

PART I. DISEASES AND PROBLEMS DISTINGUISHED BY WHO AND FAO
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KNOWLEDGE OF DIABETES AMONG CZECH OUTPATIENT NURSES TO PROVIDE
QUALITY CARE AND EDUCATION TO DIABETICS:
A CROSS-SECTIONAL STUDY

WIEDZA NA TEMAT CUKRZYCY WŚRÓD CZESKIEGO AMBULATORyjNEGO PERSONELU
PIELĘGNIARSKIEGO W CELU ZAPEWNIENIA CUKRZYKOM WYSOKIEJ JAKOŚCI OPIEKI
I EDUKACJI: BADANIE PRZEKROJOWE

Pavla Kudlová^{1(A,B,D,E,F,G)}, Ilona Kočvarová^{1(C,D)}

¹Faculty of Humanities, Tomas Bata University in Zlín, Czech Republic

Authors' contribution

Wkład autorów:

A. Study design/planning

zaplanowanie badań

B. Data collection/entry

zebranie danych

C. Data analysis/statistics

dane – analiza i statystyki

D. Data interpretation

interpretacja danych

E. Preparation of manuscript

przygotowanie artykułu

F. Literature analysis/search

wyszukiwanie i analiza literatury

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Summary

Background. Currently, 1 million diabetics (i.e., 10% of Czech people) in the Czech Republic use outpatient services. Nurses are key members of outpatient health care. The aim of the study was to evaluate knowledge about diabetes among outpatient registered nurses.

Material and methods. A cross-sectional quantitative study, using a standardized questionnaire, was conducted on a sample of 441 outpatient registered nurses in 2019-2020. Descriptive and regression analysis in an exploratory regime was used to analyze the data.

Results. Respondents achieved 7-43 points (26 on average), which corresponds to a 60% success rate on the knowledge test. The best results regarding knowledge of diabetes mellitus were achieved by nurses working in diabetology outpatient departments (10 points more than other outpatient departments according to a regression analysis). On the other hand, no correlation between the length of practice or age of registered nurses was proven.

Conclusions. Nurses providing primary care or other specialist care to people with diabetes do not have the knowledge to provide quality care and education to them. Therefore, greater attention must be paid to educating outpatient nurses in diabetes management.

Keywords: registered nurses, quality care, diabetics, diabetes, education

Streszczenie

Wprowadzenie. Obecnie z opieki ambulatoryjnej w Czechach korzysta 1 milion diabetyków (tj. 10% Czechów). Pielęgniarki i pielęgniarze są kluczowymi członkami ambulatoryjnej opieki zdrowotnej. Celem badań była ocena wiedzy na temat cukrzycy wśród dyplomowanych pielęgniarek i pielęgniarzy ambulatoryjnych.

Materiał i metody. W przekrojowym badaniu ilościowym wykorzystano standaryzowaną ankietę, przeprowadzoną na próbie 441 dyplomowanych pielęgniarek i pielęgniarzy ambulatoryjnych w latach 2019-2020. Do analizy danych wykorzystano analizę opisową i regresyjną w trybie eksploracyjnym.

Wyniki. Respondenci uzyskiwali od 7 do 43 punktów (średnio 26), co odpowiada 60% skuteczności w teście wiedzy. Najlepsze wyniki w zakresie wiedzy na temat cukrzycy uzyskał personel pielęgniarski pracujący w przychodniach diabetologicznych (według analizy regresji o 10 punktów więcej niż dla pozostałych oddziałów ambulatoryjnych). Nie wykazano natomiast korelacji pomiędzy stażem pracy a wiekiem dyplomowanych pielęgniarek i pielęgniarzy.

Wnioski. Pielęgniarki i pielęgniarze sprawujący podstawową opiekę lub inną specjalistyczną opiekę nad osobami chorymi na cukrzycę nie mają wiedzy, która umożliwiłaby im zapewnienie wysokiej jakości opieki i edukacji. Dlatego też należy zwrócić większą uwagę na edukację ambulatoryjnego personelu pielęgniarskiego w zakresie postępowania w cukrzycy.

Słowa kluczowe: dyplomowany personel pielęgniarski, wysokiej jakości opieka, diabetycy, cukrzyca, edukacja

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Address for correspondence / Adres korespondencyjny: Pavla Kudlová, Faculty of Humanities, Tomas Bata University in Zlín, Štefánikova 5670, 760 01 Zlín, Czech Republic, e-mail: kudlova@utb.cz, phone: +420 57 603 2008

ORCID: Pavla Kudlová <https://orcid.org/0000-0002-4997-790X>, Ilona Kočvarová <https://orcid.org/0000-0002-7070-7998>

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Introduction

Diabetes mellitus (DM) poses a significant global health challenge, imposing a considerable financial burden on individuals and for society [1-4]. Presently, one million people in the Czech Republic (10% of the population) utilize outpatient services for diabetes management. Primary prevention aims to delay diabetes onset, while secondary and tertiary prevention can mitigate complications and reduce premature deaths [5].

To address the rising diabetes prevalence, the American Diabetes Association (ADA) issues annual clinical practice recommendations for healthcare providers, including outpatient care providers [1,5-8]. Outpatient care is provided in both state and private healthcare facilities, with over 220 thousand diabetes patients treated in approximately 3,000 general practitioner surgeries (type 2 only), and 780 thousand patients treated in specialist outpatient clinics (type 1 and 2) [9]. Nurses, comprising 28,000 registered members with various qualifications, professional education, and competences [10,11], play a crucial role in outpatient healthcare teams. Given the inconsistency among countries regarding nurses' knowledge and competences in diabetes management [3], understanding the knowledge levels of Czech outpatient nurses is essential.

Outpatient care encompasses primary, secondary, and tertiary care for individuals with diabetes. Primary outpatient care aims to provide preventive, diagnostic, and medical care, expertise, consultation, and ensure continuity of healthcare services. Expert nursing knowledge and skills are crucial for improving diabetic care outcomes [12,13]. In the Czech Republic, outpatient nurses are responsible for administering medication, providing nursing care, and educating patients about diabetes treatment regimens and lifestyle changes. However, unlike in some other countries (e.g., the United Kingdom, Sweden, or the Netherlands), nurses in the Czech Republic do not have the authority to prescribe certain drugs or medical aids [3,4,14]. Studies on internationally or nationally agreed roles or responsibilities for non-specialist nurses in diabetes care are lacking [3]. There is a growing expectation that registered nurses in the Czech Republic should possess greater knowledge, skills, and competences when working in outpatient clinics. However, the practical reality remains uncertain. Previous studies abroad [15-21] have indicated a lack of knowledge among nurses in primary and follow-up care, emphasizing the importance of exploring this issue in the Czech Republic.

Aim of the work

Our goal was to assess the level of knowledge and self-assessment regarding diabetes mellitus among nurses working in outpatient care. Additionally, we aimed to determine the influence of overall self-assessment, age, length of practice in healthcare, qualifications and education, current work position, type of outpatient care, daily contact with persons with diabetes, and the number of diabetic persons treated on the overall level of general knowledge.

Material and methods

Our cross-sectional study was designed to ascertain and analyze the current knowledge and preparedness of registered nurses in outpatient care regarding securing nursing care for persons with diabetes within the regions of the Czech Republic. A total of 441 registered nurses, actively engaged in providing outpatient care in the Czech Republic, were included in the study through intentional sampling. Questionnaires were distributed among the respondents in 2019. Among them, 237 (54%) worked in primary outpatient care, 97 (22%) in specialist outpatient care focused on other diseases and 107 (24%) in specialist outpatient care with an emphasis on diabetology/endocrinology. The respondents' gender did not play a role in their selection, and thus it was not recorded. The respondents were assured of the anonymous nature of the research and asked not to give

distorted information when filling out the test. All respondents were informed in a document accompanying the questionnaire that their participation in the study was voluntary.

The questionnaire comprised a total of 68 items distributed across four sections. The first section gathered socio-demographic details, including age, qualifications, specialist training in diabetology or a related field, and length of practice in healthcare. The second section consisted of 25 items focused on self-assessment, measuring respondents' knowledge and skills related to nursing care for people with diabetes. These items were developed in collaboration with a psychologist and a special needs teacher. The third section contained a 23-item standardized Diabetes Knowledge Test (DKT) [22]. The DKT encompassed 14 general knowledge items for individuals with type 1 and type 2 diabetes (DM1T and DM2T) and nine items for those treated with insulin. The DKT underwent revision in 2015 ("revDKT") [23]. The questionnaire is freely available, with the only condition being that its original authors be cited. 10 semi-open items primarily created to determine the knowledge of participants of a certified course focused on nursing care and education in diabetology were added to this revDKT.

All the respondents were informed at the beginning of the questionnaire that their participation in the study is voluntary and that by submitting the completed questionnaire, they consent to its anonymous processing.

A descriptive analysis and a regression analysis were conducted as part of the data analysis, to monitor the relations between the dependent variable (overall level of knowledge of diabetes) and selected independent variables. This analysis was conducted in exploratory mode. Emphasis was placed on values of substantive significance, not values of statistical significance, meaning the results cannot be generalized.

Ethical approval

This study was consulted by the relevant ethical commission in the Tomas Bata University in Zlín, the Czech Republic. The questionnaire was approved by the management of selected medical facilities where targeted distribution was requested. All the respondents were informed in a document accompanying the questionnaire that their participation in the study was voluntary. Within the research, no personal data was processed. The research was conducted with nurses who had shown interest in it and were willing to fill the form out voluntarily. The questionnaires were filled out anonymously. After being collected, it was not possible to identify the persons who had filled them out.

Results

The mean age of respondents was 40.9 ± 10.0 , with a range of 22 to 66 years. 7 respondents (2%) said they had had practice of up to one year, 66 (15%) up to five years, 69 (16%) up to 10 years, 50 (11%) up to 15 years, 66 (15%) up to 20 years, 99 (22%) up to 25 years, and 84 (19%) said they had had practice of 26 or more years. As such, these are mainly experienced health care workers, of whom a total of 249 (56%) had practiced for over 15 years. A total of 311 respondents (71%) said they had completed secondary education, and 130 respondents (19%) said they had completed higher education (56 a bachelor's degree, 26 a master's degree), or college education (total of 46). A total of 328 respondents (74%) work as registered nurses (RN) without specialization, 56 (13%) work as RN with a specialization, 57 (13%) work as RN with special expertise (SE).

237 respondents (54%) work in primary outpatient care, 97 (22%) work in specialist outpatient care with a focus on other diseases, and 107 (24%) work in specialist outpatient care with a focus on diabetology/endocrinology.

The respondents stated the activities they most commonly undertook with diabetic patients. They most frequently (100%) undertake administration, measure physiological functions, 94% measure diabetic patients'

blood glucose levels, 84% take blood samples, 57% treat defects/wounds, 55% provide education on diet and lifestyle, 52% apply insulin, 47% undertake leg ulcer prevention, 37% administer antidiabetic agents, 31% provide broader education, 31% do dispensing, 10% work with an insulin pump and 4% care for foot ulcers. 176 respondents (40%) said that they encountered diabetic patients daily, while the rest said they did so less frequently. 251 respondents (57%) declared they had treated more than 100 diabetic patients to date.

Regarding the sources of information the respondents use to acquire information on diabetes, 100% said they used qualified studies, 59% respondents said general courses, 53% said self-study, 51% said they get their information directly from practice, 45% take part in conferences or symposiums, and 36% use certified or specialist courses.

The second part of the questionnaire contained 25 items focused on the level of self-assessment regarding knowledge and skills in diabetology. These items were divided into four areas. Table 1 shows the results for these areas and overall results. The reliability of the self-assessment questionnaire was high (Cronbach's alpha 0.930).

Table 1. Results in self-assessment areas, and overall

Self-assessment areas	Mean	SD	Minimum	Maximum
1. (Self-)management of diabetes and education	2.98	0.75	1.17	4.83
2. Insulin therapy, pharmacotherapy, and education	3.13	0.77	1.17	5.00
3. Lifestyle, diet, and education	3.19	0.82	1.17	5.00
4. Diagnostics and treating complications including education	3.10	0.73	1.00	5.00
Overall self-assessment	3.10	0.72	1.24	4.92

Notes: SD = standard deviation.

Regarding the different areas, the self-assessment scores do not differ greatly, with central values on the scale (3) seen in all cases. We can say that the nurses' self-assessment is average (neither positive nor negative).

The third part of the questionnaire was focused on ascertaining the level of general knowledge of diabetes mellitus by using revDKT [23,24]. The questionnaire was used to test nurses and nursing students in a number of studies [18,20,24-26]. A maximum of 23 points could be achieved from the 23 closed items, and a maximum of 20 points could be achieved from the 10 open items.

The overall level of general knowledge (the sum of the points from the total of 33 knowledge items) could range between 0 and 43 points. The 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).

Our respondents achieved 7-43 points, with an average of 26 points, representing a 60% success rate in the test. The primary outpatient care nurses achieved an average of 22 points, as did the nurses in outpatient care specializing in other diseases. Nurses working in outpatient care, focused on diabetology/endocrinology, received an average of 38 points, which was significantly higher. A comparison of all groups in descriptive terms is shown in Table 2. Since a different total number of points could be achieved in different areas, the points have been converted to percentages (percentage success rate) so that the results in the table are comparable.

Table 2. Nurses' knowledge and work position

Theme areas	Work position		
	Primary outpatient care	Specialist outpatient care with a focus on other diseases	Specialist outpatient care with a focus on diabetology/ endocrinology
	Success rate (%)	Success rate (%)	Success rate (%)
1. Knowledge: (self-)management of diabetes and education	52	57	91
2. Knowledge: insulin therapy, pharmacotherapy, and education	38	40	86
3. Knowledge: lifestyle, diet, and education	47	48	88
4. Knowledge: diagnostics and treating complications including education	73	68	92
Sum of points for the 33 knowledge items	52	52	89

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

In terms of descriptive analysis, it is evident that there is a marked difference between the results of nurses working in specialist outpatient care focused on diabetology/endocrinology, compared with the other two groups of nurses examined. The nurses specializing in diabetology/endocrinology show significantly better results both overall and in individual areas. We do, however, need to consider the fact that in the descriptive analysis of the results in Table 2, we are only looking at two dimensions of reality (level of knowledge and nurses' work position). The subsequent regression analysis allows us to monitor all the required dimensions of reality at once (in one complex model) and using this means, the results will be a lot more precise.

A regression analysis was also conducted to ascertain the relationship between overall level of general knowledge (the dependent variable) and independent variables, whose descriptive results are presented above.

Dependent variable:

1. overall level of general knowledge (sum of points for the total of 33 knowledge questions).

Independent variables:

1. overall level of self-assessment (the mean for 25 items assessed on a scale of 1-5, with the lower the value, the more positive the self-assessment); therefore, negative values in the regression analysis table reflect a positive relationship with the overall level of knowledge and vice versa),
2. age,
3. length of practice in the health service (for purposes of the analysis, this was simplified to two categories: up to 15 years and over 15 years); 192 respondents (44%) fall under the first category, and 249 (56%) come within the second,
4. education and qualifications (for the purposes of the analysis, this was simplified to two categories: secondary (311; 71%) and college or higher (130; 19%)),
5. current work position of the respondents (for the purposes of the analysis, this variable was simplified to two categories: RN with no specialization and RN with specialization/special expertise); 113 respondents (26%) fall under the category of RN with specialization, while the majority (328; 74%) come within the category of no specialization,

6. type of outpatient care; 237 respondents (54%) work in primary outpatient care, 97 (22%) work in specialist outpatient care with a focus on other diseases and 107 (24%) work in specialist outpatient care with a focus on diabetology/endocrinology,
7. daily contact with persons with diabetes; this includes 176 respondents (40%), compared with less frequent contact of 265 respondents (60%),
8. more than 100 diabetic patients have been treated to date.

Wherever variables were reduced into a smaller number of categories, this was carefully considered beforehand, primarily taking into the size of individual categories (categories which are too small would lead to unnecessary complication of the model) and also on previous comparison of results in these particular groups (so as not to eliminate core findings as a result of simplifying categories).

A multiple linear regression was performed using the enter method. The model ($F=95.612$; $df=9$; $p \leq 0.005$) characterizes an overall level of explained variable of 67% (according to the R^2 co-efficient; or in adjusted form 66%). The resulting model is shown in Table 3.

Table 3. Regression analysis model

Independent variables	Nonstandard. Coef.		Standard. Coef.	T	Sig.	Collinearity Statistics
	B	Std. Error	Beta			Tolerance
(Constant)	29.042	2.179	-	13.326	0.000	-
Overall self-assessment	-3.127	0.498	-0.251	-6.276	0.000	0.486
Age	0.070	0.042	0.078	1.672	0.095	0.357
Experience of over 15 years (vs. experience of up to 15 years)	0.476	0.814	0.026	0.585	0.559	0.386
RN with specialization or special expertise (versus RN with no specialization)	2.314	0.802	0.112	2.885	0.004	0.513
College or higher education (vs. secondary)	2.606	0.666	0.119	3.911	0.000	0.832
Specialist outpatient care – other diseases (vs. primary outpatient care)	-0.413	0.697	-0.019	-0.593	0.554	0.755
Specialist outpatient care – diabetology/ endocrinology (vs. primary outpatient care)	10.297	0.985	0.490	10.452	0.000	0.353
Daily contact with persons with diabetes (vs. less frequent contact)	-1.204	0.677	-0.065	-1.777	0.076	0.572
Over 100 diabetic patients treated to date (vs. up to 100 treated)	1.051	0.645	0.058	1.628	0.104	0.616

Notes: B = unstandardized coefficient Beta, t = test criteria, Sig. = value of statistical significance, RN - registered nurses.

In interpreting this table, the levels of non-standardized and standardized Beta coefficients were examined (Table 3).

The strongest influence on the overall level of knowledge is clearly working in specialist outpatient care with a focus on diabetology/endocrinology, which increases the overall score in the test by more than 10 points

compared with nurses working in primary outpatient care. To add further context, we can also say that nurses working in outpatient care specializing in other diseases achieve approximately the same results as nurses working in primary outpatient care.

In second place is the overall level of self-assessment. The value of the model is negative (in the case of self-assessment, the scale is reversed, i.e., 1 is very good, 5 very bad). That is why a negative value here is assessed as 'positive'. Nurses with high self-assessment levels show a higher level of actual knowledge.

In the third place is the influence of educational attainment, where nurses with a college degree or a higher education degree achieve almost three extra points on the test compared with nurses who have only secondary education. This result would appear logical, as better education would imply better knowledge.

In the fourth place is the positive influence of specialization, where nurses with specialization or special expertise achieve over two extra points on the test compared with nurses with no specialization. The effect of the other predictors is weaker and appears inconclusive compared to those mentioned above.

The values measured to check for multicollinearity in the model are within the norms (tolerance in all cases > 0.2).

Discussion

In the Czech Republic, as in other parts of the world, the population is aging. With aging, the prevalence of chronic diseases (such as DM type 2, cardiovascular diseases, etc.) increases. Moreover, in the Czech Republic, we are confronted with a shortage of doctors and nurses. Consequently, there is a need to reorganize healthcare and enhance the competences of registered nurses, particularly in outpatient care. This is in agreement with the recommendations of the World Health Organization (WHO). Hence, the Czech Department of Health is presently undertaking initiatives to bolster competences for nurses.

The development of new competences should be considered in legislation addressing the education and competences of non-medical healthcare personnel. Additionally, legislation related to medical devices should enable nurses to write prescriptions. Moreover, amendments to the act on public health insurance are crucial to ensure subsequent reimbursements from health insurance companies.

Our aim was to ascertain the level of knowledge regarding diabetes mellitus (DM) among nurses working in outpatient care before we support the initiative to increase the competence of registered nurses. We found that nurses working in primary outpatient care and nurses working in specialist outpatient care for other diseases than diabetes show little knowledge of diabetes management (a 52% success rate on the test). As could be anticipated, nurses working in diabetology/endocrinology clinics do much better in terms of knowledge (89% success rate on the test). The item which gave the nurses the greatest problems was Question 8 (what should not be used to correct hypoglycemia), with a 48% success rate, while in contrast a 98% success rate was achieved in Question 19 (what a diabetic person should do when they suffer from a hypoglycemic reaction). The strongest positive influence on the overall level of knowledge was working in specialist outpatient care, with a focus on diabetology/endocrinology. A college or higher education degree also had a positive influence on the result of the knowledge test. Better results were also achieved by nurses with a specialization or specialist expertise (Table 3). At the same time, our study has proven registered nurses in primary outpatient care do not possess the necessary knowledge to provide education regarding diabetic persons' lifestyle (only a 47% success rate on the test, Table 2), despite the fact they are authorized to do so. Studies [9,14,16,24,26] have demonstrated the effectiveness of postgraduate education in diabetes. Education in diabetology needs to be addressed in the undergraduate education of nurses. At several universities (Tomáš Baťa University in Zlín, Palacký University in Olomouc), the subject of diabetology has been an optional choice for 10 years and is widely chosen by students for its practical utility.

Conclusions

We recognize the need to enhance the competencies of nurses in primary and secondary care. However, the study indicates that nurses in primary outpatient care and those in specialized care for diseases other than diabetology exhibit a low level of knowledge about diabetes (52% success rate in the test).

To improve the quality of care in outpatient facilities, clear definitions of nurses' competencies and educational requirements are recommended. Currently, we are exploring the options for both undergraduate and postgraduate education for nurses.

Based on initial findings, we recommend implementing specialized courses in diabetology as part of lifelong learning for outpatient nurses. In undergraduate education, we suggest supplementing the curriculum with a diabetology subject, at least as an option.

These changes in education should be reflected in the Health 2030 strategic plan. The results will also be communicated to the Ministry of Health of the Czech Republic, which is preparing measures to increase the competencies of primary nurses.

Study limits

While the study provides unique insights into the Czech context, its limitations include a non-representative research sample due to intentional sampling. The relatively small sample size necessitated simplifying variable categories in regression analysis. Despite these limitations, the study's robust regression model explains 66% of the variability in the dependent variable, incorporating key variables that significantly influence knowledge levels.

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References:

1. ADA–American Diabetes Association. 5. Lifestyle Management: Standards of Medical Care in Diabetes-2019. *Diabetes Care*. 2019; 42(Suppl. 1): S46-S60. <https://doi.org/10.2337/dc19-S005>.
2. International Diabetes Federation. *IDF Diabetes Atlas*. 10th edition. Brussels: International Diabetes Federation; 2021.
3. Nikitara M, Constantinou CS, Andreou E, Diomidous M. The role of nurses and the facilitators and barriers in diabetes care: a mixed methods systematic literature review. *Behav Sci (Basel)*. 2019; 9(6): 61. <https://doi.org/10.3390/bs9060061>.
4. World Health Organization. *Global Report on Diabetes*. Paris: WHO; 2016.
5. ADA–American Diabetes Association. 2. Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes-2021. *Diabetes Care*. 2021; 44(Suppl. 1): S15-S33. <https://doi.org/10.2337/dc21-S002>.
6. Johnson TM, Murray MR, Huang Y. Associations between self-management education and comprehensive diabetes clinical care. *Diabetes Spectrum*. 2010; 23(1): 41-46. <https://doi.org/10.2337/diaspect.23.1.41>.

7. Robbins JM, Thatcher GE, Webb DA, Valdmanis VG. Nutritionist visits, diabetes classes, and hospitalization rates and charges: the Urban Diabetes Study. *Diabetes Care*. 2008; 31(4): 655-660. <https://doi.org/10.2337/dc07-1871>.
8. Steinsbekk A, Rygg LØ, Lisulo M, Rise MB, Fretheim A. Group based diabetes self-management education compared to routine treatment for people with type 2 diabetes mellitus. A systematic review with meta-analysis. *BMC Health Serv Research*. 2012; 12: 213. <https://doi.org/10.1186/1472-6963-12-213>.
9. Karen I, Svačina S. Recommended diagnostic and therapeutic procedures for general practitioners. Diabetes mellitus. Prague: Society of General Medicine ČLS JEP; 2019, (in Czech).
10. Czech Republic. Government Directive 164/2018 Coll., on fields of specialization education and denoting expertise of healthcare professionals with specialized competences. Available from: <https://www.zakonyprolidi.cz/cs/2018-164> (in Czech).
11. IHIS CR–Institute of Health Care Information and Statistics of the Czech Republic. Hospitalization in hospitals in the Czech Republic. National Registry of Hospitalized Patients, statistical data: 2019. Prague: IHIS CR; 2019 (in Czech).
12. Czech Republic. Act 372/2011 Coll., on health care services and conditions of their provision. Available from: <https://www.zakonyprolidi.cz/cs/2011-372> (in Czech).
13. Tschannen D, Aebersold M, Sauter C, Funnell MM. Improving nurses' perceptions of competency in diabetes self-management education through the use of simulation and problem-based learning. *Journal of Continuing Education in Nursing*. 2013; 44(6): 257-263. <https://doi.org/10.3928/00220124-20130402-16>.
14. Carey N, Courtenay M. An exploration of the continuing professional development needs of nurse independent prescribers and nurse supplementary prescribers who prescribe medicines for patients with diabetes. *Journal of Clinical Nursing*. 2010; 19(1-2): 208-216. <https://doi.org/10.1111/j.1365-2702.2009.02943.x>.
15. Baxley SG, Brown ST, Pokorny ME, Swanson MS. Perceived competence and actual level of knowledge of diabetes mellitus among nurses. *Journal for Nurses in Professional Development*. 1997; 13(2): 93-98.
16. Daly BM, Arroll B, Scragg RKR. Diabetes knowledge of primary health care and specialist nurses in a major urban area. *Journal of Clinical Nursing*. 2019; 28(1-2): 125-137. <https://doi.org/10.1111/jocn.14684>.
17. Gossain VV, Bowman KA, Rovner DR. The actual and self-perceived knowledge of diabetes among staff nurses. *Diabetes Education*. 1993; 29(3): 215-219. <https://doi.org/10.1177/014572179301900309>.
18. Haugstvedt A, Aarflot M, Iglund J, Landbakk T, Graue M. Diabetes knowledge in nursing homes and home-based care services: a validation study of the Michigan Diabetes Knowledge Test adapted for use among nursing personnel. *BMC Nurs*. 2016; 15: 40. <https://doi.org/10.1186/s12912-016-0159-1>.
19. Hollis M, Glaister K, Lapsley JA. Do practice nurses have the knowledge to provide diabetes self-management education?. *Contemporary Nurse*. 2014; 46(2): 234-241. <https://doi.org/10.5172/conu.2014.46.2.234>.
20. Kudlová P, Kočvarová I. Knowledge and self-assessment of general practitioner nurses in the area of diabetes mellitus. *Kontakt*. 2020; 22(3): 165-171. <https://doi.org/10.32725/kont.2020.031>.
21. Livingston R, Dunning T. Practice nurses' role and knowledge about diabetes management within rural and remote Australian general practices. *FEND*. 2010; 7(2). <https://doi.org/10.1002/edn.158>.
22. Fitzgerald JT, Funnell MM, Anderson RM, Nwankwo R, Stansfield RB, Piatt GA. Validation of the Revised Brief Diabetes Knowledge Test (DKT2). *Diabetes Education*. 2016; 42(2): 178-187. <https://doi.org/10.1177/0145721715624968>.

23. Fitzgerald JT, Funnell MM, Hess GE, Barr PA, Anderson RM, Hiss RG, et al. The reliability and validity of a brief diabetes knowledge test. *Diabetes Care*. 1998; 21(5): 706-710. <https://doi.org/10.2337/diacare.21.5.706>.
24. İdiz C, Çelik S, Bağdemir E, Dişsiz M, Satman İ. Turkish adaptation of Michigan diabetes research and training center's revised diabetes knowledge test and determination of factors affecting the knowledge level of diabetic individuals. *The Turkish Journal of Endocrinology and Metabolism*. 2020; 24(1): 38-46. <https://doi.org/10.25179/tjem.2019-71974>.
25. Kudlová P, Kočvarová I, Soukup P. Michigan diabetes knowledge test: validation of modified version among Czech students of nursing. *Kontakt*. 2022; 24(2): 114-122. <https://doi.org/10.32725/kont.2022.018>.
26. Ramjan LM, Watanabe H, Salamonson Y. Diabetes knowledge and perceptions among nursing students, and curriculum differences in Japan and Australia: a cross-sectional study. *Nurse Education Today*. 2017; 53: 7-12. <https://doi.org/10.1016/j.nedt.2017.03.005>.