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ORIGINAL PAPER

Analysis of medication administration safety in hospital settings

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Abstract

Aim: The aim of this study was to assess medication administration safety from the perspective of nurses working in standard inpatient care units at a large regional teaching hospital in Slovakia. *Design:* A cross-sectional study. *Methods:* For data collection, we used the validated Patient Safety Assessment in Medication Administration (ASPAM) tool to detect risk-generating conditions for the occurrence of adverse drug events in nursing practice. The sample consisted of 211 nurses from a selected teaching hospital in the Slovak Republic. For data analysis, we used descriptive and inferential statistical methods. *Results:* The mean ASPAM score was 4.30 ± 0.39, indicating generally high adherence to medication safety practices. However, the overall Positivity Index (52.29%) suggested a low quality of safe medication practices. The lowest adherence was detected in the domains "Right patient" and "Right time". Nurses with ≥ 20 years of experience reported significantly lower adherence, while nurses in surgical units demonstrated significantly higher adherence in several domains. Nurses' age was a statistically significant negative predictor of adherence to safe medication practices across multiple domains. *Conclusion:* This study revealed gaps in nurses' adherence to safe medication administration practices which may compromise patient safety and the quality of nursing care.

Keywords: medication administration, medication errors, nurse interventions, patient safety.

Introduction

Nurses, as providers of nursing care, have a responsibility to protect patients from harm of any kind and severity. Medication errors (MEs) are among the most common adverse events (AEs) in nursing practice with the potential to harm a patient. These errors are preventable AEs that may cause or lead to the inappropriate use of a medication by healthcare professionals or patients during the treatment process. MEs represent more than half of all preventable AEs in healthcare, with estimated annual costs of €4.5 to €21.8 billion in Europe (World Health Organization [WHO], 2022). Besides the high costs, medication errors may cause patient harm, disability, or even death. They can also lead to increased hospitalizations, loss of trust, and decreased patient satisfaction with nursing care, as well as consequences for nurses themselves (e.g., disciplinary action, dismissal, or psychological distress) (Hamoudi et al., 2018). MEs can occur at various stages of the medication process, including prescribing, transcribing, dispensing, preparation, administration, and monitoring of effects. The most common MEs occurring in hospital settings are administration errors, estimated to account for 5–10% of all MEs (Bucknall et al., 2019). In the United Kingdom in 2021, 15.9% of errors occurred during dispensing of medications, 21.3% during the prescribing phase, and as many as 54.4% during the administration phase (European Collaborative Action in Medication Errors and Traceability [ECAMET], 2022). The analysis of reported MEs in England and Wales between 2007 and 2016 identified the most common administration errors as dose omission (31.4%), incorrect dose (10.5%), and administration of the wrong medication (7.0%) (Härkänen et al., 2019). Medication errors occurring during the medication administration process often result from nurses' failure to adhere to the fundamental principles of safe medication administration, which include the right patient, right medication, right route, right dose, right time, right documentation, right drug form, right guidance, and right response (Hanson & Haddad, 2023).

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Nurses represent the largest group of healthcare professionals involved in the medication administration process. Consequently, they play a crucial role in preventing MEs and protecting patients from harm. To ensure safe medication practices, nurses should implement evidence-based interventions grounded in the principles of safe medication administration, identify and mitigate risks, and report patient safety concerns (Rixon, 2023). Nurses should apply preventive interventions in nursing practise including identifying a patient using at least two identifiers, checking the drug name, dose, form, and route of administration, maintaining aseptic technique during preparation and administration of medications, ensuring correct timing and speed of medication administration, monitoring patient's response to a medication, and reporting any AEs related to medications (Ricciardi & Cascini, 2021). To ensure safe and high-quality nursing care, it is necessary to assess the implementation of these interventions in nursing practice.

Aim

The aim of this study was to assess medication administration safety from the perspective of nurses working in standard inpatient care units at a large regional teaching hospital in Slovakia. Specifically, the study sought to evaluate how consistently nurses apply safety principles during the medication administration process and to identify factors influencing adherence to these practices.

Methods

Design

A cross-sectional study.

Sample

To meet the study objectives, a single teaching hospital in Slovakia was selected. As one of the largest regional institutions, it reflects typical Slovak hospital settings in terms of nursing practice, with a diverse patient base and standardized procedures that provided a relevant context for evaluating medication safety.

After permission to conduct the study was granted, a total of 11 care units were approached and agreed to participate in the study. Subsequently, nurses from these units were selected using a convenience sampling method. The study specifically targeted nurses working in standard inpatient care units, as these units reflect typical medication administration processes relevant to the study objectives. Nurses from pediatric, psychiatric, and intensive care units, as well as those in managerial positions, were excluded due to ethical and legal considerations, as well as differences in medication administration protocols. Although the selected hospital employs a total of 680 nurses, only those meeting the inclusion criteria – 250 nurses across 11 inpatient care units – were approached. Of the 250 distributed questionnaires, 229 were returned, yielding a response rate of 91.6%. After excluding ten incomplete and eight blank questionnaires, 211 were deemed valid for analysis. The final research sample therefore consisted of 211 nurses from the selected teaching hospital in the Slovak Republic.

Data collection

Data collection was conducted between December 2024 and January 2025 in a selected teaching hospital in Slovakia using the Patient Safety Assessment in Medication Administration (ASPAM) tool developed by Araújo et al. (2019). The instrument was translated into Slovak using the forward-backward translation method by two certified translators. One culturally relevant adaptation was made in the item 21 with the authors' approval: the term "Patient Safety Center" was replaced with "The State Institute for Drug Control," reflecting the local institutional context.

The instrument focuses on identification of the risk-generating conditions for the occurrence of adverse drug events in nursing care practice. It consists of 28 items categorized into domains based on the principles of safe medication administration: Right patient (1 item), Right medication (5 items), Right route of administration (4 items), Right time (3 items), Right dose (5 items), Right documentation (5 items), Right guidance (2 items), Right form (1 item), and Right response (2 items). Each item represents a specific nursing intervention aimed at ensuring patient safety during the medication administration process. To assess how frequently these interventions were implemented in clinical practice, a five-point Likert scale was used (1 – never, 2 – almost never, 3 – sometimes, 4 – almost always, 5 – always). Respondents were asked to indicate how often they performed each intervention in a manner that best reflects their actual nursing practice. Five sociodemographic items (age, experience, education, specialization, and care unit) were added to the tool. Questionnaires were distributed in paper form in the respective care units with the assistance of nurse managers.

Data analysis

Data were analysed using JASP software and MS

Excel. Descriptive statistics (frequencies, mean, standard deviation) was used to analyse sociodemographic data and identification of the risk-generating conditions for the occurrence of adverse drug events in nursing care practice. To further assess the quality of care associated with each item / intervention implementation, the Positivity Index (PI) was applied. As a quantitative indicator, the PI serves as a component of quality-of-care assessment, reflecting how frequently recommended safety practices are followed in clinical routines. Only the response "always" was considered indicative of an adequate frequency for the safe performance of medication administration. Based on the original ASPAM validation study, PI values were categorized as desirable (100%), adequate (90–99%), sufficient (80–89%), safe (71–79%), and low (< 70%). Tests of normality were conducted using the Kolmogorov-Smirnov test, which indicated that the data followed a normal distribution ($p \geq 0.05$); therefore, parametric tests were used in the subsequent analysis.

Differences in the identification of risk-generating conditions for the occurrence of adverse drug events in nursing care practice based on sociodemographic variables (experience, education, unit type, specialization training) were analysed using one-way ANOVA (three or more groups) with Bonferroni post hoc test and independent t-test (two groups). Pearson's correlation coefficient (r) was applied to analyze the association between age of nurses and identification of risk-generating conditions for the occurrence of adverse drug events in nursing care practice. Multiple linear regression analysis was performed using the Enter method to examine whether nurses' age (independent variable) predicted risk-generating conditions for the occurrence of adverse drug events in nursing care practice (dependent variable), based on its significant correlations. The level of statistical significance was set at $\alpha = 0.05$. Cronbach's alpha coefficient was calculated for the overall instrument to assess the internal consistency. With a value of 0.89, the ASPAM instrument demonstrated strong internal consistency, supporting its reliability as a measurement instrument.

Results

Demographic characteristics of the set

The study included 211 nurses with an average age of 37.89 (SD = 10.719) ranging from 23 to 60 years old. Characteristics of our sample are reported in Table 1.

Table 1 Demographic characteristics of the sample (N = 211)

Variable		N	%
Experience (years)	0–4.9	45	21.33
	5–9.9	56	26.54
	10–14.9	57	27.1
	15–19.9	22	10.43
	20 and more	31	14.69
Education	secondary vocational education	25	11.85
	post-secondary vocational education	48	22.75
	Bachelor's degree	91	43.13
	Master's degree	43	23.28
	higher	4	1.90
Specialisation in the given field	yes	123	58.29
	no	88	41.71
Unit type	medical disciplines	95	45.02
	surgical disciplines	116	54.98

Identification of the risk-generating conditions for the occurrence of adverse drug events in nursing care practice

The mean ASPAM score was 4.30 ± 0.39, indicating a high overall adherence to recommended medication safety practices. However, the overall Positivity Index (PI) was 52.29%, placing it in the "low" category according to the original classification – suggesting that only about half of the responses reflected optimal practice. The highest-scoring domains were "Right form" (4.48 ± 0.76; PI = 63.51%) and "Right medication" (4.45 ± 0.46; PI = 70.99%), reflecting relatively frequent implementation of these practices, yet still classified as "low" and "safe," respectively.

Conversely, the lowest scores were observed in the domains "Right patient" (3.82 ± 0.80; PI = 22.75%) and "Right time" (3.97 ± 0.55; PI = 30.18%), indicating these safety practices were rarely performed consistently at the optimal level. According to respondents, the most frequently performed interventions were verifying the name of the medication (4.76 ± 0.49; PI = 79.15%) and checking the medication dose (4.75 ± 0.47; PI = 77.25%). In contrast, the least frequently reported practices were identifying the patient using at least two identifiers (e.g., full name and medical record number or date of birth) (3.82 ± 0.80; PI = 22.75%) and using aseptic techniques during medication preparation and administration (3.74 ± 0.84; PI = 22.27%). Overall, only three interventions fell within the "safe" category (PI 71–79%), while all others were classified as "low" (PI < 70%), indicating generally limited adherence to optimal safety standards (Table 2).

Table 2 Risk-generating conditions for the occurrence of adverse drug events in nursing care practice

Domain	Intervention	M	SD	PI
Right patient		-	-	-
	1. identifies the patient	3.82	0.800	22.75
Right medication		4.45	0.455	62.09
	2. verifies the name of a medication	4.76	0.489	79.15
	3. brings to the bed the medications for a single patient	4.33	0.943	55.45
	4. medication administration by verbal order only in emergencies	4.08	0.983	41.23
	5. checks allergies	4.55	0.698	66.82
	6. identifies the allergic patient	4.55	0.812	67.77
Right route		4.32	0.561	54.86
	7. identifies the route of administration	4.69	0.512	71.09
	8. checks if the prescribed route is technically recommended	4.44	0.873	64.93
	9. washes hands	4.42	0.903	61.14
	10. uses aseptic techniques	3.74	0.836	22.27
Right time		3.96	0.553	30.17
	11. prepares the medication prior to its administration	3.66	0.767	15.17
	12. administrates medications at the right time	4.10	0.798	36.02
	13. adjusts administration times	4.13	0.817	39.34
Right dose		4.45	0.427	60.95
	14. checks medication dose	4.75	0.474	77.25
	15. checks administration speed	4.54	0.596	57.35
	16. double checks high vigilance medications	4.62	0.624	69.19
	17. uses standard measuring tools	4.68	0.507	69.67
	18. returns leftover medications to the pharmacy	3.67	1.185	31.28
Right documentation		4.18	0.509	48.53
	19. records administration time after administration	4.12	0.997	46.92
	20. records MEs	4.58	0.681	68.25
	21. notifies about MEs	3.25	1.009	13.27
	22. keeps records of prepared medications to be stored	4.43	0.660	50.71
	23. monitors temperature in fridge for medication storage	4.55	0.698	63.51
Right guidance		4.26	0.714	49.53
	24. clarifies doubts to the prescriber	4.28	0.864	50.71
	25. guides the patient	4.25	0.839	48.34
Right form		-	-	-
	26. checks the form of medication	4.48	0.764	63.51
Right response		4.43	0.617	55.45
	27. evaluates patient response	4.38	0.682	49.29
	28. informs the prescriber of medication effects	4.49	0.733	61.61

M – mean; SD – standard deviation; PI – positivity index (%); MEs – medication errors

Factors associated with risk-generating conditions for the occurrence of adverse drug events in nursing care practice

Correlation analysis showed that nurses' age was significantly negatively associated with several domains of the ASPAM instrument (Table 3). This indicates that as nurses' age increased, their scores in specific domains of the ASPAM scale decreased, suggesting lower reported adherence to certain medication safety practices among older nurses.

Table 3 Association between age of nurses and identification of risk-generating conditions for the occurrence of adverse drug events in nursing care practice

Domains	Age (r)
Right patient	-0.315**
Right medication	-0.100
Right route	-0.451**
Right time	-0.436**
Right dose	0.015
Right documentation	-0.147*
Right guidance	0.097
Right form	-0.163*
Right response	-0.016

*r – Pearson's correlation coefficient; *p ≤ 0.05; **p < 0.001*

Differences in the identification of the risk-generating conditions for the occurrence of adverse drug events in nursing care practice were identified based on nurse experience, education, specialization training and unit type (Table 4).

Nursing experience was significantly associated with adherence to multiple domains of safe medication administration, including "Right patient" ($p < 0.001$), "Right medication" ($p = 0.022$), "Right route" ($p < 0.001$), "Right time" ($p < 0.001$), "Right documentation" ($p = 0.027$), and "Right form" ($p = 0.015$). Post hoc comparisons using the Bonferroni test revealed that nurses with ≥ 20 years of experience consistently reported lower adherence in several domains compared to less experienced colleagues. Specifically, in the "Right patient" domain, they scored lower than those with 5–9.9 ($p = 0.007$), 10–14.9 ($p = 0.006$), and 15–19.9 years ($p = 0.026$). In the "Right medication" domain, their scores were significantly lower than those with 5–9.9 and 10–14.9 years of experience (both $p = 0.028$). In the "Right route" domain, significant differences were observed between nurses with ≥ 20 years and those with 0–4.9 ($p < 0.001$), 5–9.9 ($p < 0.001$), and 10–14.9 years ($p = 0.016$). Likewise, in the "Right time" domain, those with ≥ 20 years scored lower than nurses with 0–4.9 ($p < 0.001$), 5–9.9 ($p < 0.001$), and 10–14.9 years ($p = 0.009$). Additionally, in the "Right form" domain, nurses with 15–19.9 years reported significantly lower adherence than those with 0–4.9 years ($p = 0.049$).

Table 4 Differences in identification of the risk-generating conditions for occurrence of adverse drug events in nursing care practice based on individual variables

Domains	Nurse experience[a]	Education[a]	Specialization training[b]	Unit type[b]
Right patient	< 0.001**	0.989	0.427	0.182
Right medication	0.022*	0.158	0.207	0.262
Right route	< 0.001**	0.453	0.999	0.002*
Right time	< 0.001**	0.390	0.922	< 0.001**
Right dose	0.487	0.405	0.380	0.030*
Right documentation	0.027*	0.359	0.856	< 0.001**
Right guidance	0.589	0.343	0.428	< 0.001**
Right form	0.015*	0.270	0.194	0.007*
Right response	0.792	0.252	0.132	0.013*

*[a] one-way ANOVA; [b] independent t-test; *p ≤ 0.05; **p < 0.001*

Significant differences in adherence to safe medication administration practices were found between nurses working in medical care units and those in surgical care units. Nurses in surgical units reported significantly higher adherence in several domains of the ASPAM instrument,

including the correct route of administration ($p = 0.002$), correct timing of medication ($p < 0.001$), correct dose ($p = 0.031$), proper documentation of administration ($p < 0.001$), provision of guidance and education to patients ($p < 0.001$), verification of the correct form of medication ($p = 0.008$), and monitoring of patient response after administration ($p = 0.013$).

Predicting adherence to safe medication practices

Table 5 presents the results of multiple linear regression analyses examining whether nurses' age predicted adherence to safe medication practices across five ASPAM domains. The findings show that age was a statistically significant negative predictor in all five domains, indicating that with increasing age, reported adherence to safety practices decreased. The strongest associations were found in the domains "Right route" ($\beta = -0.451$, $p < 0.001$; $R^2 = 0.203$) and "Right time" ($\beta = -0.436$, $p < 0.001$; $R^2 = 0.190$), suggesting that older nurses were less likely to consistently follow correct administration route and timing procedures. Similarly, "Right patient" adherence was negatively associated with age ($\beta = -0.315$, $p < 0.001$; $R^2 = 0.099$), indicating less frequent verification of patient identity among older nurses. Although the predictive power of age was lower in the domains "Right documentation" ($\beta = -0.147$, $p < 0.001$; $R^2 = 0.022$) and "Right form" ($\beta = -0.163$, $p = 0.018$; $R^2 = 0.027$), these associations remained statistically significant, underscoring a general trend of declining adherence to medication safety practices with increasing age.

Table 5 Regression analysis: nurses' age as a predictor of safe medication practices

	Right patient	Right route	Right time	Right documentation	Right form
R^2	0.099	0.203	0.190	0.022	0.027
Adj R^2	0.095	0.199	0.186	0.017	0.022
SE	0.761	0.502	0.499	0.505	0.755
F	23.074	53.240	48.969	4.625	5.729
p	< 0.001**	< 0.001**	< 0.001**	0.033*	0.018
Constant (p)	< 0.001**	< 0.001**	< 0.001**	< 0.001**	< 0.001**
Age (β, p)	-0.315, < 0.001**	-0.451, < 0.001**	-0.436, < 0.001**	-0.147, < 0.001**	-0.163

*R^2 – R square; Adj R^2 – Adjusted R square; SE – Std. error of the estimate; F – F-statistics; β – standardized beta coefficient; p – significance level; *p < 0.05, **p < 0.001*

Discussion

Our study revealed not only a low adherence to safe medication administration practices, but also a significant influence of age, years of experience and unit type, which may compromise patient safety in the medication administration process and affect the quality of nursing care provided.

In the "Right patient" domain, patient identification using at least two identifiers (e.g., name and date of birth, name and medical record number, name and identification wristband) is necessary. However, our respondents did not sufficiently apply this intervention in practice, often relying on only one identifier. The use of this intervention was significantly associated with nurses' age and years of experience. The WHO (2007) has emphasized the importance of patient identification and defined core strategies, stating that identification should always involve at least two identifiers during patient admission, transfer, medication administration, or any clinical procedure. The WHO also recommends educating healthcare professionals on proper patient identification protocols and implementing technological innovations that improve accuracy and efficiency, such as the Barcode system. This technology automates the verification process by scanning the barcode, on both the medication and the patient's wristband, supporting nurses in confirming the "rights" of medication administration. In addition to significantly reducing the occurrence of MEs and potential harm to the patient, this technology also increases the frequency of patient verification in clinical nursing practice (Mulac et al., 2021).

Verbal medication orders pose a significant risk of MEs, primarily due to misunderstandings between the prescriber and nurse, often caused by communication noise. This may result in administering the wrong drug, wrong dose, to the wrong patient or other serious errors (Moghaddasi et al., 2017). According to Cho et al. (2014), 2.3% of all MEs in their study were associated with verbal orders. Verbal orders include those delivered by telephone, face-to-face communication, or other voice transmission systems, and are acceptable only in emergency situations or when written and electronic documentation is not available. Although it is impossible to completely eliminate verbal orders, their use should be

minimized. Our study found that medications were sometimes administered on verbal orders even outside emergency situations, thereby increasing the risk of medication errors.

Microbial contamination of medications due to poor aseptic technique is another risk factor that may compromise patient health or even threaten life. Our findings revealed a notably low frequency of adherence to aseptic techniques and hand hygiene in the "Right route" domain, which was significantly associated with nurses' age, experience, and care unit. Aseptic technique is essential to reduce contamination risk, but the environment in which medications are prepared also plays a significant role. A systematic review covering data from 1950 to 2007 revealed that 7% of prepared medications or solutions were contaminated, with 5% of contamination in individual doses and 2% in admixtures in hospital settings, compared to 2% and 0% in pharmaceutical environments respectively. An updated systematic review and meta-analysis covering data from 1950 to 2014 confirmed higher contamination rates in hospital settings (3.7%) compared to pharmaceutical environments (0.5%) (Austin & Elia, 2009; Austin et al. 2015). This highlights the need for off-site preparation of medications in pharmaceutical environments, to ensure sterility, better stability, proper storage, to reduce risks of cross-contamination, and to lessen the burden on healthcare staff. Additionally, factors such as insufficient training, lack of practice, and poor knowledge of aseptic techniques contribute to contamination risks. Repeated training and continuous education of nurses are necessary to maintain high-quality care based on the latest scientific knowledge to ensure aseptic medication preparation and administration (Chen et al., 2024).

Our findings revealed that safety practices were rarely performed consistently at the optimal level in the domain "Right time" which was significantly associated with nurses' age, experience and care unit. Adherence to proper medication preparation prior to its administration as well as administration of medications at the right time is essential to ensure patient safety, treatment effectiveness, medication stability, and to reduce the risks of contamination, self-administration of drugs without a clear protocol, and medication errors in general (Nagar & Davey, 2015). To support a safe clinical environment, nurses are expected to prepare medications as close to the time of intended administration as possible, avoiding pre-pouring. According to the Institute for Safe Medication Practices Canada – ISMP (ISMP, 2023) analysis of real clinical cases, pre-pouring increases the risk of MEs. This analysis revealed that pre-pouring contributed to medication errors, including overdosing from self-administration, oversedation, and administration of medication to the wrong patient.

In our study, nurses' age, experience and care unit were significantly associated with adherence to medication safety practices in the domain "Right documentation". Moreover, we detected a notably low frequency of reporting MEs, or any incidents related to medication administration to management, risk departments, or regulatory authorities. The reporting of MEs is crucial for learning from mistakes, preventing future errors, identifying risks, improving interdisciplinary collaboration and communication, and ultimately enhancing the quality and safety of nursing care (Elden & Ismail, 2016). According to European Collaborative Action in Medication Errors and Traceability (ECAMET, 2022), voluntary reporting is essential to understand both the consequences and the circumstances of incidents. Implementing a reporting system alongside a safety no-blame culture is necessary – a work culture that encourages healthcare professionals to report errors without fear of punishment, fosters open communication and constructive feedback while ensuring accountability. Further research is necessary to evaluate medication errors reporting in nursing practice.

Nurses in surgical units from our study reported significantly higher adherence in providing guidance and education to patients than nurses in medical care units. According to Bowen et al. (2017), only 58% of nurses considered patient education about medications to be important. Nurses felt more confident explaining the drug name, generic name, and reasons for prescribing, but were less confident when educating patients about therapeutic effects and potential side effects. However, patient education is crucial for improving patient adherence, treatment efficacy, and response to potential adverse effects. Effective education should involve simple language, visual and written aids, engaging patients and their families, and encouraging questions (Bhattad & Pacifico, 2022). To improve patient medication education, multidisciplinary collaboration should be enhanced, particularly with hospital pharmacists, through better communication, training, workshops, online courses, simulation exercises, and the use of digital tools, medication databases, and patient education

materials (Dilles et al., 2021). It is also essential for nurses to clarify any doubts regarding medications and treatment with the prescriber. They must respect, consider and clarify the patients' right to refuse the treatment, critically assess the refusal, investigate the reasons, provide education about the consequences, report the refusal to the physician, document it properly, and discuss possible treatment alternatives in a respectful manner (The University of New Mexico Health Science Centre, n.d.). Importantly, nurses also have the right to refuse to administer a medication they believe is unsafe or incorrectly prescribed. They should always advocate for patient safety, making evidence-based decisions with autonomy and critical thinking, without fear of blame from physicians, management, or peers (Vera, 2024).

Based on the study findings, we recommend implementing regular refresher training sessions for all nurses – particularly older and more experienced staff – focused on the core principles of safe medication administration, including correct patient identification and timely administration. Additionally, the integration of technological tools such as barcode medication administration systems, automated dispensing systems and electronic medication administration records (eMAR) should be prioritized to improve safety, consistency and accuracy in clinical routines (Mulac, et al., 2021). To minimize microbial contamination risks, centralized medication preparation in pharmacy-controlled environments and improved ward infrastructure (e.g., designated clean areas) are advised. We also strongly recommend establishing a non-punitive reporting culture that encourages the open reporting of medication errors and near misses and enhancing interprofessional collaboration with physicians and pharmacists to strengthen patient education and shared responsibility for medication safety (Grimes & Guinan, 2023).

Limitation of the study

The limitations of our study include the potential for subjective and intentional response bias among nurses, known as social desirability bias, in which respondents provide answers they perceive to be socially or morally desirable. Other limitations include the convenience sampling method, the small sample size, which does not allow the results to be generalized or applied to the overall nursing care conditions in the Slovak Republic. To confirm the validity and reliability of the measurement tool in the Slovak context, it is necessary to supplement Cronbach's alpha with additional calculations including, besides others, factor analysis.

Conclusion

This study highlights key gaps in nurses' adherence to safe medication administration practices. While overall adherence was high, domains such as patient identification and timely administration showed notably low performance. Older and more experienced nurses reported lower adherence in several areas, suggesting the need for targeted refresher training. Additionally, nurses in surgical units demonstrated better compliance than those in medical units. These findings emphasize the importance of reinforcing safety protocols across all levels of experience. Regular education, monitoring, and supportive clinical environments are essential to improve safety. The ASPAM tool proved to be a valid and reliable instrument for assessing adherence to medication safety standards in hospital settings.

Ethical aspects and conflict of interest

The Ethics Committee of the Teaching Hospital in Nitra approved the study (reference number FNNR-EK-7/2024-04, November 28, 2024). The participants' demographic data were processed in accordance with Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data. Participation of respondents was voluntary and anonymous, with all participants being informed in writing about these conditions prior to completing the questionnaires. Permission to translate and use the instrument was obtained from the authors (November 13, 2024).

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Author contributions

Conception and design (PB, ZS), data analysis and interpretation (PB), manuscript draft (PB), critical revision of the manuscript (PB, ZS), final approval of the manuscript (PB, ZS).

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