



Original research article

# Knowledge of nurses in relation to the treatment of medicinal products

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## Abstract

The administration of medicines is a well-known risk factor associated with patient safety. Handling medicines is a routine daily activity for nurses. As such, nurses need to know basic information about how medicines are administered, as well as medicine storage, labeling, security, documentation, and how to dispose of unused medicines. As part of a standardized, controlled interview, we examined the knowledge base of nurses relative to the items list above. We also examined daily routines and habits relative to this topic.

Our sample consisted of 1,202 nurses, who were representative of nurses in health care facilities, in terms of region and age, in the Czech Republic. The sample included nurses from a variety of hospital types.

Most nurses (67.5%) reported that in their workplaces, doctors were only allowed to verbally prescribe drugs under special circumstances. Roughly the same percentage of nurses were able to correctly identify the risk categories of drugs. However, only 10% of nurses knew the correct temperature for drug storage. A majority (64.9%) regularly checked drug expiration dates (once a week). Most nurses (72.6%) reported that they never prepared medications taken multiple times per day, in advance.

Based on the results of our survey, nurses have a good understanding of how to handle and dispense medication; nonetheless, we found considerable room for improvement. Proper drug handling and administration are critically important for patient safety, and any omission or failure in these protocols can have serious or even fatal consequences.

**Keywords:** Drug misconduct; Handling of medicinal products; Knowledge of nurses; Patient safety

## Introduction

Decree No. 55/2011 Coll., as amended, establishes the competences of nurses in relation to the handling of medicines. This document states that, in addition to drug administration, nurses must ensure proper storage, labeling, and handling of medicines, including addictive substances, and they must also ensure that adequate supplies are maintained.

To fulfill these competencies, nurses must have the appropriate education and demonstrated an appropriate level of knowledge. Nurses need to know both the legislative regulations and the specific internal regulations related to medication handling. The treatment of medicinal products is regulated by Act No. 378/2007 Coll., regarding pharmaceuticals and by amendments to certain related laws. This law describes the treatment of medicinal products, their preparation, and modification, and it defines the eligibility requirements of persons who are authorized to handle medicinal products and regulates the issue of who can provide approval for the use of medicinal products (Prošková et al., 2014). Decree No. 84/2008 Coll., as

amended, is also valid in connection with the handling, storage, and documentation of medicines. The decree states that medical institutions are responsible for the proper handling of medicinal products and for ensuring quality, efficacy, and safety of the medicinal products used.

In the context of the accreditation of medical facilities, there is also a strong emphasis on the safe handling of medicinal products. In Accreditation Standard No. 2.5 of the United Accreditation Commission, indicators of compliance with the standard are specified. The standard is met when a medical institution has internal regulations for the ordering, storage, prescribing, administration, and disposal of unusable medicinal products; additionally, there needs to be a process for the documentation of the above-mentioned procedures (Marx and Vlček, 2013). All these provisions must comply with the law and the implementing regulations. Ignorance and non-compliance can lead to medication errors that harm patients (Brabcová et al., 2014). Published reports regarding medication errors in the Czech Republic are lacking; however, a pilot study seems to suggest that it occurs too often (Měrková et al., 2019).

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The aim of our research was to evaluate the knowledge and understanding of nurses regarding the use of pharmaceuticals; this included not only a knowledge of basic information regarding pharmaceuticals but also an evaluation of basic knowledge relative to handling and administration of drugs.

## Materials and methods

The research was carried out using a quantitative interview method. The field investigation used a standardized, controlled (face-to-face) interview with respondents. The final form of the interview was determined based on the results of pre-research. Respondents were informed in advance of the research objectives and were familiar with the interviewer's technique. The research was anonymous, and participation was voluntary. The investigation itself did not present any ethical issues.

Statistical analysis was performed using the Statistical Analysis Social Data program (SASD 1.4.10). The 1st level of sorting and pivot tables of selected indicators of the 2nd level of sorting were processed. The dependency rate of the selected variables was determined on the basis of the  $\chi^2$  independence test, and other test criteria were used based on the nature of the variables. Based on this analysis, the data was interpreted, and the relevant tables and charts were generated.

## The sample and its representativeness and characteristics

The sample consisted of 1,202 nurses. These respondents were selected using the quota selection method. The parameters of the nurse sample were constructed based on data from the Institute of Health Information and Statistics from the Ministry of Health of the Czech Republic, valid as of 31 December 2016. The sample included nurses working in inpatient wards of hospitals and other medical institutions. In the absence of data on the internal structure of these groups of nurses in terms of age, the parameters of this sample were derived from the basic population of all nurses in the Czech Republic. The sample of nurses was designed to match the composition of the basic population in terms of geographic region and age. The sample was intended to be representative of nurses in the Czech Republic according to age: the sample composition was 234 (19.5%) were less than 30 years of age, 338 (28.1%) were 30–39 years, 330 (27.4%) were 40–49 years, 223 (18.8%) were 50–59 years, and 77 (6.4%) were 60 years or over. As part of the study, nurses from all regions of the Czech Republic were approached, with their representation corresponds to the structure of the general population of the Czech Republic (Table 1).

**Table 1. Sample composition by region**

Region	N	%	Region	N	%
Prague	247	20.5	Hradec Králové	61	5.1
Central Bohemia	103	8.6	Pardubice	49	4.1
Southern Bohemia	64	5.3	Vysočina	49	4.1
Pilsen	70	5.8	Southern Moravia	146	12.1
Karlovy Vary	33	2.7	Olomouc	76	6.3
Ústí nad Labem	76	6.3	Zlín	55	4.6
Liberec	43	3.6	Moravian-Silesian	130	10.8

Relative to education level, the sample consisted of nurses with secondary educations (459; 38.2%), higher vocational educations (354; 29.5%), bachelor educations (274; 22.8%), and master educations (115; 9.6%). A total of 799 (66.5%) nurses stated that they did not have a specialization during their education, and the remaining 403 (33.5%) nurses had some type of specialized education. The largest part of the sample consisted of nurses working in university hospitals and local hospitals (296 [24.6%] and 279 [23.2%], respectively). There were 159 (13.2%) nurses from regional hospitals, 163 (13.6%) from the city hospitals, 210 (17.5%) from private hospitals, and 96 (7.9%) from other institutions. The representation of nurses from different types of medical facilities was well balanced.

Years of service was used as an indicator of stability within the profession as well as a measure of professional experience in the healthcare sector (Table 2).

## Results

The study sought to measure the knowledge and understanding of nurses relative to their pharmaceutical-related duties. We also assessed normal routines and habits used while handling and dispensing medicines and the level of experience with these duties. We examined the drug administration process within nursing, as well as knowledge and experience

**Table 2. Years of service as a nurse and years at current workplace**

Years as a nurse	N	%	Years at current workplace	N	%
Less than 1 year	39	3.2	Less than 1 year	118	9.8
1–5 years	238	19.8	1–5 years	410	34.1
6–10 years	222	18.5	6–10 years	281	23.4
11–15 years	186	15.5	11–15 years	183	15.2
16–20 years	175	14.6	16–20 years	76	6.3
21 years and over	342	28.5	21 years and over	134	11.1

regarding security, labeling and storage, preparation, administration, methods of disposal, and specific procedures for handling opiates and other drugs, were identified.

Medicines brought to the hospital by patients and nurse's station pharmacy management.

With regard to medicines brought to the hospital by the patient, the majority of nurses (83.3%) correctly stated the procedure of taking the drugs from the patient, storing them marked with the patient's name and the nurse's name, while leaving rescue medicines (e.g., inhalers, nitroglycerin) with the patient.

Regarding drugs brought in by patients, more than 2/3 (68.6%) correctly understood that these drugs must be kept in a secure and locked location, and the key needs to be under the control of a designated nurse for each shift. The study found that among nurses ( $N = 1202$ ) working in private hospitals, a significant number reported that patient medications must be kept in a secure and locked location but that the key could be kept in a place where it could not be found by patients

( $P < 0.001$ ) (Table 3). The study found that, for instance, nurses working in internal departments, reported that unless the nurse's station pharmacy was left unsupervised, patient medicines did not have to be kept under lock and key ( $P < 0.01$ ).

With regard to the level of education, the study found that nurses with high school educations were significantly more likely to know how a nurse's station pharmacy should be properly managed ( $P < 0.001$ ); certified nurses and nurses of bachelor's degrees, on the other hand, were significantly more likely to report ( $P < 0.001$ ) that the nurse's station pharmacy must be locked and the key should be kept where it cannot be found by patients.

Regarding work experience, nurses with less nursing experience were significantly more likely to report ( $P < 0.01$ ) that the nurse's station pharmacy must be locked, and the key should be kept where it cannot be found by patients. The same response was also commonly given by nurses with less experience in their current workplace ( $P < 0.05$ ).

**Table 3. The link between nurse's station pharmacy management and selected socio-demographic features**

Relationship	$P$	$\chi^2$	df
Nurse's station pharmacy management and type of medical facility	<0.001	45.475	10
Nurse's station pharmacy management and hospital department	<0.01	19.994	6
Nurse's station pharmacy management and how nurses were trained and educated	<0.001	24.252	6
Nurse's station pharmacy management and overall length of nursing practice	<0.01	24.046	10
Nurse's station pharmacy management and length of practice in the current workplace	<0.05	21.301	10

The issue of drug security was also examined relative to how medicines were prescribed in the workplace by physicians. The correct answer, "it happens only under exceptional circumstances and follows a standardized procedure", was noted by more than two-thirds (67.6%) of nurses. Almost one-quarter of nurses stated that doctors were not allowed to verbally prescribe medicines, and 7.3% said that it was a routine occurrence.

A statistically significant association was found between the type of hospital ward and the frequency of verbally prescribed medications by doctors. Nurses from internal medicine departments and other departments reported significantly more often ( $P < 0.05$ ) that verbal prescriptions were not allowed in their hospital; this was also true of nurses from surgical departments and intensive care departments ( $P < 0.05$ ).

### Handling of potentially dangerous medications

One question in this part of the research was focused on the knowledge of potentially dangerous medications. Based on their departmental safety objectives, 61.1% of nurses recognized medicines such as injectable KCl solutions (with concentrations of 7.45% or higher), insulin, and undiluted heparin as potentially dangerous. More than one-third (36.0%) of nurses reported medicines such as sedatives, opiates, and other addictive substances and 2.4% reported drugs like analgesics and antidepressants as potentially dangerous; 0.4% of nurses included other drugs.

A statistically significant link was identified between the type of medical facility and the knowledge of potentially dangerous drugs. Nurses working in university hospitals were significantly more likely ( $P < 0.01$ ) to know the correct response, i.e., that the list includes injectable KCl solutions >7.45%, insulins, and undiluted heparins. Nurses from private hospitals reported significantly more often that medications such

as sedatives, opiates, and addictive substances are potentially dangerous drugs. Nurses with specialized educations showed significantly greater ( $P < 0.05$ ) knowledge of potentially dangerous medicines than nurses without specialized educations. The study found that 96.8% of nurses knew that potentially dangerous medicines should be stored separately from other medicines.

### Storage, expiration dates and times, and drug labels

Regarding medicines that require refrigeration, only 10.0% of nurses knew that these drugs should be stored at 8–15 °C. A majority (63.1%) reported that these drugs should be stored at 2–8 °C, almost one-quarter (23.1%) reported 3–5 °C, and the remaining 3.7% reported a storage temperature of 0–2 °C. Statistically significant relationships were identified between knowledge of drug storage temperatures and the type of healthcare facility in which the nurse worked, specific hospital wards, and the level and type of education. Nurses from larger hospitals were significantly more likely ( $P < 0.01$ ) to report a temperature range of 3–5 °C for drug storage. Nurses from surgical departments were significantly more likely ( $P < 0.05$ ) to know the correct temperature range (8–15 °C). Nurses from intensive care units were significantly more likely ( $P < 0.05$ ) to report a temperature range of 2–8 °C. Nurses with secondary educations were significantly more likely ( $P < 0.01$ ) to indicate a temperature range of 2–8 °C, while nurses with bachelor degrees were significantly more likely to know the correct answer (8–15 °C) ( $P < 0.01$ ). Nurses with master's degrees were significantly more likely ( $P < 0.01$ ) to indicate the wrong temperature range (3–5 °C).

Another area of inquiry was focused on the knowledge and experience of nurses regarding drug expiration dates. The majority of nurses (64.9%) correctly stated that the expiration dates of drugs should be checked once a week. The knowledge

of nurses relative to this item was significantly influenced by the level of education. Nurses with secondary educations were significantly more likely to report that regular checks should be carried out once a month, while nurses with higher education degrees were significantly more likely to indicate the correct interval, i.e., once per week ( $p < 0.05$ ).

Regarding how long eye drops can be used after opening, most nurses (51.6%) correctly responded that it was necessary to follow the recommendation of the manufacturer (i.e., the SPC – Summary of Product Characteristics, Package Leaflet). More than one-quarter (26.5%) of nurses reported that eye drops could be used for 28 days after opening, and 16.1% report the time to be 14 days.

The results were similar with regard to how long insulin could be used after opening. The correct answer, which was to follow the recommendation of the manufacturer (SPC – Summary of Product Characteristics, Package Leaflet), was given by 40.8% of nurses. The largest proportion of nurses (44.6%) reported that insulin could be used for 28 days after opening, 7.7% of nurses reported 14 days, and another 6.2% reported 1 week (7 days). Statistically significant connections were identified with the type of medical facility, whether or not

the nurse had specialized education and years of employment at the current workplace. At  $P < 0.001$ , nurses from regional hospitals are significantly more likely to answer 28 days or one week, while nurses from other facilities were significantly more likely to answer 14 days. Nurses with specialization educations reported significantly more often ( $P < 0.001$ ) that insulins could be used for 28 days after opening. Furthermore, nurses with the shortest workplace experience (i.e., less than 1 year) were significantly more likely ( $P < 0.05$ ) to report that insulins could be used for 7 days (1 week) after opening.

The study also examined the issue of drug labeling. For each question, nurses were offered several possible answers from which to choose. Regarding the use of red labels for medicines prepared in the pharmacy, the majority of nurses (87.0%) knew the correct answer, i.e., that medicines prepared in a pharmacy with a red-label must not be taken (orally) internally. For medicines prepared in the pharmacy with a white-label, black inscription, and a blue stripe, most nurses (71.8%) correctly answered that these labels indicated addictive medicines. Table 4 shows the results of the analysis of the relationships with selected sociodemographic characteristics.

**Table 4. Link between knowledge of drug labeling protocols and selected socio-demographic characteristics**

Relationship	<i>P</i>	$\chi^2$	df
Red label and type of medical facility	<0.001	92.839	15
Red label and department type	<0.01	22.800	9
Red label and specialization education of nurses	<0.01	13.661	3
White label, black print, blue stripe and type of medical facility	<0.01	35.911	15
White label, black print, blue stripe and total length years of nursing experience	<0.001	38.545	15
White label, black print, blue stripe and length of employment at the current workplace	<0.001	48.688	15

### **Preparation and administration of medications and handling of restricted medications**

Another area examined by the study was the preparation and administration of medicines by nurses. As in previous cases, nurses could choose from several possible answers for each question.

With regard to repeatedly administered medications, nurses were asked if they prepared these in advance. Most nurses (72.6%) correctly answered that they never prepared such medications in advance. When asked, "When do you prepare infusions?" most nurses (81.5%) correctly answered that infusions should be prepared just before administration. Statistically significant associations were identified between the preparation of medicines and the type of hospital, department, age of the nurse, and type of education.

The study found that (1) nurses 30–59 years of age were significantly more likely ( $P < 0.01$ ) to indicate that they never prepared repeatedly administered medications in advance, (2) nurses over 60 years of age were significantly more likely ( $P < 0.01$ ) to report doing so, but only in exceptional cases, (3) nurses with university educations (Mgr.) were significantly more likely ( $P < 0.05$ ) to report that repeatedly administered medications were never prepared in advance, (4) nurses with higher education degrees were significantly more likely ( $P < 0.01$ ) to do so exceptionally, (5) nurses with specialized educations were significantly more likely ( $P < 0.01$ ) to report that repeatedly administered medications were never prepared in advance, and (6) nurses without a specialization education

were significantly more likely to report that they did so, but only in exceptional cases.

With regard to the preparation of infusions, nurses from city hospitals were significantly more likely ( $P < 0.001$ ) to correctly answer that they prepared infusions just before administration, while nurses from other hospitals chose this response significantly less often. Nurses in intensive care units were significantly more likely ( $P < 0.05$ ) to choose the correct answer.

In terms of dealing with missing or unaccounted for medicines, nurses were asked what they would do if, when they went to get medicine for a patient, they noticed that the medicine was missing in part or in whole. The largest percentage (56.8%) correctly reported that they would not give the medicine, document the situation, and inform the doctor. A little over one-third of nurses (38.3%) reported that they would find the missing medicine in the medicinal products information system, even if it was a generic substitute, give the medicine to the patient, and note the incident and the name of the drug in the patient's documentation. Only 1.5% of nurses said they would not administer the drug and marked it as having been given to the patient. The remaining nurses (3.4%) offered different courses of action. Table 5 shows the analysis of this topic relative to selected sociodemographic characteristics.

With regard to the type of medical institution nurses from regional hospitals were significantly more likely ( $P < 0.001$ ) to give the correct answer, i.e., that they do not give the medicine, mark it in the patient's documentation, and inform the



**Table 5. Associations between nurse behavior in the event of missing medicines and selected socio-demographic characteristics**

Relationship	<i>P</i>	$\chi^2$	df
Nurse response relative to type of hospital	<0.001	37.837	15
Nurse response relative to type of department	<0.05	20.813	9
Nurse response relative to specialization of education	<0.05	7.933	3
Nurse response relative to the total years in nursing	<0.05	27.447	15
Nurse response relative to years of employment at the current workplace	<0.01	35.803	15

doctor. Nurses from university and city hospitals were more likely to find a substitute for the missing medicine (using the information system of medicinal products), give the medication to the patient, and document the actual drug given in the patient's record. Depending on department (excluding internal, surgical, and intensive care departments) nurses were significantly more likely ( $P < 0.05$ ) to give the correct answer. Nurses with specialized educations were significantly more likely to give the correct answer ( $P < 0.05$ ). Nurses without specialized educations were significantly more likely to find, administer, and document an alternative medicine. Based on the length of practice, nurses with more than 1 year of experience were significantly more likely to give the correct answer. Nurses with less than 1 year of experience were significantly more likely to find, administer, and document an alternative medicine. Nurses employed in the workplace for more than 1 year were significantly more likely ( $P < 0.01$ ) to give answer correctly, while nurses with less than one year of experience in the current workplace were significantly more likely to find, administer, and document an alternative medicine.

The study also looked at nurse activity relative to the administration of medicines. Nurses were asked how they identified patients before administering a drug or drugs. The majority of nurses (92.6%) chose the correct answer which was to identify the patient using 2 unique identifiers, most often by name and surname, and year of birth of the patient.

The study also examined the use of insulin in infusions. Almost three-quarters (74.6%) of nurses chose the correct answer, i.e., only fast-acting insulins can be injected into IV infusions. Nurses without specialized educations were significantly more likely ( $P < 0.01$ ) to report that only depot insulin can be injected into infusions, while nurses with specialized educations were significantly more likely to choose the correct answer. The correct answer was also chosen significantly more often ( $P < 0.05$ ) by nurses with the greatest experience in the current department (i.e., 21 years or more), while nurses with less than one year of experience were significantly more likely to think that insulin cannot be injected into an infusion.

With regard to the "SR" drug designation, over three-quarters (79.2%) knew that it meant slow or gradual drug release, while 11.1% of nurses thought it meant rapid drug release, 7.0% thought it indicated a drug that was twice as strong drug, and 2.7% of nurses chose a different response.

With regard to understanding the meaning of the term "infantibus" (for children) on a medication label, the vast majority (90.9%) of nurses knew the correct answer, i.e., that it was a drug intended for use in children, while 4.8% of nurses thought the label meant the it was a strong drug, 2.8% thought it meant that the drug was twice as strong, and the remaining 1.5% chose a different response.

Regarding the administration of low molecular weight heparin (LMWH), the majority of nurses (85.9%) knew that low molecular weight heparins should be administered *s.c.* (*sub*

*cutem* – under the skin), while 10.1% of nurses thought that LMWH was administered *i.v.* (intravenously – into the vein), 2.3% thought that LMWH was administered *per os* (by mouth), and the remaining 1.7% thought LMWH was administered *i.m.* (intramuscularly – into the muscle).

The research also monitored the actions of nurses in relation to recording medications in the patient records. The majority of nurses (94.5%) gave the correct answer and stated that the unadministered medications were noted in the patient's record and an explanation for why the drug was not given was also include. The vast majority (94.5%) used the correct procedures.

The last question on medication documentation was whether nurses used the "Self-Medication Protocol" in their wards when patients insisted on self-medicating. Only 16.9% of nurses said that the protocol was used in their departments.

With regard to the disposal of unused medicines, the majority of nurses (90.8%) considered unused medicines to be hazardous waste, and 88.9% thought that expired medicines were sent back to the institutional pharmacy.

The last item studied was the handling of additive substances in the workplace. Nurses were asked which medical personnel in their workplace could administer (inject) opiates. The majority of nurses (71.9%) correctly answered that only authorized persons, whose name was maintained on a list available to the department, were allowed to administer opiates; 18.0% of nurses said that only nurses with college degrees were allowed to administer opiates their workplace, 3.6% of nurses thought that only doctors were allowed to administer (inject) opiates in their workplace, and 2.6% of nurses were unsure as to who was and was not allowed to administer (inject) opiates.

Statistically significant associations were identified between knowing who was authorized to administer opiates in the workplace and the type of hospital, specialized education or training, total number of years of experience, and number of years working at the current workplace. Nurses from university hospitals were significantly more likely to report ( $P < 0.01$ ) that all medical staff were entitled to administer opiates in their workplace, while nurses from private hospitals are significantly more likely to answer "only nurses with higher levels of education". Nurses with specialized educations were significantly more likely ( $P < 0.001$ ) to correctly answer that only authorized persons, whose name was maintained on a list available to the department, were allowed to administer opiates. Nurses without a specialized education were significantly more likely to report that only nurses with higher levels of education were allowed to administer (inject) opiates in their workplace. Nurses with less than 5 years of experience were significantly more likely ( $P < 0.05$ ) to report that only nurses with a higher education degrees were entitled to administer (inject) opiates in their workplace, while nurses with more than 11 years of experience were significantly more likely to

know the correct answer. Nurses with less than one year of experience in the current workplace and those with more than 20 years of experience were significantly more likely ( $P < 0.05$ ) to report that nurses with higher levels of education were allowed to administer (inject) opioids in their workplace. Nurses with 6–20 years of experience were significantly more likely to know the correct answer.

Another area examined in relation to the handling of opiates was documentation of opiate use (opiate register). A majority of nurses (52.4%) correctly answered that the record of narcotics used should be checked at the beginning and the end of each shift; 20.4% of nurses indicated that they only checked it once a day, 14.9% reported checking once a week, and 10.2% reported checking once a month. The remaining 2.1% of nurses chose a different option. At a significance of  $P < 0.001$ , nurses from university hospitals and other large facilities, nurses from intensive care and surgical wards, and nurses with specialized educations gave the correct answer more often.

## Discussion

Providing quality and safe care is the goal of all medical facilities. To accomplish this, health professionals focus on reducing the risks associated with the provision of health services. Drug administration is one such risk area. Medication errors of almost any kind can cause or lead to serious or even fatal consequences (National Coordinating Council for Medication Errors, 2020). Medication errors have been the subject of many studies. In one, multi-country, study approximately 1% of all hospitalizations reported a drug-related adverse event (Runciman et al., 2003). According to Patient Safety Practices Rated by Strength of Evidence (2001), 2–7% of all hospitalized patients are affected by medication errors. According to (Breckenkamp et al., 2007) medication errors injure 40,000 Germans per year and 12,000 drug-related incidents are under judicial review. Medication errors are the result of human error and thus can affect all aspects of the medication chain (Štrbová, 2013), i.e., they can arise during prescribing, ordering, storage, dispensing, preparation, and administration of medicines (Malý et al., 2009). Research carried out from 2012–2014 found that drug administration errors ranked third among the most common errors in nursing (Brabcová et al., 2015). These results show that proper education and training in pharmacology and pharmacotherapy is critical for nurses. However, the increasing demands being placed on nurses are starting to test the limits of standard nursing educations. Nurses not only need to have basic information about the medicines they administer, they also need to be well-versed in safety issues, storage, labeling, documentation, and disposal of medicines.

As part of our research, we surveyed, using a questionnaire, the working knowledge of nurses regarding day-to-day management and administration of medicines as well as their routine habits in this area. While results in some areas were good, results in other areas were alarming. Although the raw numbers were low, the percentages were significant, and given that these are daily activities that can routinely affect patient safety, they need to be improved. It is essential to understand that any medication error has the potential to be extremely serious or even fatal. As such, medication competence requires a solid knowledge base as well as the ability to apply this knowledge in real-life situations, which can often include complex and dynamic patient medication processes (Sulosaari et al., 2010).

During hospitalization, attending physicians are responsible prescribing medications and nurses is responsible for the proper and safe administration of the prescribed medications (Prošková et al., 2014). Nurses can only be held responsible medications administered to a patient from those medications the patient brought with them to the hospital. Although the Health Services Act requires that patients truthfully inform the attending healthcare professional, both doctors and nurses, regarding the medicines they brought from home, the Act does not have any real penalty for violation (Act No. 372/2011 Sb.). However, patients, as reported by Prošková et al. (2014) are obliged to abide by the internal rules of the medical institution and if they violate this obligation can be released from inpatient care. The physician is solely responsible for prescribing medication, which is noted in the patients record.

Oral prescription for medications, is only done by physicians and only in exceptional and properly justifiable situations, using a standardized procedure. In our research most nurses identified this as the correct response, with the exception of nurses from surgical and intensive care departments. Therefore, it can be assumed that in these departments, which often see unexpected changes in a patient's health, that attending physicians are more likely to verbally prescribe medications. Although Act No. 378/2007 Coll. on pharmaceuticals and the relevant implementing decree does not specify the method of prescribing medicines, it is important that the process is unambiguous, so as not to jeopardize the patient's safety. According to the United Accreditation Commission (SAK) standard (Marx and Vlček, 2013), hospitals should have a protocol for verbal or telephone prescription as part of its internal regulation. It is important that the internal regulation accurately defines what constitutes an "exceptional situation", which should, of course, be based on the patient's health. The internal regulation should also unconditionally respect the requirement of the Department Security Objective No. 6 – Procedure for verbal or telephone prescription of medicines. This requires full identification of the patient, complete identification of the physician, and the address of their office, which should be written down and read back to the physician to verify accuracy (Marx, 2013). It is not enough for the nurse listen to the doctor's prescription for the medicine and repeat it back to the doctor (calling person); it is always necessary to document the verbal or telephone prescription first and then read it back to the doctor. Only after the doctor confirms the correctness of the data read back, can the nurse administer the drug. Nevertheless, it must be remembered that oral prescriptions are more error prone, mainly due to miscommunications and misunderstandings inherent in verbal communications, e.g., similar sounding medicines, similar-sounding numbers, etc. (Prošková et al., 2014).

More than half of the nurses had good knowledge of potentially dangerous medications. The results show that nurses who responded correctly are also aware of their hospital's internal regulations and SAK standards for handling potentially dangerous medications (Marx and Vlček, 2013).

Results regarding the storage of medicines were so what alarming. Only 10% of nurses knew that medicines should be stored at 8–15 °C. Since incorrect storage temperatures can affect drugs quality and effectiveness, this lack of knowledge represents a risk to patients. According to Decree No. 84/2008 Coll. on Good Pharmacy Practices, the temperature for the storage of medicines should be continuously monitored and maintained within specified limits.

There was also room for improvement relative to how long certain drugs can be used after opening. Only half of the nurs-

es knew that it was necessary to follow the recommendation of the manufacture (SPC – Summary of Product Characteristics, Package Leaflet).

To ensure patient safety, it is desirable that medications be administered by the nurse who prepared them. Our research show that most nurses followed this practice. Similarly, two-thirds of nurses followed this practice with regard to the preparation of insulin.

Our results showed us that more than one-third of nurses, when faced with a missing medication, would find and administer as substitute or generic replacement. Although nurses receive some training in pharmacology they are not authorized or replace (find an alternative for) a missing drug, even if a drug-equivalent is found in the information system of medicinal products. In the event of an adverse reactions, nurses who fails to administer drugs exactly as prescribed by the patient's physician, are legally responsible. This restriction is primarily because different formulations can have different pharmacokinetics, which could have serious consequences. Another problem is that drug prices are not fixed in the Czech Republic, and hospitals buy different generics to save money. This is normally dealt with through close cooperation between pharmacists and doctors, information that nurses normally do not have access to. Additionally, electronic prescribing often restricts doctors to prescribing drugs that are available in the central hospital pharmacy (or in the ward pharmacy).

Regarding insulin injected into infusions, two-thirds knew the rules, although there were discrepancies between nurses with more and those with less experience in their current workplace. These results show that the experience has a positive effect on the consolidation of a nurse's knowledge. Educational and acquired knowledge is critical for theoretical competence, which, in addition to decision-making and practical competences, is the basis for overall competence in handling medications (Sulosaari et al., 2010). Medication competencies apply not only to the administration of drugs, but also the entire medication chain. A failure anywhere along the chain can lead to potentially serious or fatal medication errors (Brabcová et al., 2014).

Safe handling of medicines also includes the safe disposal of unused medicines. Unused drugs were considered to be hazardous waste by most nurses, and were sent back to the institutional pharmacy for disposal. The disposal of unused medicines is handled by those authorized to dispose of hazardous

waste (Act No. 378/2007). Proper disposal does not include toilets, sinks and trash cans (Abahussain et al., 2012). Appropriate disposal of unused and expired medicines is also essential to protect the safety of the natural environment (Bhayana et al., 2016).

## Conclusions

Based on the results of this study, while nurses generally have a working knowledge of how to handle and administer medicines, there are many areas where it needs to be improved. Other quantitative studies in other areas of nursing often have excellent results, but relative to the handling of medications some of the results were alarming. Any of the "incorrect" responses on the questionnaire, if actually used, could potentially lead to a medication error. Improving the overall process of getting the right medications to the right patient will require focusing on both the systemic and individual sources of medication errors that threaten patient safety. This approach needs to be integrated into the general risk management program of all health care facilities, as part of an effort to eliminated or reduced risks to patients. Our study indicates that nurses should be offered courses related to the handling and administration of medicines within the framework of lifelong learning (also known as "continuing education"). Furthermore, methods for increasing familiarization with new regulations and notices would also make a significant contribution to safe nursing care as it relates to the handling and administration of medicines.

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## Conflict of interests and ethical aspects

The authors declare that they have no conflicts of interest with respect to articles content or publication. The research plan was approved by the Ethics Committee of the University of South Bohemia in České Budějovice, Faculty of Health and Social Sciences. Respondents were prior informed of the purpose of the research and agreed to be their results included in the research file.

## Znalosti sester ve vztahu k zacházení s léčivými přípravky

### Souhrn

Podávání léčiv patří k rizikovým faktorům, které mohou ovlivnit bezpečnost pacienta. Manipulace s léčivými přípravky patří mezi každodenní činnosti sester. Sestry by neměly mít jen základní informace o podávaných lécích, ale je nutné, aby znaly i jejich uložení, označení, zabezpečení, dokumentování a likvidaci nepoužitých léciv. V rámci standardizovaného řízeného rozhovoru tazatele s respondentem jsme zjišťovali znalosti sester v oblasti nakládání s lécivy a jejich zvyklosti či zkušenosti v této oblasti.

Výběrový soubor tvořilo 1 202 sester a soubor byl reprezentativním vzorkem pro zdravotnická zařízení lůžkové péče České republiky z hlediska regionů a věku a byly zde zařazeny sestry z různých typů nemocnic.

V rámci výzkumného šetření 67,5 % sester uvedlo, že na jejich pracovištích je ústní ordinace léciv lékařem využívána pouze ve výjimečných případech. Přibližně stejná část sester z výzkumného souboru označila správné rizikové skupiny léciv. Pouze 10 % sester znalo správnou teplotu pro uchovávání léciv. Většina sester (64,9 %) provádí pravidelnou kontrolu expiračních dob léciv jednou týdně. Chronickou medikaci pacientů 72,6 % sester nikdy nepřipravuje s předstihem.

Na základě výsledků výzkumu lze konstatovat, že sestry sice znalosti o zacházení s léčivými přípravky mají, ale tyto znalosti jsou nedostačující. Je nutné si uvědomit, že podávání léciv je úkon nesmírně zodpovědný a každé opomenutí, každé špatné zacházení s lécivy může způsobit velmi závažnou, ne-li neřešitelnou komplikaci.

**Klíčová slova:** bezpečnost pacienta; lékové pochybení; manipulace s léčivými prostředky; znalosti sester

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