

DOI: 10.5455/msm.2022.34.149-154

Received: May 02 2022; Accepted: Jun 14, 2022

© 2022 Tarik Catic, Snjezana Pejicic Popovic, Zeliya Veliya Asimi, Lucia Hlavinkova

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

PROFESSIONAL PAPER

Mater Sociomed. 2022 Jun; 34(2): 149-154

# Costs of Diabetes Mellitus and Its Complications in Bosnia and Herzegovina

Tarik Catic<sup>1,2</sup>, Snjezana Pejicic Popovic<sup>3</sup>, Zeliya Veliya Asimi<sup>2</sup>, Lucia Hlavinkova<sup>4</sup>

<sup>1</sup>Novo Nordisk Pharma d.o.o, Sarajevo Bosnia and Herzegovina

<sup>2</sup>University Sarajevo School of Science and Technology Medical School, Sarajevo, Bosnia and Herzegovina

<sup>3</sup>University Clinical Center of Republic of Srpska, Banja Luka, Bosnia and Herzegovina

<sup>4</sup>Novo Nordisk Slovakia s.r.o, Bratislava, Slovakia

**Corresponding author:** Tarik Catic, PhD Pharm, Novo Nordisk Pharma d.o.o Sarajevo, Bosnia and Herzegovina. Address: Trg Solidarnosti 2, 71000 Sarajevo, Bosnia and Herzegovina. Phone: +38733773930. E-mail: tacc@novonordisk.com. ORCID ID: <https://orcid.org/0000-0003-1799-9503>.

## ABSTRACT

**Background:** The economic burden induced by all types of Diabetes mellitus (DM) and their complications has reached 1.8% of gross domestic product (GDP) globally. The economic burden of diabetes mellitus in Bosnia & Herzegovina (B&H) is still unknown. **Objective:** To investigate the economic burden of diabetes in Bosnia and Herzegovina, including the costs of diagnosing and treating diabetes and its complications. **Methods:** The study was designed as a top-down cost of illness study, based on prevalence, analyzing both direct and indirect costs of DM and complications caused by DM. All types of DM were taken into account, and estimates were based on total B&H population. Costs of services per patient were calculated by multiplication of share of treated population, service utilization data and unit costs. **Results:** Annual economic burden associated with DM in B&H is around 189 million euro (739 euro per patient), which makes 1.11% of gross domestic product (GDP) of B&H in 2020 (16,993,101,523 euro, according to the World Bank data). The largest part of this burden was created by DM medication and costs of managing complications (heart failure and stable angina being major cost drivers among the complications), followed by laboratory tests and physician visits. **Conclusion:** Total costs of DM per patient in B&H are within the range of costs in other Central-Eastern European (CEE) countries, reflecting significant economic burden, but also determination of healthcare payers in B&H to provide optimal management of DM in congruence with contemporary clinical guidelines.

**Keywords:** diabetes mellitus, cost of illness, burden of disease, complications.

## 1. BACKGROUND

Diabetes mellitus (DM) is one of the most complex human diseases based on the loss of control over normal glucose metabolism. According to the division in modern guidelines for diagnosis and treatment, patients with diabetes mellitus are classified into four groups: type 1, which occurs at a younger age due to destruction of pancreatic beta cells, type 2, which occurs in adulthood due to insufficient insulin secretion and cell resistance on its effect, type 3, which includes patients with a known, specific cause of endocrine pancreas damage (eg pancreatitis, drug toxicity, genetic defects, etc.), and type 4, gestational diabetes (first occurs during pregnancy) (1).

Regardless of the type, due to angiopathy and neuropathy, diabetes is accompanied by serious complications on many organs and tissues, which require complex diagnostic and therapeutic procedures (2). Despite specific therapy, complications of diabetes lead to shortening of life expectancy, reduction of quality of life (3) and increased use of health services with a concomitant increase in costs per patient (4).

The global prevalence of diabetes mellitus is around 8.8%, and from year to year shows a tendency to grow (5). The economic burden induced by all types of diabetes and their complications has reached 1.8% of gross domestic product (GDP) globally; in the region of Europe this percentage is slightly lower (1.4%), but varies from country to country, being higher in countries with absolutely lower GDP per capita (6). About 30.8% of this economic burden goes to indirect costs (6). Epidemiological data for diabetes in Bosnia & Herzegovina (B&H) are mostly partial; a standardized annual incidence of type 1 diabetes in the period 1998-2010 was

Service type	Healthcare service	Average frequency (per year)	Unit price in private health-care sector	Unit price in public health-care sector	Private health-care costs in B&H	Public healthcare costs in B&H
Blood & Oral Tests (costs of detection, non-repeatable)	Blood Insulin	1	22.50 €	9.00 €	3,987 €	18,341 €
	Blood sugar - glucose test	1	5.00 €	2.00 €	886 €	4,076 €
	OGTT (Oral Glucose Tolerance Test)	1	30.00 €	12.00 €	5,316 €	24,454 €
	C-PEPTIDE	1	30.00 €	12.00 €	5,316 €	24,454 €
Blood Tests	HbA1c - Glycosylated Hemoglobin	2	15.00 €	6.00 €	614,441 €	2,826,429 €
	Total cholesterol	1	6.00 €	2.40 €	122,888 €	565,286 €
	LDL and HDL cholesterol	1	5.00 €	2.00 €	102,407 €	471,071 €
	Triglycerides	1	5.00 €	2.00 €	102,407 €	471,071 €
	Creatinine	1	2.00 €	0.80 €	40,963 €	188,429 €
Urin Tests	General urine analysis	1	12.00 €	4.80 €	245,776 €	1,130,572 €
Other Tests	Eye fundus examination / Ophthalmological examination	1	33.00 €	13.20 €	675,885 €	3,109,072 €
	Neurological examination	1	33.00 €	13.20 €	675,885 €	3,109,072 €
	Resting and exercise ECG	0.5	8.00 €	3.20 €	81,925 €	376,857 €
	Cardiological control	1	33.00 €	13.20 €	675,885 €	3,109,072 €
	Blood pressure tests	3	Included in costs of visit	NA		
	Foot examinations	1	Included in costs of visit	NA		
Diabetes Detection (non-repeatable costs)	Visits to a diabetologists	1	30.00 €	12.00 €	5,316 €	24,454 €
Control visits	Physician (GP / Family Doctor)	3.2	30.00 €	12.00 €	1,185,036 €	5,451,164 €
	Visits to a diabetologists	3.2	32.50 €	13.00 €	1,283,789 €	5,905,428 €
Emergency	Emergency care visit-advice	2.6	40.90 €	16.36 €	718,736 €	3,306,187 €
	Emergency care visit-treatment	0	NA	NA		
	Hospitalization / Hospital treatment	1.3	71.79 €	28.72 €	175,855 €	808,932 €
Total service costs					37,647,121 €	
NA – not applicable						

Table 1. Healthcare utilization and costs of DM patients in B&H per year, separated by the healthcare provider type (private or public)

7.5/100,000 inhabitants under the age of 18 (with a tendency of annual growth of 2.3%) in peripheral parts of the country (7), while the incidence in the central regions was initially lower (3.03/100,000 inhabitants under the age of 18) in the period 1990-1998 (8), only to increase to 6.9/100,000 inhabitants from 1999-2004 (8).

The prevalence of gestational diabetes in the southern parts of the country was about 10.9% during 2010-2011. (9). However, the economic burden of diabetes mellitus in B&H is still unknown, either for the disease in general, or for certain complications (10).

## 2. OBJECTIVE

The aim of this study was to investigate the economic burden of diabetes in Bosnia and Herzegovina, including the costs of diagnosing and treating diabetes and its complications.

## 3. MATERIALS AND METHODS

The study was designed as a top-down cost of illness study, based on prevalence, analyzing both direct and indirect costs of DM and complications caused by DM. All types of DM were taken into account, and estimates were based on total B&H population. The data about the popu-

Type of costs	Annual costs per patient	Percent of affected patients	Annual costs for whole B&H population of DM patients
Medication costs (ATC -A10)	157.87 €	NA	40,417,530 €
Glucose measuring instruments	0.34 €	NA	87,459 €
Accessories for glucose measuring instruments	0.01 €	NA	1,487 €
Glucose test stripes	13.39 €	NA	3,427,304 €
Costs of complications: diabetic foot	4727.73 €	0.48%	5,759,556 €
Costs of Complications: end-stage renal disease (ESRD)	696.56 €	0.05%	88,394 €
Costs of Complications: heart failure	1268.8 €	4.40%	14,169,057 €
Costs of Complications: painful neuropathy	366.74 €	3.42%	3,183,314 €
Costs of Complications: peripheral vascular disease	2535.18 €	0.27%	1,737,271 €
Costs of Complications: retinopathy	287.76 €	0.56%	408,991 €
Costs of Complications: stable angina	1629.01 €	6.15%	25,426,933 €
Total costs of DM without complications	319.0 €	NA	<b>81,580,901 €</b>
Total costs of DM with complications	516.97 €	NA	<b>132,354,418 €</b>
Loss of productivity costs	222.0 €	NA	<b>56,723,322 €</b>
Total costs of DM in B&H	<b>738.97 €</b>	NA	<b>189,077,740 €</b>

Table 2. Other annual costs of DM management in B&amp;H

lation of B&H were taken from the worldometer webpage (11). Number of patients with DM in B&H used in costs calculations was average of three independent estimates: the first estimate was based on data about sales of insulins, metformin and other antidiabetic drugs in B&H during the period 2018 – 2020, obtained from IQVIA (12); the second estimate came from multiplication of average DM prevalence in B&H (published in medical journals and by the European Office of the World Health Organization) and population of B&H (6, 11, 13); and the third estimate used prevalence data from the benchmark countries (Central Eastern European countries–CEE) which share social and economic status with B&H (14).

Both direct and indirect costs were included in the study, while intangible costs were omitted. The following drivers of direct costs were taken into account: emergency department visits, hospital inpatient care, laboratory and other medical tests, medications to treat diabetes and its complications, and physician's office visits. Costs of services per patient were calculated by multiplication of share of treated population, service utilization data and unit costs. The medication costs were derived from the IQVIA sales data (12). Costs (test prices and prices of services) for out-of-pocket payments were based on actual prices in private clinics in Bosnia and Herzegovina (15, 16, 17); for public healthcare prices were calculated based on CEE benchmark (~40% of private test price).

All costs (prices) were verified with the CEE benchmark. Indirect costs included costs incurred by increased absenteeism, reduced productivity while at work for the employed population, reduced productivity for those not in the labor force, inability to work due to disease-related disability, and lost productive capacity due to premature death. All costs were expressed at annual level.

A number of assumptions were made within the frame-

work of this analysis, based on IQVIA data, benchmark data from CEE countries and published studies (7, 8, 12, 14). Treatment rate was assumed to be 84.9%, and the newly treated patients rate 0.86%. Share of patients with public insurance was assumed to be 92%, while the rest of the patients (8%) were making out-of-pocket payments for healthcare services and medication. It was assumed that annually 60% of patients would use primary healthcare services, 33% emergency care services, and 9% would be hospitalized. Indirect costs due to loss of productivity were assumed to be 30% of total costs, and total costs due to DM complications was assumed to be 50.7 million euro, based on the costs data from benchmark countries.

#### Statistical analysis

Primary data were tabulated and double-checked for accuracy and completeness. Categorical variables were presented by frequencies and rates. Continuous variables were first checked for normality of data distribution, and then presented by mean with standard deviation, or median with range if not normally distributed. Assumed data and estimated data were presented by absolute numbers.

## 4. RESULTS

With a current population of 3,280,819 inhabitants and 9.0% prevalence of DM, there are 301,636 patients with diabetes in B&H. Assuming a treatment rate of 84.9%, in total 256,017 patients with DM will generate healthcare costs. About 0.86% of them, or 2,215 DM patients per year, are newly treated, while the rest are receiving continuous care from year to year. Structured data about annual healthcare utilization and costs are shown in Table 1.

The costs of medication used for treatment of DM, costs of complications, costs of over-the-counter (OTC) medical devices (glucose measuring instruments, accessories for glucose measuring instruments and glucose test stripes)

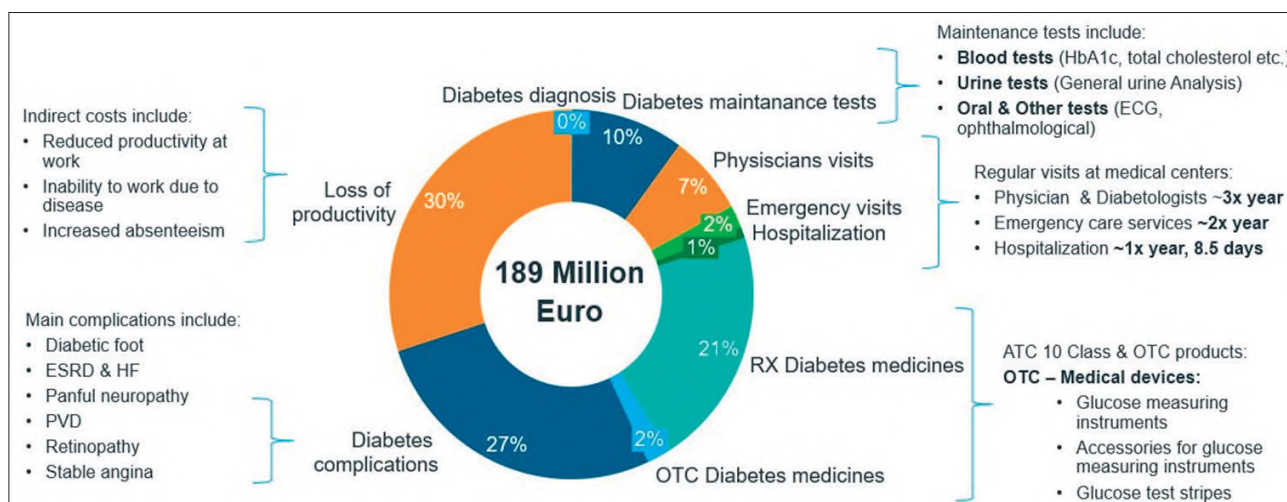


Figure 1. Maximum share of total DM management costs for treatment of complications - distribution of specific cost types

and indirect costs due to productivity loss are shown in the Table 2.

Maximum share of total DM management costs have medication and treatment of complications. Detailed distribution of specific cost types is shown in Figure 1.

### 5. DISCUSSION

Our study showed that annual economic burden associated with DM in B&H is around 189 million euro (739 euro per patient), which makes 1.11% of gross domestic product (GDP) of B&H in 2020 (16,993,101,523 euro, according to the World Bank data) (18). The largest part of this burden was created by DM medication and costs of managing complications (heart failure and stable angina being major cost drivers among the complications), followed by laboratory tests and physician visits.

If the burden of DM per capita in B&H is compared with that in some other CEE countries, the differences are not impressive (e.g. 1,309 € in Hungary, 850 € in Croatia, 750 € in Poland and 472 € in Bulgaria) (19). Although the benchmark countries have much higher GDP per capita than B&H (Bulgaria 1.5 times higher, and the other three countries more than 2 times higher), amounts paid per capita for DM management are within the range of payments of the CEE countries that all belong to the European Union. This reflects the fact that B&H is an upper-middle income economy, like Bulgaria, and far from lower-middle income economies, which have much different conditions for national healthcare systems to operate with. Recent systematic review of studies investigating the economic burden of DM in low and lower-middle income countries reported total annual costs of DM below 205 euro in the majority of countries, with hospitalizations being the main cost driver. This situation probably reflects low investment in strategies that prevent DM complications, like more intensive monitoring and therapy, that result with increased prevalence of complications and their more severe forms which require hospital treatment (20). GDP per capita is the main factor that is highly correlated with direct costs of DM in a country: higher GDP means higher direct DM costs, i.e. willingness of health insurance funds to pay more for innovative antidiabetic drugs, improved insulin analogues,

monitoring and intensive patient counseling strategies.

Indirect costs of DM are also higher in high-income economies, because persons with DM have much less chances to be employed and to keep their jobs (21). When it comes to insulin costs, significant portion of costs are related to human insulins, premixes and older generation of long-acting basal insulins, while modern insulins are reimbursed under different prescribing limitations and restrictions.

Since prevalence of DM in B&H does not differ significantly from global trends (9% in men and 7.9% in women), cost of DM per patient directly reflects nationwide investment in care of DM patients (22). Although this investment in B&H is relatively similar, albeit somewhat lower than in CEE countries, distribution of the investment between various aspects of DM care is significantly different in B&H. Annual costs of DM medication per patient are lower than in Bulgaria and all other benchmarking CEE countries, and specifically, some innovative oral antidiabetic drugs are missing from the market in B&H, like Sodium-glucose Cotransporter-2 (SGLT2) inhibitors (canagliflozin, dapagliflozin, and empagliflozin) (12). On the other hand, Glucagon-like peptide-1 receptor agonists (GLP-1 RA) are marketed in Bosnia and Herzegovina, but with significant prescribing limitations and inequalities among regions (2 entities and 10 cantons as administrative units in the country with autonomy on reimbursement decisions) (23, 24). Limited access to these medicines due to high threshold of body mass index (BMI) as one of criteria to initiate treatment, and lack of recognition of cardiovascular benefits of liraglutide, semaglutide and dulaglutide probably had negative impact on rate of cardiovascular complications among patients with diabetes.

The distribution of total DM management costs in B&H shows a high share (around 9%) paid for visits to general practitioners, physicians specialized in diabetology and emergency physicians. The reason behind this finding is intensive follow-up of patients with DM by general practitioners and specialists who prescribe their antidiabetic medication. Such practice should be encouraged, since a number of observational studies showed that more frequent visits of DM patients to physicians result with more optimal therapy, better control of blood glucose and glycosylated he-

moglobin, and decreased rate of complications (25, 26, 27).

There are a number of limitations of our study. In the first place, due to unavailability of certain data, assumptions were made, making accuracy of the results dependent on precision of the assumptions. Second, costs of the DM complications and their rates were not drawn from actual B&H data, but approximated from the benchmark CEE countries; although there are many similarities between B&H and the benchmark CEE countries, significant discrepancies between the approximations used in the study and actual values in B&H could not be overruled. Third, there is no accurate data in medical literature about DM incidence and prevalence in B&H, and approximations used in the study on the basis of global DM prevalence data may not represent the true situation. Also, we want to emphasize that the views and conclusions contained within in this article reflect only those of the author and whilst are based in part upon the research and findings of third parties give rise to no representation by such third parties upon which reliance by the reader can be made.

## 6. CONCLUSION

Total costs of DM per patient in B&H are within the range of costs in other CEE countries, reflecting significant economic burden, but also determination of healthcare payers in B&H to provide optimal management of DM in congruence with contemporary clinical guidelines. High intensity of patient monitoring and counselling should be continued, and reimbursement of innovative antidiabetic drugs should be one of the priorities in the future, in order to further decrease rate of complications and eventually mortality.

- **Authors contribution:** TC, SP, ZV gave a substantial contribution to the conception and design of the work. TC gave a substantial contribution of data. TC, SP, ZV, LH gave a substantial contribution to analysis, or interpretation of data for the work. TC, SP, ZV, LH had a part in article preparing for drafting or revising it critically for important intellectual content. All authors gave final approval of the version to be published and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.
- **Conflict of interest statement must be:** There are no conflicts of interest.
- **Financial support and sponsorship:** This study was supported by Novo Nordisk Pharma doo

## REFERENCES

1. Petersmann A, Nauck M, Müller-Wieland D, Kerner W, Müller UA, Landgraf R, et al. Definition, Classification and Diagnosis of Diabetes Mellitus. *Exp Clin Endocrinol Diabetes Off J Ger Soc Endocrinol Ger Diabetes Assoc.* 2018; 126(7): 406–410.
2. Cole JB, Florez JC. Genetics of diabetes mellitus and diabetes complications. *Nat Rev Nephrol.* 2020; 16(7): 377–390.
3. Stojanović M, Cvetanović G, Anđelković Apostolović M, Stojanović D, Rančić N. Impact of socio-demographic characteristics and long-term complications on quality of life in patients with diabetes mellitus. *Cent Eur J Public Health.* 2018; 26(2): 104–110.
4. Cannon A, Handelsman Y, Heile M, Shannon M. Burden of Illness in Type 2 Diabetes Mellitus. *J Manag Care Spec Pharm.* 2018; 24(9-a Suppl): S5–13.
5. Lovic D, Piperidou A, Zografou I, Grassos H, Pittaras A, Manolis A. The Growing Epidemic of Diabetes Mellitus. *Curr Vasc Pharmacol.* 2020; 18(2): 104–109.
6. Bommer C, Heesemann E, Sagalova V, Manne-Goehler J, Atun R, Bärnighausen T, et al. The global economic burden of diabetes in adults aged 20–79 years: a cost-of-illness study. *Lancet Diabetes Endocrinol.* 2017; 5(6): 423–430.
7. Radosevic B, Bukara-Radujkovic G, Miljkovic V, Pejicic S, Bratina N, Battelino T. The incidence of type 1 diabetes in Republic of Srpska (Bosnia and Herzegovina) and Slovenia in the period 1998–2010. *Pediatr Diabetes.* 2013; 14(4): 273–279.
8. Tahirović H, Toromanović A. Incidence of type 1 diabetes mellitus in children in Tuzla Canton between 1995 and 2004. *Eur J Pediatr.* 2007; 166(5): 491–492.
9. Tomic V, Misic M, Simic AD, Boskovic A, Kresic T, Peric O, et al. Prevalence of gestational diabetes in the southern part of Bosnia and Herzegovina. *Mater Sociomed.* 2016; 28(5): 329–332.
10. Jaki Mekjavić P, Jūratė Balčiūnienė V, Čeklić L, Ernest J, Jamrichova Z, Zsolt Nagy Z, et al. The Burden of Macular Diseases in Central and Eastern Europe—Implications for Healthcare Systems. *Value Health Reg Issues.* 2019; 19: 1–6.
11. Bosnia and Herzegovina Population (2021)—Worldometer [Internet]. [cited 2021 Oct 23]. Available from: <https://www.worldometers.info/world-population/bosnia-and-herzegovina-population/>
12. IQVIA—Cost of Diabetes in Bosnia and Herzegovina [Project], March 2021, Łukasz Zemlo, Alexandra Cieplinska, Jasmina Efendić, Adnan Arnautovic. [Internet]. [cited 2021 Oct 23]. Available from: <https://www.iqvia.com/>
13. WHO European health information at your fingertips. [Internet]. [cited 2021 Oct 23]. Available from: [https://gateway.euro.who.int/en/indicators/hfa\\_379-2370-prevalence-of-diabetes-mellitus/](https://gateway.euro.who.int/en/indicators/hfa_379-2370-prevalence-of-diabetes-mellitus/)
14. Bosnia and Herzegovina BA: Diabetes Prevalence: % of Population Aged 20–79 | Economic Indicators | CEIC [Internet]. [cited 2021 Oct 23]. Available from: <https://www.ceicdata.com/en/bosnia-and-herzegovina/health-statistics/ba-diabetes-prevalence—of-population-aged-2079>
15. Cjenovnik | Laboratorija Atrijum Sarajevo, BiH [Internet]. Laboratorija | Poliklinika Atrijum. [cited 2021 Oct 23]. Available from: <https://poliklinika-atrijum.ba/lab/cjenovnik/>
16. Cenovnik [Internet]. Limana—internističko—kardiološka ordinacija, Novi Sad—kardiolog, pulmolog, endokrinolog, nefrolog, hematolog, imunolog, gastroenterolog, onkolog. [cited 2021 Oct 23]. Available from: <https://limana.rs/cenovnik/>
17. Cjenovnik – Moja Klinika [Internet]. [cited 2021 Oct 23]. Available from: <http://mojaklinika.ba/cjenovnik/>
18. DataBank | The World Bank [Internet]. [cited 2021 Oct 24]. Available from: <https://databank.worldbank.org/home.aspx>
19. Grelewska J, Jakubczyk M, Niewada M, Lipka I, Petrova G, Tcharaktchiev D, Mitkova Z et al. The cost of macro- and microvascular diseases in patients with diabetes mellitus

- in selected Central and Eastern European countries. *J Health Policy Outcomes Res.* 2019; 2019(1): 33.
20. Afroz A, Alramadan MJ, Hossain MN, Romero L, Alam K, Magliano DJ, et al. Cost-of-illness of type 2 diabetes mellitus in low and lower-middle income countries: a systematic review. *BMC Health Serv Res.* 2018; 18(1): 972.
  21. Seuring T, Archangelidi O, Suhrcke M. The Economic Costs of Type 2 Diabetes: A Global Systematic Review. *PharmacoEconomics.* 2015; 33(8): 811–831.
  22. NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in diabetes since 1980: a pooled analysis of 751 population-based studies with 4.4 million participants. *Lancet Lond Engl.* 2016; 387(10027): 1513–1530.
  23. Health insurance fund of Republic of Srpska [Internet]. [cited 2021 Oct 28]. Available from: [https://www.zdravstvo-srpske.org/files/cjenovnici/lista\\_ind.pdf](https://www.zdravstvo-srpske.org/files/cjenovnici/lista_ind.pdf).
  24. Ministry of Health of Federation of Bosnia and Herzegovina – Reimbursement lists [Internet]. [cited 2021 Oct 28]. Available from: <https://www.fmoh.gov.ba/index.php/preporucujemo/liste-lijekova>
  25. Brink SJ. How to apply the experience from the diabetes control and complications trial to children and adolescents? *Ann Med.* 1997; 29(5): 425–438.
  26. Kvapil M. The SPACE project (Stav Pacientů Akceptovaných diabetologem Cestou Exportu/The Health Records of Patients Accepted by a Diabetologist by way of Export). *Vnitr Lek.* 2016; 62(9 Suppl 3): 22–27.
  27. Penfornis A, Personeni E, Tiv M, Monnier C, Meillet L, Combes J, et al. Quality of care of patients with type 1 diabetes: population-based results in a French region. *Diabetes Metab.* 2012; 38(5): 436–443.