KNOWLEDGE OF DIABETES AS ONE OF THE FACTORS REQUIRED TO PROVIDE QUALITY INPATIENT NURSING CARE: A CROSS-SECTIONAL STUDY
ZNALOST DIABETU POTŘEBNÁ K POSKYTOVÁNÍ KVALITNÍ A BEZPEČNÉ OŠETŘOVATELSKÉ PÉČE V LŮŽKOVÝCH ZAŘÍZENÍCH: PRŮŘEZOVÁ STUDIE

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ABSTRACT
Background: Nurses bear responsibility for the daily care of persons with diabetes within the hospital environment. Insufficient knowledge of diabetes may have impact on safe care for hospitalized patients with diabetes.
Objectives: To evaluate both actual and perceived knowledge of diabetes among nurses at inpatient departments.
Design: A cross-sectional study that was carried out in November and December 2019.
Settings and participants: Registered nurses working in inpatient medical facilities in the Czech Republic.
Methods: A knowledge of diabetes questionnaire incorporating a standardized diabetes knowledge test (revDKT); 10 semi-open items focused on nursing care in diabetology, and 25 scale items focused on self-assessment in nursing care for people with diabetes was designed. Descriptive and regression analysis in an exploratory regime was used to analyse the data.
Results: 593 registered nurses voluntarily participated in the study (average age of 39 ± 10). Their knowledge corresponds to an average 57 % success rate in the test. The overall level of knowledge is positively correlated with the overall level of self-assessment, specialization of nurses, length of their practice, and the level of education attained.
Conclusions: Nurses working in hospitals have a lot of gaps in their knowledge of diabetes and its care. This study demonstrates the need for targeted educational activities in diabetes management for nurses working in inpatient facilities to secure safe care for patients with diabetes.

Key words: Diabetes mellitus. Inpatient care. Registered nurse. Knowledge. Self-assessment. Safe care

ABSTRAKT
Východiska: Sestry nesou odpovědnost za každodenní péči o osoby s diabetem v nemocničním prostředí. Nedostatečná znalost diabetu může mít dopad na bezpečnou péči o hospitalizované pacienty s diabetem.
Cíle: Zhodnotit aktuální i domnělou znalost diabetu u sester na lůžkových odděleních.
Design: Průřezová studie, která byla provedena v listopadu a prosinci 2019.
Nastavení a účastníci: Registrované sestry pracující v lůžkových zdravotnických zařízeních v ČR.

Metody: Znalost diabetologického dotazníku zahrnujícího standardizovaný test znalostí diabetu (revDKT); Bylo navrženo 10 polootevřených položek zaměřených na ošetřovatelskou péči v diabetologii a 25 škálových položek zaměřených na sebehodnocení v ošetřovatelské péči o osoby s diabetem. K analýze dat byla použita deskriptivní a regresní analýza v explorativním režimu.
Výsledky: Studie se dobrovolně zúčastnilo 593 registrovaných sester (průměrný věk 39 ± 10 let). Jejich znalosti odpovídají průměrné 57% úspěšnosti v testu. Celková úroveň znalostí pozitivně koreluje s celkovou úrovní sebehodnocení, specializací sester, délkou jejich praxe a úrovní dosaženého vzdělání.
Závěry: Sestry pracující v nemocnicích mají mnoho mezer ve znalostech diabetu a péče o něj. Tato studie prokazuje potřebu cílených vzdělávacích aktivit v léčbě diabetu pro sestry pracující v lůžkových zařízeních k zajištění bezpečné péče o pacienty s diabetem.

Klíčová slova: Diabetes mellitus. Lůžková péče. Registrovaná sestra. Znalost. Sebehodnocení. Bezpečná péče.

INTRODUCTION

Diabetes mellitus is one of the most serious and most widespread illnesses in the world (IDF, 2021; Saeedi et al., 2019)**.** In the Czech Republic, 10 % of the population regardless of age has been diagnosed with diabetes, while its prevalence in late adulthood categories is even higher (IHIS CR, 2021). Due to its increasing prevalence and its complications, diabetes is impacting the health and social care system (IDF, 2021). Patients with diabetes complications, or with other comorbidities, are sent by their doctors to medical facilities which provide inpatient care. In the Czech Republic inpatient care is provided as: a) acute standard inpatient care, b) acute intensive inpatient care, c) inpatient follow-up care, d) long-term inpatient care (Czech Republic. Act 372/2011 Coll.).

BACKGROUND

According to available data for 2019, there were over 2.368 million hospital discharges, with an average length of inpatient care of 6.0 days. There were 223 cases of hospitalization per thousand population. The largest proportion of hospitalizations (16 %) took place at internal medicine departments with an average length of care of 5.9 days. This includes hospitalization of patients with decompensated diabetes. Patients with diabetes dependent on insulin were treated for an average of 8 days in hospital, with other diabetes patients treated for 11 days (IHIS CR, 2021). It is known world-wide that persons with diabetes are hospitalized more often and for a longer period than other patients, and they have poorer clinical outcomes (Akiboye et al., 2021).

In recent years, the principles of treating diabetes for hospitalized patients have undergone rapid changes, specifically in terms of goals for setting blood glucose level (BG) and insulin regimens (ADA, 2021).

Nurses bear responsibility for the daily care of persons with diabetes within the hospital environment. They provide nursing care and education at various levels to patients with DM. Insufficient knowledge of current diabetes treatment trends may impact the quality of care and safety of hospitalized patients with diabetes, which can result in a longer hospital stay and an increased level of readmissions (Modic et al., 2014). Studies found in full-text databases of academic journals Web of Science, Pub Med, EbscoHost, Scopus (Chan et al., 2007; Drass et al., 1989; Gerard et al., 2010; Ahmed et al., 2012; Odili et al., 2010; Yacoub et al., 2014; Yacoub et al., 2015; Thomas et al., 2019) show that nurses working in hospitals have deficits in their knowledge of diabetes and diabetes care. The reason we undertook our study was that there is a lack of research in the Czech Republic providing valid information on the level of knowledge in diabetes management in this area. According to (Yacoub et al., 2015), a better understanding of evidence-based practices by nurses involved in the care of hospitalized individuals with diabetes can have a positive impact on care outcomes (Yacoub et al., 2015).

In 2019, there were 48,000 registered nurses working in acute inpatient care in the Czech Republic, with about 6,000 nurses working in follow-up and long-term care (IHIS CR, 2021). Some of the most common nursing interventions which inpatient nurses perform on diabetes patients include taking samples of blood and other biological material; blood glucose testing; administering food; checking physiological functions; administering medicines; injections, especially insulin application; resolving hypo/hyperglycaemia complications; educating patients or family members in insulin application and self-monitoring; dressing wounds and defects (including leg ulcers), etc. These and other interventions are performed by registered nurses holding various qualifications and specialist training (see Government Decree no. 164/2018 Coll. amending Government Decree no. 31/2010 Coll.). The question thus arises of whether the current education and training system implemented in the Czech Republic means that nurses are sufficiently prepared for nursing care of and educating persons with DM.

Our cross-sectional study was designed to ascertain and analyse the current knowledge and preparedness of nurses providing inpatient care regarding securing nursing care for persons with diabetes within the regions of the Czech Republic.

OBJECTIVE

Our objective was to ascertain the level of knowledge regarding diabetes mellitus and its management within compared groups of nurses working in the provision of inpatient care (in acute standard care, acute intensive care, follow-up care and long-term care) and determine the influence of overall self-assessment, age, length of practice in health care, qualifications and life-long learning, current work position including type of inpatient care, daily contact with persons with diabetes and number of diabetic persons treated on the overall level of general knowledge.

METHOD AND CHARACTERISTICS OF RESPONDENTS

A cross-sectional study was conducted on the selected sample of nurses in 2019. 593 registered nurses were included in the study (average age of 39 ± 10 years), working in the provision of inpatient care in the Czech Republic, and they were included in the study based on intentional selection. Respondents' sex did not play a role in their selection, and it was not ascertained. Respondents were assured of the anonymous nature of the research and asked not to give distorted information when filling in the test. When filling in the questionnaires, they were also informed in advance that by filling in and

submitting the questionnaire, they were consenting to it being processed.

The questionnaire contained a total of 68 items and comprised four sections. The first section ascertained respondents' socio-demographic details: their age, qualifications, specialist training in diabetology or a related field, length of practice in health care, current work position in general medicine surgery. The second part of the questionnaire contained 25 items focused on the level of self-assessment on a 5-point Likert scale (1 = very good level, 5 = very bad level) to establish subjectively perceived general knowledge and skills of nurses regarding nursing care for people with DM. Reliability of the self-assessment questionnaire was high (*Cronbach's alpha 0.930*). These items were produced in cooperation with a psychologist. The third section contained the 23-item standardized Diabetes Knowledge Test (DKT), which was developed, validated, and published by the Michigan Diabetes Research Training Centre (MDRTC) in 1998 to ascertain general knowledge about diabetes mellitus (Fitzgerald et al., 1998). The DKT contains 14 general knowledge items designed for persons with Type 1 and Type 2 diabetes (DM1T and DM2T) and 9 items designed for persons treated with insulin (Fitzgerald et al., 1998). The DKT was revised in 2015 ("revDKT") (Fitzgerald et al., 2016). The questionnaire is freely available, with the only condition being that its original authors be cited. The RevDKT was added to for the nurses with 10 semi-open items focused on nursing care and education in diabetology (Kudlová et al., 2020). Of the 23 closed items, a maximum of 23 points could be achieved. Of the 10 open items, a maximum total of 20 points could be achieved. The overall level of general knowledge is expressed by summing the points from the total of 33 knowledge items. This allowed a theoretical achievement of 0 – 43 points. Reliability of the knowledge test calculated on this sample of respondents is good (*Cronbach's alpha 0.849*). However, a limitation of the calculation of reliability is that the result is a value after connecting two different tests (the MDKT plus 10 semi-open items, provided that these 10 questions of own construction enabled the respondents to reach 0 – 2 points for each question, while they could reach 0 – 1 point on the MDKT). A total of 22 (9.5 %) of inpatient care providers within the Czech Republic out of a total of around 230 (i.e., university hospitals, hospitals, follow-up care hospitals, long-term care facilities, other specialist medical facilities) (see ÚZIS ČR, 2019) were included in the study.

A descriptive analysis was performed as part of the data analysis to characterize the research sample, followed by descriptive statistics. A regression analysis was subsequently performed to monitor the relations between the dependent variable (overall level of knowledge of DM) and selected independent variables (overall self-assessment, age, length of practice in health care, qualifications and life-long learning, current work position including type of inpatient care, daily contact with persons with diabetes and number of diabetic persons treated). This analysis was performed in exploratory mode. Emphasis was placed on the values of substantive significance, and not statistical significance, meaning that the results cannot be generalized.

RESULTS

Respondents' ages came to a mean of 39 ± 10, min. 21, max. 64 years. Other characteristics of respondents are in Table 1.

Respondents stated the activities they most commonly perform with diabetics. They most frequently (100 %) they undertake administration and measure physiological functions, 99 % measure diabetic patients' blood glucose levels, 91 % take blood samples, 89 % perform insulin application, 81 % administer anti-diabetic agents, 78 % treat defects/wounds, 58 % undertake leg ulcer prevention, 55 % provide education on food and lifestyle, 47 % provide broader education, 21 % work with an insulin pump, 6 % perform leg ulcer care and 2 % do dispensing. 281 respondents (47 %) said that they met diabetic patients within HHC daily, 227 (38 %) said frequently, 71 (12 %) said very little, and 14 (3 %) said they had no contact.

286 respondents (48 %) declare they have treated more than 200 patients with diabetes to the current time, 97 (16 %) declared more than 100, with the remaining respondents declaring a lower number of treated patients.

Regarding the sources of information respondents use to acquire information on diabetes mellitus, 584 respondents (99 %) said they used qualified studies, 416 (70 %) said experience, 305 (51 %) said from self-study, 272 (46 %) said from courses or seminars, 177 (30 %) said from conferences or sym-

Table 1 Characteristics of respondents

Categories and subcategories		Count	Column N
Length of practice in the health service	up to 10 years	224	38 %
	11 - 20 years	192	32 %
	21 and more years	177	30 %
Highest education level	ISCED 3ab	294	50 %
	ISCED 5	134	22 %
	ISCED 6-7	165	28 %
Current work position of registered nurses	without specialization	399	67 %
	with specialization	113	19 %
	with special expertise	81	14 %
Inpatient care type	acute standard inpatient care	322	54 %
	acute intensive inpatient care	166	28 %
	long-term and follow-up care	105	18 %
Daily contact with diabetic patients	No	312	53 %
	Yes	281	47 %
More than 100 diabetic patients treated in work to present time	No	210	35 %
	Yes	383	65 %

Table 2 Nurses' knowledge and work position

	Work position		
Categories	**acute standard inpatient care**	**acute intensive inpatient care**	**long-term and follow-up care**
	Success rate	Success rate	Success rate
Sum of points for 33 knowledge items	56 %	59 %	61 %
Q1 Knowledge: (Self-) management of diabetes and education	59 %	61 %	59 %
Q2 Knowledge: Insulin therapy, pharmacotherapy, and education	45 %	48 %	51 %
Q3 Knowledge: Lifestyle, diet, and education	49 %	54 %	54 %
Q4 Knowledge: Diagnostics and treating complications including education	72 %	77 %	82 %

Legend: Success rate (%) shows the percentage success rate achieved in the test (theoretically between 0 and 100%)

posiums, while other options (postgraduate studies, general lack of interest in information) were mentioned to a minimal extent. The overall level of self-assessment appears to be average 3.1 (± 0.6).

The third part of the questionnaire was focused on ascertaining the level of general knowledge of diabetes mellitus. The overall level of general knowledge is expressed by summing the points from the total of 33 knowledge items. This allowed a theoretical achievement of 0 – 43 points. Our respondents received between 9 and 43 points, with a mean value of 24.7 points, which represents a 57 % success rate in the test.

Considering the need to balance the results in individual areas, where different maximum points could be achieved in different areas, the following table presents the points score as a percentage success rate.

In Table 2, we do not see major (practically significant) differences across the groups. Differences are only evident when looking at the different areas, with all groups demonstrating their best results in the Q4 area, while the weakest results are in the Q2 area.

A regression analysis was also performed in order to ascertain the relationship between the overall level of general knowledge (dependent variable) and these independent variables: (1.) overall level of self-assessment; (2.) age in years; (3.) length of practice in the health service; (4.) highest education level; (5.) current work position of respondents; (6.) inpatient care type; (7.) daily contact with diabetic patients; (8.) more than 100 diabetic patients treated in work to present time. More information about categories of categorical variables is in Table 1.

We performed a classical multiple linear regression using the ENTER method. The model (F =

Table 3 Model of regression analysis

Categories	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	VIF
	B	Std. Error	Beta			
(Constant)	32.818	2.118	-	15.498	0.000*	-
Overall self-assessment	-3.917	0.405	-0.372	-9.681	0.000*	1.190
Age	0.005	0.046	0.007	0.100	0.920	3.972
Practice up to 10 years (ref. cat)						
Practice of 11-20 years	1.638	0.776	0.115	2.111	0.035*	2.411
Practice of 21 or more years	2.360	1.123	0.163	2.101	0.036*	4.867
Education ISCED 3ab (ref. cat)						
Education ISCED 5	1.326	0.719	0.084	1.845	0.066	1.654
Education ISCED 6-7	2.148	0.629	0.145	3.415	0.001*	1.453
GN without specialization (ref. cat)						
GN with specialization	4.871	0.646	0.289	7.536	0.000*	1.186
GN with special expertise	1.378	0.739	0.071	1.863	0.063	1.179
Acute standard inpatient care (ref. cat)						
Acute intensive inpatient care	0.836	0.573	0.057	1.460	0.145	1.210
Long-term and follow-up care	2.265	0.711	0.130	3.184	0.002*	1.349
Daily contact with diabetic patients	-0.698	0.535	-0.053	-1.305	0.193	1.308
Over 100 treated patients	0.220	0.550	0.016	0.399	0.690	1.267

Legend: B = unstandardized coefficient Beta, t = test criteria, Siq. = value of statistical significance (* indicates statistically significant values at the 5% significance level), VIF = Variance Inflation Factor, ref. cat = reference category serving as a basis for comparison with the other observed categories of the given variable.

18.679; df = 12; p ≤ 0.001) characterizes an overall level of explained variance of 28 % (according to the R^2 co-efficient; or in adjusted form 26 %). The resulting model is shown in Table 3.

Focusing on levels of substantive significance in unstandardized (B) and standardized (Beta) form, we can say that the overall level of knowledge positively correlates with the overall level of self-assessment (the higher the self-assessment, the higher the knowledge).

With each increase in self-assessment of one point on the five-point scale, the number of points received increases by almost four (note, the scale is set from 1 – very good to 5 – very bad level of self-assessment, therefore the value in the table is negative). The relationship to nurses' specialization is also significant, with nurses with specializations receiving roughly five points more in the test compared to nurses with no specialization. In third place is the correlation with length of work experience, with experience of over 21 years resulting in receiving more than 2 extra points. Attaining higher education (ISCED 6 – 7) leads to receiving two extra points compared to those with lower education. Other predictors appear to have less impact. The values measured to check for multicollinearity in

the model are within the norms (VIF in all cases < 10).

DISCUSSION

The inpatient treatment of diabetes has been the subject of much attention in recent years. The people with diabetes are hospitalized more frequently and for longer than other patients. They are often hospitalized due to comorbidities/ complications rather than the primary diagnosis, and they have worse clinical outcomes and a higher proportion of readmissions (Akiboye et al., 2021; Drincic et al., 2017; Modic et al., 2014; Roschkov et al., 2021). Hospitalized patients with diabetes often acquire hypoglycaemia in hospital, or they are discharged without receiving sufficient education. Yet managing hypoglycaemia has become an important indicator of care quality within the inpatient environment (Cornish, 2014; Hughes et al., 2021).

As such, patients with DM should be treated at facilities or at sites where treatment can be provided at an appropriate level according to type of diabetes and severity, and in accordance with standard recommended procedures (ADA, 2019; Davies et al., 2018). The involvement of an educated and competent multidisciplinary team is crucial in securing

safe, effective evidence-based care (Thomas et al., 2019).

Our study, however, has revealed a deficit in knowledge of diabetes amongst nurses in inpatient departments (Tables 1, 2). Our respondents gained a mean of 24.7 points in the knowledge test, representing a 57% success rate in the test. Within the questions contained in the revDKT test, the poorest success rate was seen for Question 4, focused on amount of sugar in a carbohydrate unit (35% gave the correct answer), while the highest success rate was for Question 19 focused on what a diabetic person should do in the event of hypoglycaemia (98% correct). Although the nurses were able to select the right answer in the revDKT test regarding insulin therapy, in the follow-up open questions they were not as sure. In general, they are not aware of the latest trends in insulin therapy, administering antidiabetic agents, and in (self) management of diabetes. The overall 57% success rate in the DM knowledge test is insufficient considering the announced increase in competences of registered nurses without specialization, and those with specialization in prescription and other areas. Inpatient nurses' knowledge regarding self-management and education, insulin therapy, pharmacotherapy and education, lifestyle, diet, and education is below average. Nurses only received more points in their knowledge of diagnostics and treating complications (over 70% success rate, for long-term and follow-up care nurses as much as an 82% success rate). In our opinion, this is because nurses rely on doctors more in acute departments, performing only routine activities which they are specifically instructed to carry out by doctors. At long-term and follow-up care departments, nurses deal with complications more frequently, considering the lack of doctors at these sites. Unfortunately, other studies looking at ascertaining diabetes knowledge have demonstrated a general lack of knowledge amongst healthcare workers, especially inpatient nurses (Abduelkarem & El-Shareif, 2013; Ahmed et al., 2012; Haugstvedt et al., 2016; Ndebu et al., 2018; Thomas et al., 2019; Trepp et al., 2010; Yacoub et al., 2014). The authors of these and other studies concur that it is important to educate nurses further regarding DM, as only in this way can patients with DM be given optimal care. They recommend expanding the content of DM teaching in the curricula for nursing qualifications and stress the necessity of further life-long training of nurses in this field (Daly et al., 2019; Haugstvedt al., 2016; Hollis et al., 2014).

The increasing number of hospitalizations of DM patients also demonstrates the importance of continuity of care when patients transfer from inpatient to outpatient providers (Black & Duval, 2019). Considering the limited time to educate the patient or to optimize diabetes care during hospitalization, some countries have introduced diabetes inpatient specialist nurses, case managers and other nursing positions (Akiboye et al., 2021; Black & Duval, 2019; Drincic et al., 2017; Lawler et al., 2021). In a systematic review, authors Akiboye et al. (2021) confirmed the benefit of nurses specialized in diabetology in the inpatient environment. Studies have shown that places where these nurses work have seen a reduction in total errors made in administering medicine, improved patient knowledge, greater patient satisfaction, improved glycemic control following discharge, reduced readmission levels, etc.

In our study, the overall level of knowledge positively correlated with the overall level of self-assessment. Important here is also the relation to nurses' specialization, with nurses with a specialization receiving five points more in the test compared to nurses without specialization.

In third place is the correlation with qualification and education, with those who have attained higher education receiving two points more compared to those with secondary education. Other predictors appear to be unimportant in terms of substantive significance. This raises the question of how we should give nurses the adequate knowledge they need to ensure high quality and safe nursing care for clients with DM. One possible solution to the current unfortunate situation is to include the subject of diabetology as one of the obligatory subjects within curricula for qualification. Another option is to create an education program comprising a certified course which would correspond to the practice and scope of activities undertaken by registered nurses. The content of the course, however, needs to be adapted to the latest findings in diabetology and progress in smart technologies. Educational technology and the use of webinars appear to provide new opportunities for sharing knowledge, having shown good results in several studies (Benson, 2004; Tschannen, 2013). Specialist organizations and experts recommend the systematic organization of inpatient diabetology services headed by a diabetolo-

gist providing regular training and support to residents and nurses, something which is missing in many healthcare facilities. In hospitals with no diabetologist, this training can be taken on by nurses who are specialists in diabetes. The role of a Diabetes Management Mentor is another way for nurses to improve their clinical knowledge base and acquire skills in diabetes (Modic et al., 2012).

However, registered nurses need to be trained not just once, but repeatedly. Only in this way can their knowledge continue to consolidate and expand to incorporate new trends in diabetology (Cardwell, 2016; Hearnshaw et al., 2004; Herring et al., 2013; Kudlová, Kočvarová, 2020; Rubin et al., 2007).

CONCLUSION
Nursing staff play an important role in diabetes management for hospitalized patients. We found in our study that care for diabetes patients in inpatient facilities was provided by registered nurses with various types of professional qualifications and specializations who have a low level of knowledge of the area. This study demonstrates the need for targeted educational activities in diabetes management for nurses working in inpatient facilities.

Implications
The results of our study can help the government in making political decisions to identify gaps in required knowledge of diabetes management and help implement the required and expected knowledge of diabetes within nursing qualification courses and life-long education.

Study limits
Our results are based on intentional sampling, which is not strictly representative. Thus, we do not think that our results can be generalized, and in interpreting them we do not focus on results of statistical significance. Considering the size of the research sample and the complexity of the regression model, we chose to reduce the number of some sub-categories, but this does not have a fundamental impact on the results obtained.
The results of our study are not directly comparable to the results of other similar studies, because in addition to the standard 23 revDKT test items our questionnaire also included 10 original questions created solely for the purposes of this study.

Ethical Approval
The questionnaire was approved by the management of selected medical facilities where targeted distribution was requested. The name of a specific medical facility was not requested as information in the questionnaire. For respondents there were no complications or possible risks ensuing from participating in the research. All respondents were informed in a document accompanying the questionnaire that their participation in the study was voluntary. By submitting the questionnaire, they gave approval with its anonymous processing. The research was conducted in nurses who had shown interest in it and were willing to fill the form out voluntarily. The questionnaires were filled out anonymously. Right after collecting the questionnaires, it was not possible to identify the persons who had filled them out.

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