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Medication administration errors in the selected Czech hospitals: an observational study

Błędy w podawaniu leków w wybranych czeskich szpitalach: badanie obserwacyjne

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A – Development of the concept and methodology of the study/Opracowanie koncepcji i metodologii badań; B – Query - a review and analysis of the literature/Kwerenda – przegląd i analiza literatury przedmiotu; C – Submission of the application to the appropriate Bioethics Committee/Złożenie wniosku do właściwej Komisji Biotycznej; D – Collection of research material/Gromadzenie materiału badawczego; E – Analysis of the research material/Analiza materiału badawczego; F – Preparation of draft version of manuscript/Przygotowanie roboczej wersji artykułu; G – Critical analysis of manuscript draft version/Analiza krytyczna roboczej wersji artykułu; H – Statistical analysis of the research material/Analiza statystyczna materiału badawczego; I – Interpretation of the performed statistical analysis/Interpretacja dokonanej analizy statystycznej; K – Technical preparation of manuscript in accordance with the journal regulations/Opracowanie techniczne artykułu zgodne z regulaminem czasopisma; L – Supervision of the research and preparation of the manuscript/Nadzór nad przebiegiem badań i przygotowaniem artykułu

STRESZCZENIE

BŁĘDY W PODAWANIU LEKÓW W WYBRANYCH CZESKICH SZPITALACH: BADANIE OBSERWACYJNE

Cel pracy. Celem badania była określenie występowania błędów w podawaniu leków w praktyce klinicznej.
Materiał i metody. Przeprowadzone badanie było bezpośrednim badaniem obserwacyjnym. Badanie obejmowało obserwację procesu podawania leków przez trzy lata w czterech szpitalach w Republice Czeskiej. W badaniu wykorzystano listę kontrolną STROBE.
Wyniki. Zaobserwowano i zarejestrowano łącznie 18 370 podań leków hospitalizowanym pacjentom, w tym poranne, południowe i wieczorne podania leków. Najczęstszym błędem w podaniu leku była zamiana przepisanego leku bez zgody lekarza, błędy te popełniały szczególnie pielęgniarki w wieku 35-44 lat ($p < 0,001$). Błędy obejmowały podanie leku o innej mocy niż przepisana ($p < 0,001$), podanie niewłaściwego leku ($p < 0,001$) i podanie innej dawki niż wskazana ($p < 0,001$). Do zamiany leków dochodziło najczęściej podczas porannego podawania leków ($p < 0,001$).
Wnioski. Najistotniejszym odkryciem tego badania było zamienianie leków na inne bez zgody lekarza. Stwierdzono, że błędy w podawaniu leków nie były rzadkością w praktyce klinicznej, a czynniki takie jak wiek pielęgniarki, ogólna długość praktyki klinicznej, wykształcenie i zakłócenia w miejscu pracy odgrywały w tym swoją rolę.

Słowa kluczowe: szpitale, recepty, błędy w podawaniu leków, pielęgniarstwo

ABSTRACT

MEDICATION ADMINISTRATION ERRORS IN THE SELECTED CZECH HOSPITALS: AN OBSERVATIONAL STUDY

Aim. The study aimed to identify the occurrence of medication administration errors in clinical practice.
Material and methods. This was a direct observational study. The study included observing the medication administration process over three years in four hospitals in the Czech Republic. STROBE was used as a checklist.
Results. A total of 18,370 medication administrations to hospitalized patients were observed and recorded, including morning, noon, and evening administrations. The most common MAE was substituting a prescribed medication without the doctor's consent, especially among nurses aged 35-44 ($p < 0.001$). These MAEs involved giving a medication of different strength than prescribed ($p < 0.001$), giving the wrong medication ($p < 0.001$), and giving a different dose ($p < 0.001$). Substitutions of MAEs occurred most often during morning medication administration ($p < 0.001$).
Conclusions. A critical finding of this study was the substitution of medications without a doctor's consent. It has been found that MAEs were not uncommon in clinical practice, and factors such as the nurse's age, overall length of clinical practice, education, and workplace interruptions played a role.

Key words: hospitals, prescriptions, medication administration errors, nursing

INTRODUCTION

The safety of patients in hospitals is still essential to healthcare quality [1]. Medication administration errors (MAEs) pose a severe danger to the patient, and therefore, measures must be taken to eliminate them. MAEs can extend a patient's hospital stay and unnecessarily decrease healthcare resources [2]. The occurrence of MAEs can directly affect the patient's health, ranging from minor to severe adverse events, and result in death in roughly 6.5% of patients [3, 4]. The concept of MAEs typically refers to any preventable incident resulting in a patient's inappropriate medication use [5]. MAEs are frequently caused by issues such as a lack of communication about medication orders, illegible handwriting, selecting the incorrect medication from a drop-down menu, confusion over medications with similar names, confusion arising from similar packaging of products, or mistakes related to dosing units or weight. Medication errors can be caused by human error, but they are more often caused by a flawed system that lacks adequate safeguards to detect errors [6].

The nurses take on responsibility for providing the highest quality treatment and ensuring patient safety, which includes giving patients the correct medication and identifying MAEs as soon as possible [7]. The process medication administration by a nurse consists of prescribing the medication by the doctor in the patient's medical records, recording the prescription of the medication in the patient's documentation, preparation of a mobile pharmacy (preparation of medications, control of medications), mechanical hand washing and hygienic hand disinfection, arrival of a nurse with a mobile pharmacy, correct identification of the patient actively and passively, preparation of the medication (checking the correctness/originality of the medication in the so-called triple administration, administration of the medication to the patient, verifying that patient took or used the medication, record of administration/non-administration of the prescribed medication in the medical documentation, cleaning of equipment, waste disposal, and replenishment of missing medications in the mobile pharmacy [8, 9]. Nurses in the Czech Republic acquire professional competence to administer prescription medicines based on a physician's prescription immediately after completing their qualified studies [10]. Nurses in the Czech Republic hospitals are not authorised to prescribe medicines but only to administer them. Considering that the occurrence of MAEs can impact patient health [11], it is necessary to identify high-risk factors associated with MAEs within healthcare units and implement strategies for their prevention.

AIM

The aim of the study was to identify the occurrence of medication administration errors in clinical practice.

MATERIALS AND METHODS

This prospective observational study was conducted in four hospitals in one region of the Czech Republic using the STROBE checklist [12]. Individual observations took place in 2021, 2022, and 2023. Data from each hospital was collected from the internal medicine, surgery, and follow-up care departments. The study included all patients present in the departments who had at least one monitored medication administration. Excluded from the research (i.e., not monitored) were the administration of infusions, administration of medications outside the specified observation time frame, and situations where observations could not be made (e.g., lack of patient's consent, refusal of the observer to enter isolation areas, ethical reasons). The process of medication administration by nurses to individual patients was monitored for morning, noon, and evening administrations. Medications administered „as needed" were also monitored. Specifically, we monitored (1) right dose, (2) whether the medication was administered at the prescribed time ± 15 minutes, (3) whether the medication was changed without consulting a doctor (i.e., an unauthorized medication substitution), (4) whether the medication was administered correctly. Data collection was done by direct observation by a team consisting of a pharmacist and a nurse. Each observation was preceded by a trial observation the day before, so that the observers became familiar with the ward (layout, drug administration system). For the observation, a secure database was created to store anonymised data on patients admitted to the wards and their medication at the time of observation and data on the nurses observed. The database was used to generate record sheets for data collection, recording, categorizing, controlling and exporting data obtained by observation. Immediately after completing a single medication round, the records were reviewed by consensus within the team that conducted the observation in that ward and the observed condition was recorded in the database. Data collection, entry and assessment were performed according to a standardized protocol. Mathematical-statistical techniques, including percentages, means, median, and standard deviation, were employed for the statistical analysis. Tests such as the χ^2 test and the test for independence were used. The levels of statistical significance were set at $p < 0.05$, $p < 0.01$, and $p < 0.001$. The data were processed statistically using SASD 1.5.8.

Ethical consideration

The study was approved by the Research Ethics Committee of the f the Faculty of Health and Social Sciences of the University of South Bohemia in Ceske Budejovice on 18 June 2019. In this study, the guidelines of the World Medical Association's Declaration of Helsinki [13] were followed. The participation of patients and nurses in the study was voluntary.

RESULTS

In total, 18,370 medication administrations in hospitalized patients were observed and recorded. The study included nurses from four hospitals. In 2021, medications

were administered by 58 nurses. This number increased to 59 in 2022, and in the last observed year, the number of nurses was 68. The average age of nurses was 37.4 years (range: 20–64). A total of 9,924 (54%) medication administrations to female patients were observed, and 8,446 medication administrations (46%) to male patients were observed. Additional characteristics are presented in Table 1.

The results of statistical analysis show that administration of the wrong active substance occurred most often in 2022 and least often in 2023 (see Table 2). The wrong active substance was given more often by nurses aged 35–44 years and least often by nurses ≥ 55 years; nurses with < 1 year of experience.

The results presented in Part B show that the correct doses of prescribed medications were most often administered in follow-up care departments. Dose MAEs occurred most often during lunch-time administration. Female nurses made dose MAEs more frequently than male nurses. Nurses with < 5 years of clinical experience were more likely to make dose MAEs, while nurses with ≥ 16 years of experience were the least likely to make dose MAEs.

In connection with the administration of medications at the correct time (Part C), it was noted that the highest rate of MAEs occurred in 2023. Internal departments administered medications significantly more often at prescribed times, while follow-up care departments were the least punctual. Time-related MAEs occurred most often during morning administration and least often during evening administration. Nurses aged 35–44 were the best at on-time medication administration, i.e., medications were administered on time significantly more often. Nurses with a total experience of 2–5 years and ≥ 16 years were significantly better, while nurses with a total experience of ≤ 1 year made more time-related MAEs. Nurses with nursing school educations (general nurses) had fewer time-related MAEs compared to nurses with secondary educations (practical nurses).

Table 3. shows the association between MAEs related to a medication substitution without consulting a doctor (primary factor) and MAEs related to correct dose, method of administration, dose substitution, department, year, etc. (secondary factors). A statistically significant correlation was found between medication substitution without consulting a doctor and the hospital department. MAEs related to a medication substitution without a doctor consult were significantly more common in surgical and follow-up care departments and

■ Tab. 1. Characteristics of selected variables

Monitored Characteristic	Number of medication administrations (%)
Year of observations	
2021	6,560 (35.7)
2022	5,947 (32.4)
2023	5,863 (31.9)
Type of department	
Surgical	2,409 (13.1)
Internal	7,624 (41.5)
Long-term care	8,337 (45.4)
Total	18,370 (100)
Administration time	
Morning	9,387 (51.1)
Noon	3,048 (16.6)
Evening	5,935 (32.3)
Patient's gender	
Man	8,446 (46.0)
Woman	9,924 (54.0)
Patient identification by bracelet	
Yes	6,928 (37.7)
No	11,442 (62.3)
Identification of the patient by asking for the name	
Yes	6,210 (33.8)
No	12,160 (66.2)

■ Tab. 2. Observation of medication administration by nurses in clinical practice

Monitored Characteristics	Variables	χ^2	df	P–value
A: Administration of the correct active substance	Year of observation	23.604	2	< 0.001***
	Type of department	2.991	2	0.224
	Daily Administration Time	2.196	2	0.333
	Nurse Interruption	2.914	1	0.091
	Nurse Gender	1.844	1	0.178
	Nurse Age	12.299	4	< 0.05*
	Overall Nursing Experience	9.305	3	< 0.05*
	Years of experience of the nurse on the ward	7.244	3	0.065
	Level of education of a nurse	4.955	4	0.292
B: Giving the correct dose	Year of observation	5.705	2	0.058
	Type of department	6.754	2	< 0.05*
	Daily Administration Time	12.823	2	< 0.01 **
	Nurse Interruption	0.079	1	0.783
	Nurse Gender	4.202	1	< 0.05*
	Nurse age	3.762	4	0.439
	Overall years of Nurse Experience	6.903	3	0.075
	Experience of nurses within the department	15.485	3	< 0.01**
	Nurse's education level	12.313	4	< 0.05*
C: Administration of medications at the prescribed time ± 15 minutes	Year of observation	38.988	2	< 0.001***
	Type of department	18.877	2	< 0.001***
	Daily Administration Time	67.217	2	< 0.001***
	Nurse Interruption	1.204	1	0.276
	Nurse Gender	0.001	1	0.985
	Nurse age	24.348	4	< 0.001***
	Overall Experience of the Nurse	48.277	3	< 0.001***
	Experience of the nurse in the department	28.051	3	< 0.001***
	Nurse's education level	14.742	4	< 0.01**

Note. df – degree of freedom; χ^2 – Chi-square; p - independence test; Correlation is significant at α = 0.05. **Correlation is significant at α = 0.01; ***Correlation is significant at α = 0.001.

Tab. 3. Incidence of medication errors related to changes in prescribed medications

Monitored Characteristics	Variables	χ^2	df	P–value
A: Medication substitution without consulting a doctor	Year of observation	1.826	2	0.401
	Type of department	67.940	2	< 0.001***
	Daily administration time	32.342	2	< 0.001***
	Nurse interruptions	0.224	1	0.640
	Nurse gender	4.072	1	< 0.05*
	Nurse age	22.672	4	< 0.001***
	Overall experience of the nurse	30.020	3	< 0.001***
	Experience of the nurse in the department	4.089	3	0.252
	Nurse's education level	4.350	4	0.361
B: Medication substitution without consulting a doctor	MAE related to correct active ingredient	50.497	1	< 0.001***
	MAE related to correct dose	13.252	1	< 0.001***
	MAE related to prescribed medication strength	41.998	2	< 0.001***
	MAE related to dose substitution	38.220	1	< 0.001***
	MAE related to the method of administration	9.883	1	< 0.01**

Note. df – degree of freedom; χ^2 – Chi-square; p - independence test; Correlation is significant at $\alpha = 0.05$. **Correlation is significant at $\alpha = 0.01$; ***Correlation is significant at $\alpha = 0.001$.

least common in internal departments. MAEs related to a medication substitution without a doctor consult were also significantly more likely to occur during morning administration and less likely to occur during afternoon and evening administration. MAEs related to a medication substitution without a doctor consult were significantly more likely to occur among nurses aged ≥ 55 and less often by nurses aged 35–44 years; MAEs related to a medication substitution without a doctor consult were significantly more common among female nurses. A final, significant correlation was that MAEs related to a medication substitution without a doctor consult were significantly more common among nurses with the greatest overall experience, i.e., ≥ 16 years.

We noted that if a nurse made an MAE related to a medication substitution without a doctor consult, they were significantly more likely to make an MAE related to (1) the wrong active substance, (2) the wrong dose, (3) the wrong pharmaceutical form, and (4) the wrong medication strength. Nevertheless, the substituted medications were administered correctly to patients (see Table 3, section B).

DISCUSSION

This study aimed to determine the association between the prevalence of MAEs and selected characteristics of variables; our study found multiple associations. However, a significant finding was that when nurses modify prescribed medications, it frequently results in patients receiving a strength different from the one documented in the medical record. In a prospective observational study conducted in Brazil, a high overall MAEs rate was identified. The most common errors were errors in technique, incorrect administration time, incorrect dose, and missed medication administration. Factors associated with errors were nurse interruptions during administration, method of administration, and workload during medication administration [14]. In the study from the Netherlands by Jessurun et al. [15] they identified that the most common MAEs in their study were missed medication administration, incorrect dose, and mishandling of the medication. Brabcová et al. [16] found that, in the opinion of the nurses, the most common cause of MAE was similarity in medication appearance, followed by name and packaging similarities. It may be related to the fact that nurses often do not know how to recognize LASA (Look alike-sound alike) medications. MAEs related to medication substitution were often associated with the prescription of generic medications or the prescription of unavailable medications. If a prescribed medication is unavailable in the department's stock, nurses in the Czech Republic are not competent to make a substitution; instead, they are required to ask the physician to prescribe a medication that is available within the department's stock. Achieving this can be problematic when the doctor is no longer on the ward (e.g., in surgical wards).

Preventive Strategies to Reduce Medication Administration Errors

Strategies to reduce MAEs can include electronic medical records, assisted medication administration using barcodes, automated dosing systems, pre-filled syringes, updated medication protocols, MAE prevention programs, and pharmacy-supported monitoring [17].

According to Jessurun et al. [18], central automated unit dose dosing and barcode-assisted medication delivery reduce MAEs. This intervention was associated with an absolute reduction of 4.5% in MAEs and a reduction of 2.7% in potentially harmful MAEs. Park and Han [11] offer guidelines for medication safety education in nursing. Among other things, they recommend developing a standardized curriculum to strengthen nursing competencies in the field of medication safety, using the latest educational simulations, such as virtual reality, to educate nursing students. Luokkamäki et al. [19] proposed developing clinical competencies in medication administration by using 3D games. Sessions et al. [20] pointed out the importance of intra- and interprofessional collaboration, nurse involvement, and inclusion of patients in safety training. The results of a qualitative study by Bucknall et al. [21] using nurse interviews and observations during medication administration showed the importance of educating nurses on how to involve the patient and their families in the medication administration process.

Study limitations

The limitation of this study is the possibility of observer-level bias. To minimize this, the following measures were taken: creating a very detailed standardized manual that precisely defined deviations from the practice or standards of the facilities in question; the actual observation was always done in a nurse-pharmacist pair. Questionable

cases could be consulted by the entire team of observers immediately after the completion of each observation. Another limitation of this study is the selection of healthcare facilities from only one region of the Czech Republic.

CONCLUSIONS

Giving medication to patients is one of the most critical nursing tasks in many healthcare settings. The safety of the preparation and administration of drugs should be subject to constant improvement; as such, it is necessary to identify factors that may lead to errors and then take measures to minimize or eliminate them. The results of this study point to the causes of medication errors in selected hospitals in the Czech Republic. A statistical relationship was found between the substitution of medications by nurses without the doctor's consult and MAEs. This study shows the importance of correct medication administration and the critical need for consultation with a physician before any change or substitution of a prescribed medication. Based on the results of the observations, measures were taken to streamline the process and reduce its risks. A number of recommendations related to the prescription process and the administration of medicines were provided. According to the project results, internal nursing care documents were modified.

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