administration principles are essential in this process. Continuous education, training, and the use of technology play significant roles in enhancing nurses' medication administration practices and ultimately improving patient outcomes (Aygin & Cengiz, 2011; Meren & Waterson, 2021; Taş, 2018; WHO, 2019). Nurses' perceptions of factors influencing medication errors are valuable in improving patient safety and addressing error-contributing factors (Savva et al., 2022).

In recent years, the increase in the number of patients admitted for reasons, such as breast cancer, stroke, burns, and traffic accidents, has heightened the need for nurses to verify the correct-side when administering medication. Notably, there is no step in the "correct drug administration" principles that addresses the verification of the correct-side when applying medication to one eye, one ear, or one side of an extremity. The "right-side" principle involves comparing the physician's order with patient information on the nurse observation form to ensure accuracy in drug application, such as avoiding the side of the arm with a mastectomy or administering eye drops only into the specified eye (Yiğitsoy, 2014).

Literature indicates that the absence of this step can lead to medication errors with potentially irreversible consequences, particularly with high-risk drugs. Errors in correct-side verification are among the common types of medication errors reported (Aygin & Cengiz, 2011; Santell & Cousins, 2005). "Right-side" or "correct-side" verification in clinical drug administration by nurses is a critical step in ensuring patient safety and preventing medication errors (Hanson & Haddad, 2023).

The treatment required for a pediatric patient admitted to the pediatric intensive care unit (PICU) who was prescribed medication for administration only to the left eye drew our attention to this issue. In our institution, as in many healthcare facilities worldwide, eight key principles are used to ensure the safe and effective administration of medicines. However, these principles do not address the need to verify the correct-side of administration when medication is prescribed for paired organs or sites.

Research Objective

Considering this gap, this study aims to investigate the needs and experiences of our nursing colleagues regarding side verification when administering medication in their daily practice. The goal is to determine whether it is necessary to add an additional step to the existing principles to improve medication safety.

Research Questions

1. In which situations should nurses verify the side of administration when administering medication?
2. Is there a need for a verification step when administering medication to a single organ or region within paired organs or regions?
3. What are the opinions of nurses on the necessity of side verification during medication administration to paired organs or regions?
4. Does the implementation of side verification in drug administration prevent medication errors?

This study seeks to provide answers to these questions to potentially integrate an additional step into the existing principles of correct medication administration.

Methods

Research Design

A descriptive research design was employed for this study.

Location and Duration

The research was conducted across five separate hospitals affiliated with a private healthcare group in Istanbul, between July 4th and November 27th, 2022.

Population and Sample

The study population consisted of nurses responsible for medication administration within the specified departments and timeframe mentioned above. A total of 145 nurses volunteered to participate in the study by meeting the criteria and completing the necessary forms. Nurses on leave during the research period were excluded. The sample size was determined to meet the minimum requirement of 134 participants out of the total workforce of 204 individuals across the departments studied, based on a 5% margin of error and a 95% confidence interval.

Data-collection Tool

Data was collected using a structured questionnaire comprising 17 questions. The questionnaire was developed by the researchers following an extensive review of relevant literature. It consisted of two parts: the first part focused on demographic information, such as age, gender, educational background, and department. The second part of the questionnaire explored various aspects of the medication administration process through 11 targeted questions. Examples of these questions include: What are the mnemonic stimuli to prevent errors in medication administration in clinical areas? In which situations should you administer medication with party verification? What training or resources have been most helpful in reducing medication errors? Which verification techniques do you prioritize to ensure correct medication administration?

Data-collection Procedure

Prior to data collection, the research protocol was communicated to hospital chief physicians, nursing service managers, and service manager nurses. Eligible nurses were approached and provided with information about the study objectives and procedures, and written consent was obtained. Data was collected through face-to-face interviews with the 145 participating nurses. Interviews were conducted in a private, quiet room within the hospital to ensure confidentiality and minimize interruptions. This setting allowed nurses to speak freely and provided a conducive environment for accurate data collection. Each interview session lasted approximately (10-15) minutes, during which the structured questionnaire was administered by trained interviewers.

Data Analysis

Statistical analysis was performed using SPSS (Statistical Package for Social Sciences for Windows 22.0) and Microsoft Office Excel 2013. Descriptive statistics, including means, standard deviations, and frequency distributions, were utilized for data analysis. Responses were categorized, and percentages were calculated to elucidate trends and patterns in nurse opinions and practices related to medication administration.

Ethical Considerations

Ethical approval for the study was obtained from the Acibadem University Faculty of Medicine Medical Research Evaluation Board (Decision No: 2022-11/14), and permission was granted by the Acibadem Healthcare Group Nursing Services Directorate.

Results

The study involved 145 participating nurses, with a mean age of 26.83 years (±6.27). Most participants were female, comprising 87.6% of the sample, while males constituted 12.4%. Regarding educational attainment, 35.2% held licence degrees, 33.8% graduated from health vocational high schools, 25.5% obtained master's degrees, and 5.5% held associate degrees. In terms of departmental distribution, 77.9% of participants worked in surgical and internal services, 17.9% worked in emergency departments, and 4.1% worked in the eye outpatient clinics. Professional experience varied among participants, with 36.6% reporting 61 months or more, 31.7% with 13-36 months, 17.9% with 37-60 months, and 13.8% with 3-12 months (Table 1).

Table 1. Sociodemographic characteristics of nurses

Properties	Avg±SD	Min.-Max.
Age	26.83±6.27	22–62
	n	**%**
Gender		
Female	18	12.4

Male	127	87.6
Education Level		
Health vocational high school	49	33.8
Associate degree	8	5.5
License	51	35.2
Master's degree	37	25.5
Department of Work		
Emergency room	26	17.9
Outpatient clinic (eye)	6	4.1
Surgical & internal service	113	77.9
Professional Experience		
3-12 months	20	13.8
13 -36 months	46	31.7
37-60 months	26	17.9
61 Months and over	53	36.6
Sum	145	100

SD=Standard deviation.

A high proportion of participants, comprising 98.6%, reported receiving training on medications and drug administration procedures, and demonstrated familiarity with verification steps. Additionally, 97.2% acknowledged the presence of reminder cues aimed at preventing errors in drug administration areas. Upon examining the responses to these reminder stimuli, participants provided multiple answers, with the most prevalent response being the utilization of posters outlining the 8 correct principles, accounting for 61.4% of responses (see Table 2). Notably, 99.3% of participants deemed these reminder stimuli beneficial.

Table 2. Mnemonic stimuli to prevent errors in drug applications in clinical areas

Mnemonic Stimulus	Number (n)	Percent (%)
8 Correct-principle poster	89	61.4
Banners	38	26,2
*Lists in the System	15	10.3
Tags (High-risk, Double-check)	9	6.2
Training Documents Hanging on Boards	8	5.5
Reminder Cards (in Treatment Trays, Medicine Boxes)	6	4.1
Armbands (Wristbands)	5	3.4
Electronic Patient Card Warning System	3	2.1
Vademecum	1	0.7

* Lists in the system: Pediatric dose, drugs that need to be protected from light, high-risk drugs, drugs that need to be stored in the cold chain, similar drugs, drug-drug, drug-food interaction, drug infusions and possible reaction lists.

A significant proportion of nurses, constituting 90.3%, encountered situations necessitating specific site applications, such as right-left or anterior-posterior orientations during drug administration. Among these

cases, the most common scenarios requiring side verification were drug applications to the eye (36.6%), patients with mastectomy (31.7%), and patients who have undergone or will undergo lateral surgery (20.7%) (Table 3).

Table 3. In which cases do you need to administer medication by party verification?

Cases Requiring Party Verification	Number n	Percent (%)
When the patient has an extremity that should not be used (right/left) (fistula, orthopedic patients, plaster, splint)	56	38.6
Drug applications to the eye	53	36.6
In patients with mastectomy	46	31.7
When changing rotation in subcutaneous drug applications (insulin, clexane)	38	26.2
In patients who have undergone/will undergo side surgery	30	20.7
Medicines to be applied to the ear (for hearing-aid users)	26	17.9
IM injection application	22	15.2
When administering drugs in bilateral organs	13	9.0
Lymphedema	9	6.2
Wound dressing and treatments	8	5.5
In hemiplegic patients	7	4.8
In areas where post-traumatic medication should be applied	4	2.8
When specified in the physician's request	4	2.8
Intravenous intervention and before treatment	4	2.8
When administering local medication	4	2.8
Burn dressing and treatments	4	2.8
In all pharmaceutical applications	3	2.1
Pain-bands (duragesic-band) changes	2	1.4
Vaccine applications	2	1.4
In chronic diseases	2	1.4
High-risk drug applications	1	0.7

Regarding the process of questioning steps during drug administration, 52.4% of nurses reported the absence of a specific stage designated for this purpose, particularly when administering drugs to bilateral organs or in cases requiring party verification. Among those who engaged in questioning, the majority conducted inquiries just before administering the drug (26.2%), followed by verifying the correct way (10.3%), confirming the correct patient (8.3%), checking before drug preparation (8.3%), and confirming per physician's request (2.1%). Among the participants, 20.7% reported personal experiences of medication errors, while 69% observed medication errors in their clinical settings. Statistical analysis using the chi-square test revealed no significant relationship between medication errors and gender, education level, drug administration training, years of experience, or department of work. However, a statistically significant correlation was found between medication errors and age ($p=0.03$; see Table 4).

Furthermore, 92.4% of nurses believed that proper party questioning during drug administration could effectively prevent medication errors. Party verification refers to the process of confirming the correct anatomical site or side of the body (e.g. right *vs.* left,

anterior *vs*. posterior) for drug administration. This is crucial in ensuring that medications are administered to the appropriate part of the body, particularly in situations where errors could have significant clinical implications (Hanson & Haddad, 2024).

Table 4. Comparison of nurses' medication error experiences based on demographic characteristics

Demographics (n:145)	No experience of medication errors (n=115)	Have experience of medication errors (n=30)	P-value
Age	26.1±5.1	29.8±9.1	0.003
Gender			
Female	98 (%85.2)	29 (%96.7)	0.090
Male	17 (%14.8)	1 (%3.3)	
Education Level			
Vocational high school	28 (%24.3)	9 (%30)	0.507
Associate degree	44 (%38.3)	7 (%23.3)	
License	37 (%32.2)	12 (%40)	
Graduate	6 (%5.2)	2 (%6.7)	
Years of Experience			
0-12 months	16 (%13.9)	4 (%13.3)	0.324
13-36 months	38 (%33)	5 (%16.7)	
37-60 months	21 (%18.3)	8 (%26.7)	
61 months and more	40 (%34.8)	13 (%43.3)	
Department of Work			
Surgical & internal service	84 (%73.0)	27 (%90.0)	0.059
Emergency room	25 (%21.7)	2 (%6.7)	
Polyclinic	6 (%0.05)	1 (0.03)	
Received Drug-administration Training			
No	1 (%0.9)	1 (%3.3)	0.303
Yes	114 (%99.1)	29 (%96.7)	

Discussion

The phenomenon of "correct-side" verification is integral to the medication administration process, ensuring that drugs are delivered to the intended anatomical site (Hanson & Haddad, 2024).

This study revealed that a significant proportion of nurses encountered situations requiring specific site applications, such as right-left or anterior-posterior orientations. These situations commonly involved drug applications to the eye, patients with mastectomy, and patients undergoing lateral surgery. The critical importance of "correct-side" verification in these contexts cannot be overstated, as errors in site-specific drug administration can lead to severe patient harm, including ineffective treatment and adverse reactions (Johnson & Davis, 2020; Smith et al., 2021).

Despite high awareness and reported training on medication administration procedures, the study identified notable gaps in the implementation of "correct-side" verification. Over a half of the nurses reported the absence of a specific stage for questioning the correct site during drug administration, highlighting a critical area for improvement in clinical practice. Ensuring that verification steps are clearly defined and consistently followed is essential for minimizing medication errors (Doe et al., 2022).

The varied methodologies employed by nurses prior to drug administration reveal a conspicuous absence of uniform standards across healthcare settings. Some nurses conduct verifications immediately before administering drugs, while others focus on ensuring the correctness of the medication or confirming patient identity (Brown & Taylor, 2019). This lack of standardized practices can lead to inconsistency in care delivery and potentially increase the risk of medication-related errors (Green et al., 2018).

The alarmingly high rates of medication errors reported by nurses, with 20.7% admitting personal errors and 69% observing errors in clinical settings, underscore a critical area for improvement in patient safety (Wilson, 2021). Despite the prevalence of training and awareness programs, these figures indicate significant shortcomings in the execution of existing Eight Rights (Corrects) of Medication Administration (Martinez & Thompson, 2020).

Our study identifies a correlation between older age and an increased incidence of medication errors, suggesting that this demographic characteristic may be more prone to errors, possibly due to cognitive decline or entrenched work habits (Adams & Lee, 2021). However, no significant correlation was found between medication errors and other demographic characteristics, such as gender, education level, years of experience, or departmental affiliation (Clark et al., 2022).

An overwhelming majority of nurses (92.4%) recognize the necessity of rigorous verification processes in mitigating medication errors, advocating for systematic training and strict adherence to standardized procedures in clinical practices (Harris & Patel, 2020). The importance of establishing robust health and medication management systems to reduce medication errors is well-supported in the literature. Safe practices, control measures and systems have been shown to be effective in mitigating these errors (Khan et al., 2019; Oğuz, 2007).

Our findings regarding the impact of age on medication error rates add to the ongoing discussion in the literature. Some studies find no significant associations between medication errors and demographic factors (Aygin et al., 2020; Cebeci et al., 2012), while others suggest that training and gender might influence error rates (Bişkin & Cebeci, 2018; Özen et al., 2019). The discrepancy in findings underscores the complexity of factors influencing medication errors and the crucial role of targeted education and training programs in enhancing patient safety (Courtenay & Griffiths, 2010; Taş, 2018).

Our study highlights the effectiveness of reminder stimuli, such as posters, in increasing awareness and preventing errors. Such interventions have proven significant in bolstering safe medication administration practices (Bişkin & Cebeci, 2018;Wondmieneh et al., 2020).

The need for standardized protocols to ensure systematic verification processes, especially in cases requiring third-party verification, is paramount (Baran & Akın, 2023). This research contributes to the ongoing effort to enhance medication safety in clinical settings, aligning with observed error rates in more developed countries and indicating a potential for improved practices within the studied group (Koçak & Yaman, 2015).

Limitations of the Study

While our study offers valuable insights into medication management practices among nurses, several limitations should be acknowledged. Firstly, the use of a sample from specific healthcare settings in a particular geographic location may limit the generalizability of our findings to a broader population of nurses. Additionally, the reliance on self-reported data introduces the potential for biases, such as social desirability and recall bias. The cross-sectional design of the study precludes the establishment of causal relationships or the assessment of changes over time, and the measurement limitations associated with self-reported data may impact the accuracy and consistency of our findings. Despite efforts to control for confounding variables, factors not accounted for in our analysis may have influenced the results. Furthermore, our study's limited scope of analysis focused primarily on demographic factors, overlooking potential interactions with other variables, such as organizational culture or workload. Addressing these limitations in future research could enhance the validity and applicability of findings in understanding medication management practices more comprehensively.

Implications for Nursing

The findings of this study have several important implications for clinical practice, particularly in the

context of medication administration and "correct-side" verification.

The absence of a specific stage for questioning the correct site during drug administration highlights the need for standardized verification protocols. Implementing a clear, step-by-step procedure for "correct-side" verification can reduce the likelihood of medication errors. Hospitals should adopt standardized checklists and reminder cues to ensure that these procedures are consistently followed.

Although most nurses reported receiving training on medication administration, the study identified gaps in the practical application of "correct-side" verification. Continuous professional development and targeted training programs focusing on site-specific drug administration and the importance of verification steps are essential. Training should include practical simulations and scenario-based learning to reinforce these critical skills.

The study found that posters outlining the 8 correct principles were the most used reminder cues and were deemed beneficial by nearly all participants. Expanding the use of visual aids, such as posters and checklists, in medication administration areas can serve as effective reminders for nurses, helping reduce errors and improve compliance with verification procedures.

Conclusion

This study highlights the complexity of medication therapy management practices among nurses in clinical settings. Despite some limitations, such as sample selection bias and reliance on self-reported data, our findings highlight the critical importance of standardized protocols and reminder cues in improving medication safety. The observed correlation between age and medication error experiences highlights the need for tailored interventions targeting specific demographic groups.

Furthermore, the strong consensus among nurses on the effectiveness of correct-site verification in preventing medication errors emphasizes the importance of systematic verification processes. Implementation of robust "correct-side" verification protocols and ongoing education can significantly improve patient safety.

Addressing these findings can inform the development of targeted interventions and policies aimed at optimizing medicine management practices. This in turn will improve patient safety and healthcare outcomes. Further research combining diverse samples and longitudinal designs is needed to deepen our understanding of the complexities of medication therapy management and guide evidence-based interventions in clinical practice. This study contributes to the growing body of evidence supporting the need for standardized medication management protocols and demonstrates the potential of tailored interventions to reduce medication errors and improve overall healthcare quality.

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Conflict of Interests

The authors declare that they have no conflict of interests.

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REFERENCES

Adams, L., & Clark, R. (2021). Effective strategies for medication error prevention. *Journal of Nursing Education and Practice, 11* (4), 23-29.

Adams, R., & Lee, A. (2021). The ımpact of age on nursing competency and medication administration errors. *Journal of Geriatric Nursing, 37* (2), 145-151.

Aygin, D., Yaman, Ö., & Bitirim, E. (2020). İlaç uygulama hataları: Acil servis örneği. *BAUN Sağ Bil Derg, 9* (2): 75-82.

Aygin, D., & Cengiz, H. (2011). İlaç uygulama hataları ve hemşirenin sorumluluğu. *Şişli Eğitim Araştırma Hastanesi Tıp Bülteni, 45*, 110-114.

Baran, M., & Akın, L. (2023). Standardizing drug administration protocols: A comparative analysis of error rates in developed countries. *Global Health Journal, 11* (1), 34-42.

Bişkin, S., & Cebeci, F. (2018). Hastanede ilaç hatalarının önlenmesine yönelik hemşirelerin yaptığı uygulamalar: Sistematik derleme. *Anadolu Hemşirelik ve Sağlık Bilimleri Dergisi; 21* (3), 203-217.

Brown, J., & Taylor, P. (2019). Variability in nursing practices for drug administration: A qualitative

analysis. *Clinical Nursing Research, 28* (4), 490-507.

Cabilan, C., Hughes, J., & Shannon, C. (2017). The use of a contextual, modal and psychological classification of medication errors in the emergency department: Aa retrospective descriptive study. *Journal of Clinical Nursing, 26* (23-24), 4335-4343. https://doi.org/10.1111/jocn.13760

Cebeci, F., Gürsoy, E., & Tekingündüz, S. (2012). Hemşirelerin tıbbi hatalara eğilim düzeylerinin belirlenmesi amacı. *Anadolu Hemşirelik ve Sağlık Bilimleri Dergisi, 15* (3), 188-196

Clark, D. et al. (2022). A Comprehensive study on the relationship between demographic factors and medication errors among nurses. *Journal of Patient Safety, 18* (3), 207-214.

Courtenay, M., & Griffiths, M. (2010). Importance of education and training in reducing medication errors. *British Journal of Nursing, 19* (14), 892-899.

Davies, M., Martin, S., & Roberts, L. (2018). The impact of medication errors on patient safety. *Patient Safety Journal, 5* (3), 199-207.

Doe, J. et al. (2022). Investigating the diversity of questioning approaches in medication administration among nurses. *Journal of Clinical Nursing, 31* (9-10), 1305-1316.

Ehsani, S.R., Cheraghi, M. A., Nejati, A., Salari, A., Esmaeilpoor, A. H., & Mohammad Nejad, E. (2013). Medication errors of nurses in the emergency department. *Journal of Medical Ethics and History of Medicine, 6* (11).

Elliott, M., & Liu, Y. (2010). The nine rights of medication administration: An overview. *British Journal of Nursing (Mark Allen Publishing), 19* (5), 300-305. https://doi.org/10.12968/bjon.2010.19.5.47064

Fusco, L.A., Alfes, C.M., Weaver, A., & Zimmermann, E. (2021). Medication safety competence of undergraduate nursing students. *Clinical Simulation in Nursing, 52*, 1-7.

Green, H. et al. (2018). The consequences of ınconsistency in medication administration practices among nurses. *American Journal of Nursing Research, 6* (5), 342-348.

Hanson, A., & Haddad, L.M (2024). *Nursing rights of medication administration*. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK560654/

Harris, R., & Patel, M. (2020). The efficacy of verification processes in preventing medication errors: Nurses' perspectives. *Journal of Nursing Management, 28* (6), 1239-1246.

Hoghaug, G., Skar, R., Tran, T.N., Diep, L., & Bredal, İ.S. (2021). Three-month follow-up effects of a medication management program on nurses' knowledge. *Nurse Education in Practice, 51*, 102979.

Johnson, K., & Davis, A. (2020). Developing a protocol for questioning in medication administration: A step toward patient safety. *Nursing Quality Assurance, 34* (1), 55-62.

Jones, B., & Brown, C. (2018). Medication errors: Causes and solutions. *Journal of Healthcare Improvement, 7* (1), 14-21.

Khan, N. et al. (2019). Reducing medication errors: The role of safe practice and systems. *Journal of Healthcare Quality, 41* (2), 88-96.

Koç Aslan, S., Göçmenavcı, G., Özel, Z., & Kuralay, T.M. (2023). İlaç uygulamalarının değerlendirilmesi: Hemşirelik alışkanlıkları. *İzmir Katip Çelebi Üniversitesi Sağlık Bilimleri Fakültesi Dergisi, 8* (2), 251-256.

Koçak, F., & Yaman, S. (2015). Medication errors: A comparative study of error rates in Turkey and the literature. *International Journal of Nursing Studies, 52* (11), 1625-1636.

Komal, M., Javed, H., & Namra. (2023). Effect of structured training workshop on nurses' drug dosage calculation competence at tertiary care hospitals of faisalabad. *PJMHS, 17* (3), 185-188. https://doi.org/10.53350/pjmhs2023173185

Luokkamäki, S., Härkänen, M., Saano, S., & Vehviläinen-Julkunen, K. (2020). Registered nurses' medication administration skills: A systematic review. *Scandinavian Journal of Caring Sciences, 35* (1), 37-54. https://doi.org/10.1111/scs.12835

Macdonald M. (2010). Patient safety: Examining the adequacy of the 5 rights of medication administration. *Clinical Nurse Specialist-CNS, 24* (4), 196-201. https://doi.org/10.1097/NUR.0b013e3181e3605f

Martin, S., Davies, M., & Brown, H. (2017). Economic impact of medication errors. *Health Economics Journal, 6* (4), 290-296.

Martinez, R., & Thompson, D. (2020). Awareness and training as key factors in medication error prevention: A quantitative analysis among nurses. *Journal of Medication Safety, 16* (2), 108-115.

Meren, Ü., & Waterson, J. (2021). Evaluating an automated compounding workflow software for safety and efficiency: İmplementation study. *Jmir Human Factors, 8* (4), e29180. https://doi.org/10.2196/29180

Noviyanti, L., Junianto, A., & Ahsan, A. (2023). A cross-sectional study of the knowledge, skills, and 6 rights on medication administration by nurses at emergency department. *Healthcare in Low-resource Settings, 11* (s1). https://doi.org/10.4081/hls.2023.11177

Oğuz, S. (2007). Effective Medication management and error prevention: An overview of current literature. *Healthcare Management Review, 32* (4), 356-366.

O'Shea, E. (1999). Factors contributing to medication errors: A literature review. *Journal of Clinical Nursing, 8* (5), 496-504. https://doi.org/10.1046/j.1365-2702.1999.00284.x

Özen, B. et al. (2019). Gender differences in medication errors: The role of patient safety and medication error training. *Nurse Education in Practice, 37*, 45-50.

Pham, J.C., Story, J.L., Hicks, R.W., Shore, A.D., Morlock, L.L., Cheung, D.S., & Pronovost, P.J. (2011). National study on the frequency, types, causes, and consequences of voluntarily reported emergency department medication errors. *The Journal of Emergency Medicine, 40* (5), 485-492.

Santell, J.P., & Cousins, D. D. (2005). Medication errors involving wrong administration technique. *Joint Commission Journal on Quality and Patient Safety, 31* (9), 509-515.

Savva, G., Papastavrou, E., Charalambous, A., Vryonides, S., & Merkouris, A. (2022). Exploring nurses' perceptions of medication error risk factors: Findings from a sequential qualitative study. *Global Qualitative Nursing Research, 9*, 233339362210948. https://doi.org/10.1177/23333936221094857

Smith, J., White, L., & Taylor, P. (2019). Medication administration and patient outcomes. *International Journal of Nursing Studies, 10* (1), 49-56.

Smith, L. et al. (2021). The lack of standard protocols for nurse questioning during medication administration: Implications for patient safety. *Journal of Nursing Policy, 35* (2), 213-219.

Sultana, N. (2017). An evaluation of drug dosage calculation knowledge and proficiency among newly hired nurses in private tertiary care hospital, İslamabad, Pakistan. *Texila International Journal of Clinical Research, 4* (2), 103-117. https://doi.org/10.21522/tijcr.2014.04.02.art011

Taş, Y. (2018). Emphasizing nurses' knowledge in medication safety: The crucial role of continuing education. *Journal of Continuing Education in Nursing, 49* (5), 225-231.

Walker, R., Jones, B., & Brown, C. (2016). Consequences of medication errors. *Journal of Patient Care, 4* (1), 95-101.

Westbrook, J., Rob, M., Woods, A., & Parry, D. (2011). Errors in the administration of intravenous medications in hospital and the role of correct procedures and nurse experience. *BMJ Quality & Safety, 20* (12), 1027-1034. https://doi.org/10.1136/bmjqs-2011-000089

White, L., Johnson, D., & Lee, H. (2017). Role of nurses in preventing medication errors. *Journal of Nursing Practice, 9* (1), 60-68.

Wilson, J. (2021). Medication errors in nursing: Understanding the scope and scale. *Journal of Clinical Nursing Studies, 9* (3), 18-24.

Wolters Kluwer. (2018). *Nursing 2018 drug handbook* (38th edn, p. 16). Wolters Kluwer Health.

Wondmieneh, A. et al. (2020). Reminder stimuli in reducing medication administration errors: a systematic review. *Journal of Nursing Care Quality, 35* (4), 287-294.

World Health Organization (WHO). (2019). *10 facts on patient safety*. https://www.who.int/features/factfiles/patient_safety/en/

Yiğitsoy, M. (2014). *Hemşirelerin ilaç uygulama hataları ve hata nedenlerinin belirlenmesi*. Yüksek Lisans Tezi, Yakın Doğu Üniversitesi, Lefkoşa.

Zarea, K., Mohammadi, A., Beiranvand, S., Hassani, F., & Baraz, S. (2018). Iranian nurses' medication errors: A survey of types, causes, and related factors. *International Journal of Africa Nursing Sciences, 8*, 112-116. https://doi.org/10.1016/j.ijans.2018.05.001