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Artur Myśliwiec[1], Przemysława Jarosz-Chobot[2], Małgorzata Myśliwiec[3], Krzysztof Strojek[4], Paweł Piątkiewicz[5], Mieczysław Walczak[6], Władysław Grzeszczak[7], Beata Koń[8], Milena Kozioł[8], Barbara Więckowska[8]

[1]Gdansk University of Physical Education and Sport, Neophilological Department of the Ateneum University in Gdansk, Poland
[2]Department of Children's Diabetology, School of Medicine in Katowice, Medical University of Silesia, Katowice, Poland
[3]Department of Pediatrics, Diabetology and Endocrinology, Medical University, Gdansk, Poland
[4]Department of Internal Diseases Diabetology and Cardiometabolic Diseases, School of Medicine with the Division of Dentistry (SMDZ) in Zabrze, Medical University of Silesia, Katowice, Poland
[5]Department of Internal Diseases, Diabetology and Endocrinology, Medical University, Warsaw, Poland
[6]Department of Pediatrics, Endocrinology, Diabetology, Metabolic Diseases and Cardiology of the Developmental Age, Pomeranian Medical University, Szczecin, Poland
[7]Department of Internal Medicine, Diabetology and Nephrology, School of Medicine with the Division of Dentistry in Zabrze, Medical University of Silesia, Katowice, Poland
[8]Department of Analysis and Strategy, Ministry of Health, Collegium of Economic Analysis, Warsaw School of Economics, Poland

Pediatric diabetes care: inpatient care in the Maps of Health Needs of Poland in 2014

ABSTRACT

Health care provision for patients with diabetes mellitus is a considerable challenge to health policy due to the increasing number of its new cases, both in adults and in children. In Poland, hospital care for children with diabetes mellitus is centralized and most services are provided by university and provincial hospitals. In spite of the above the structure of the services provided varies widely from province to province, both in terms of the number of hospitalizations per 100,000 children, net migration rate, length of hospital the stay, and percentage of hospitalizations for acute complications. It is necessary to improve the societal and medical awareness regarding the signs and symptoms of diabetes in order to reduce the number of acute complications, including those at the time of diagnosis. Furthermore, it is crucial to make every effort to provide equal access to specialist diabetes care, thus to make it consistent with the standards.

The high number and differences in the numbers, duration of hospitalizations of children with diabetes require further monitoring at a coordinated system of pediatric care. (Clin Diabetol 2018; 7, 6: 259–271)

Key words: acute complications of diabetes, hospitalization, children, diabetes, pediatric diabetes care

Address for correspondence:
mgr Artur Myśliwiec
Zakład Fizjologii Sportu
Akademii Wychowania Fizycznego i Sportu
ul. Kazimierza Górskiego 1, 80–336 Gdańsk
e-mail: admysliwiec@wp.pl
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Introduction

In 2006, the World Health Organization (WHO) placed diabetes mellitus among the four non-communicable diseases with the highest mortality [1]. The number of new cases of diabetes mellitus constantly increases, also in the case of children and adolescents, making diabetes one of the most common chronic diseases of the pediatric population [1, 2]. Diabetology in children and adolescents is a serious challenge to health policy in every country due to its social character and sustained growth rate of disease. At the same time, diabetes mellitus has become one of the most common chronic diseases of the developmental age. According to the International Diabetes Foundation (IDF), approximately 86 thousand new cases of type 1 diabetes mellitus are recorded in children each year worldwide, and the annual increase in incidence in the pediatric population is estimated at 3% [3].

All of the known types of diabetes mellitus according to the WHO classification are diagnosed in the pediatric population, with type 1 diabetes mellitus

markedly prevailing in the Caucasian population. In the population of Poland, nearly 98% of diabetic children and adolescents suffer from type 1 diabetes mellitus, an autoimmune disease. Insulin, in the model of functional intensive insulin therapy with doses adjusted to the meals and everyday activities and accompanied by self-monitoring, is the only recommended life-saving treatment option in these cases [4, 5]. No primary preventive measures are currently available in type 1 diabetes mellitus. Secondary prevention, which aim is to minimize the development of diabetic complications, remains an essential element of patient care [4–6].

Diabetes care in children and adolescents poses a wide set of challenges to any country's healthcare system due to complex treatment regimen. In Poland and in some other countries, the system of pediatric diabetes care is centralized [7]. Each provincial administrative region has one or two (depending on the region, size and history) facilities that provide specialist inpatient and outpatient diabetes care services to children and adolescents up to 18 years of age. Also, in accordance with the relevant recommendations, each new case of type 1 diabetes mellitus requires hospitalization in order to implement a holistic full-range diabetes management [4]. Pediatric diabetes care is quite an exceptional type of care. From the onset of the child's diabetes is brittle, their care requires holistic solutions and understanding the need for achieving the best possible and durable treatment effects from the viewpoints of the patient, the patient's immediate surrounding and the society as a whole [4, 5, 8]. As a consequence, the magnitude of the problem needs to be estimated, including the direct and indirect costs of diabetes based on national registries and healthcare services [7–12].

While there is no formal national registry dedicated to patients with diabetes in Poland, various research studies and publications are available based on regional research registries which report information on the numbers of patients and on the costs of diabetes treatment [13–16].

These publications include the Maps of Health Needs published in 2016 by the Ministry of Health. Diabetes was among the 32 disease groups identified for which a separate map was created [6]. In accordance with the relevant Regulation of the Minister of Health [17], the map consisted of three elements: (I) demographic and epidemiological aspects, (II) an analysis of the state and utilization of the resources, and (III) forecasts. Part (II) of the publication is worth noting, as it presents the structure of healthcare services provided to patients with diabetes, both as part of inpatient treatment and outpatient specialist care. These documents were prepared as part of the project entitled: "Maps of Health Needs: A Systemic and Implementation Analyses Base" co-financed by the European Union from the European Social Fund as part of the Operational Program Knowledge Education Development. The project is ran by the Analyses and Strategies Department, Ministry of Health (project number: POWR.05.02.00-00-0149/15-01).

The maps of health needs are a tool that supports the decision process in healthcare and are used to develop regional healthcare policy and evaluate investment plans, and are employed by the public payer in the process of commissioning healthcare services. Developing the maps of health needs required collaboration that reached beyond the group of public health experts and statisticians/IT specialists and involved expert practitioners/diabetes specialists selected in a contest organized by the Ministry of Health. The interpretation of collated data and results was subject to difficult and stringent assessment by the entire working group and to wider consultations in the professional community [6].

The aim of the study was to analyze hospitalizations of children and adolescents due to diabetes mellitus in Poland in 2014.

Material and methods

For the purpose of this study, we used individual Polish National Health Fund (NFZ) data, i.e. database including patient ID (PESEL) and information on provided services. Data from 2014 were used, where the year refers to the date of the end of service provision. The services/provisions were defined as hospitalizations reported to the NFZ by health care providers within the 1a and 1b catalogues, i.e. hospitalizations reported diagnosis related groups (DRGs, polish JGP) or distinct products [18].

The study analyzed the hospitalizations of children due to diabetes defined on the basis of the International Statistical Classification of Diseases and Related Health Problems ICD-10 [19] (Table 1, 2). We analyzed hospitalizations with the main diagnosis codes E10–E15 and E74.9. We also included codes E66 and E78, for which the coexisting diagnoses codes E10–E15 and E74.9 were reported. Hospitalizations with procedure 39.95 (haemodialysis) according to ICD-9-CM were excluded from the analysis.

The study presents a list of statistics at the national and provincial level in 2014. The analysis was conducted on the basis of the NFZ data on hospital treatment including 8.61 thousand hospitalizations for 6.90 thousand patients. The above analysis was completed by using the statistical program R. Additionally, in the demographic analysis, the studied population was di-

Table 1. ICD-10 codes considers in article

ICD-10	Disease
E10	Type 1 diabetes mellitus*
E11	Type 2 diabetes mellitus*
E12	Malnutrition-related diabetes mellitus*
E13	Other specified diabetes mellitus*
E14	Unspecified diabetes mellitus*
E15	Nondiabetic hypoglycaemic coma
E74.9	Disorder of carbohydrate metabolism, unspecified
E66	Obesity
E66.0	Obesity due to excess calories
E66.1	Drug-induced obesity
E66.2	Extreme obesity with alveolar hypoventilation
E66.8	Other obesity
E66.9	Obesity, unspecified
E78	Disorders of lipoprotein metabolism and other lipidaemias
E78.0	Pure hypercholesterolaemia
E78.1	Pure hyperglyceridaemia
E78.2	Mixed hyperlipidaemia
E78.3	Hyperchylomicronaemia
E78.4	Other hyperlipidaemia
E78.5	Hyperlipidaemia, unspecified
E78.6	Lipoprotein deficiency
E78.8	Other disorders of lipoprotein metabolism
E78.9	Disorder of lipoprotein metabolism, unspecified

*Means all ICD-10 codes with subdivisions defined in Table 2

Table 2. ICD-10 subdivisions for E10–E14

Subvdvisions for E10–E14
.0 with coma
.1 ketoacidosis
.2 with renal complications
.3 with opthalmic complications
.4 with neurological complications
.5 with peripheral circulatory complications
.6 with other specified complications
.7 with multiple complications
.8 with unspecified complications

vided into 4 age group: 0–4, 5–9, 10–14, 15–17 years of age and the structure of hospitalization in relation to the place where the patient was provided and residing.

The analysis of pediatric hospitalizations due to diabetes also included acute diabetic complications. The following ICD-10 codes were considered as acute diabetic complications: diabetes mellitus with coma (ICD-10 codes E10.0, E11.0), diabetes mellitus with ketoacidosis (ICD-10 codes E10.1, E11.1) and diabetes mellitus with other specific complications (ICD-10 codes E10.6, E11.6).

New case of diabetes was defined as a patient up to 18 years of age, for whom no health care provisions due to diabetes were reported in 2009 (defined according to ICD-10 according to the codes described above) in the outpatient specialist care or inpatient care and who were hospitalized due to these diagnoses in 2014.

The publication presents a set of descriptive statistics at the national and provincial levels. The analysis was carried out using R (a software for statistics).

Results

In Poland, in the year 2014, a total of 6.90 thousand children were hospitalized due to diabetes. The age group between 10 to 14 years old accounted for the largest percentage (41%) of patients aged below 18 years (Figure 1). There were no sex differences in

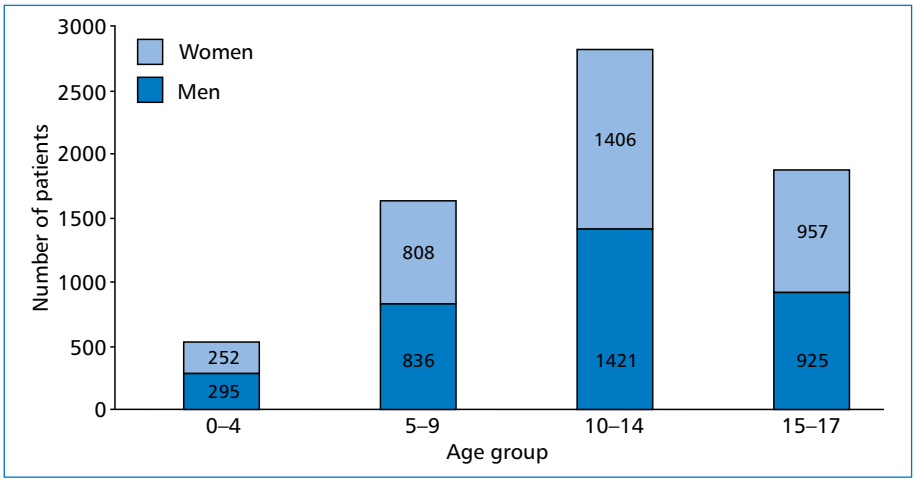

Figure 1. Age structure of children hospitalized for diabetes

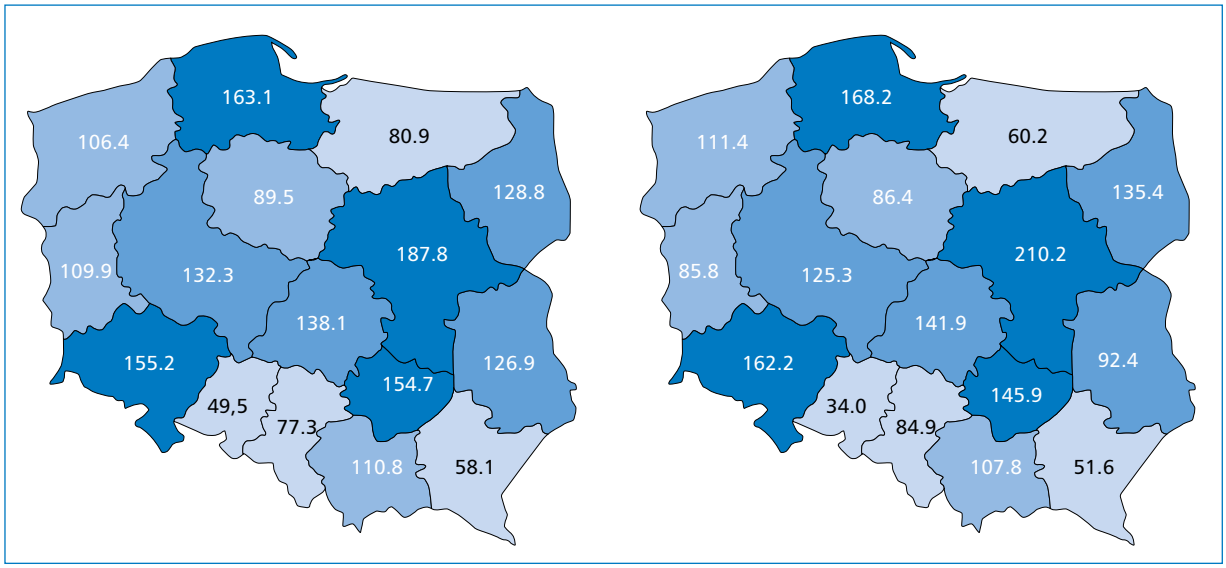

Figure 2. The number of hospitalizations of patients according to the place of residence (left map) and the number of hospitalizations according to the place of service provision (right map) per 100,000 children

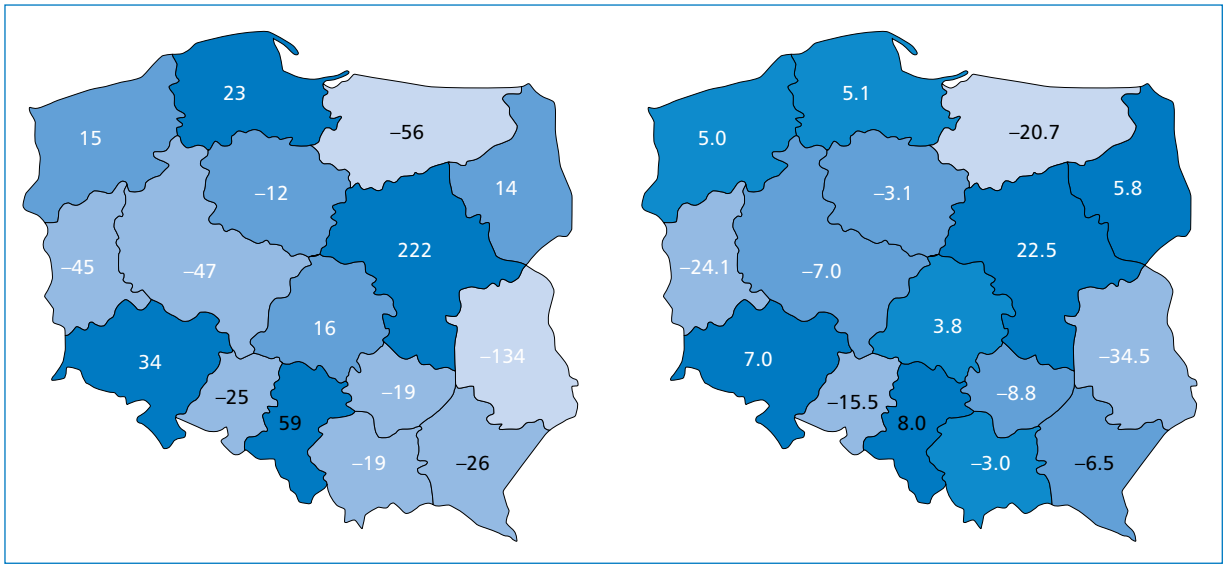

Figure 3. Net migration rate of children with diabetes (left map) and net migration rate of children with diabetes per 100,000 children (right map); hospital services

hospitalization rates (with both females and males accounting for 50% of all hospitalizations).

A total of 8.61 thousand hospitalizations due to diabetes were reported in Poland among children. This means that in Poland, on average, each child with diabetes was hospitalized 1.25 times. The number of hospitalizations per 100,000 children and adolescents in Poland was 125.

When expressed relative to the number of inhabitants in each province, children who were hospitalized the most frequently were inhabitants of the Mazovia, Pomerania, Lower Silesia and Świętokrzyskie Provinces (Figure 2). Children from the Opole and Podkarpackie Provinces were hospitalized the least frequently. When expressed relative to the number of all hospitalizations in a given province, similarly to the previous case, children from the Mazovia, Pomerania, Lower Silesia and Świętokrzyskie (Holy Cross) Provinces were hospitalized the most frequently, while those from the Opole and Podkarpackie Provinces were hospitalized the least

frequently. The significant differences between the provinces are worth noting: almost a 4-fold difference between the Mazovia and Opole Provinces in the number of patients hospitalized according to the place of residence per 100,000 children, and over a 6-fold difference between these provinces in the number of hospitalizations according to the place of service provision. The differences in the number of services according to the place of service provision and to the place of residence per 100,000 children suggest migration of children beyond their respective provinces of residence.

The highest net migration rate was identified for the Mazovia, Silesia, Pomerania and Lower Silesia Provinces (Figure 3). When expressed per 100,000 children inhabiting a given province, the lowest net migration rates were reported for the Lublin (–34.5) and Lubusz (–24.5) Provinces. The highest net migration rate per 100,000 children was identified for the Mazovia and Silesia Provinces.

In absolute terms, the highest numbers of hospitalizations of children due to diabetes were reported in the Mazovia, Pomerania, Lower Silesia, Greater Poland and Lesser Poland Provinces (Table 3). The wide distribution of the proportions of one-day hospitalizations are worth noting, particularly in the Lower Silesia and Lesser Poland Provinces (nearly 60% and nearly 45% of all hospitalizations, respectively). As already indicated and discussed with respect to patient migration, the proportions of hospitalizations of patients from outside the province are widely distributed, with more than 10% of hospitalizations from outside the province being reported in the Mazovia, Silesia and West Pomerania Provinces.

The average length of stay (ALOS) for a child with diabetes in Poland is 4.6 days, with the longest ALOS of nearly 10 days being reported for the Podkarpackie Province, and the shortest, of about 3 days, for the Lesser Poland and Lower Silesia Provinces (Table 4). Of note is also the median length of stay (MLOS) of 1 day for the Lower Silesia Province. In terms of patient age, children aged 4 years are hospitalized the longest.

On a national level, the proportion of hospitalizations due to acute diabetic complications was 12.6%, with the highest values reported for the Opole (36.4%), Greater Poland (33.0%) and Warmia-Masuria (26.4%) Provinces. These provinces were also characterized by high hospitalization rates for acute complications among new patients, i.e. above 40% (Table 5). It is worth noting that the Greater Poland Province, with a considerable proportion of one-day hospitalizations (24%) was reported additionally.

The hospitalizations of children due to diabetes were most frequent reported as with DRG code P24 (diabetes mellitus) — 88.2% of all hospitalizations [18] (Table 6). Another code, K28 (congenital metabolic disorders), was reported for 10.60% of all hospitalizations. For both codes, there is a wide variation between the provinces. Two provinces are particularly noteworthy: the Pomorskie Province, where hospitalizations were most commonly reported as DRG K28 (41.2%), and the Warmia-Masuria Province, where hospitalizations due to diabetes with the DRG code K27B were relatively frequently reported.

In children, hospital diabetes care was strongly centralized, with 80% of the services being reported by 12 hospitals (Table 7). Except for the Mazovia Province, such services were provided by one hospital in each of the provinces, a university or a provincial hospital.

Discussion

Our study, concerning diabetes mellitus in the pediatric population was based on the Maps of Health Needs (2014). This publication is a summary and extension of the content presented in the Maps of Health Needs with regard to diabetes in the developmental age population.

We strongly emphasize that we are fully aware of the multiple difficulties, ambiguities and coding errors associated with the reporting of services by healthcare facilities to the National Health Fund in Poland. In addition, due to the great differences in the regional policy of NHF branches, for instance, the absence or availability of contracts for 1-day hospitalization, or in the limits of hospitalizations, in the number of available personal insulin pumps, et cetera. Nevertheless, this is the first ever, unique publication on this topic, authored by a diverse group of experts in diabetes and statistics, offering an important point of reference for future research papers in Poland.

The admittedly society-wide nature of this serious chronic disease, which affects young patients at the beginning of their lives and during the period of stormy development, requires a comprehensive context and multi-layered involvement both on the service provider's and service recipient's part, and at the level of the entire health policy. As a consequence, childhood diabetes has become a priority of health and social policies both in Poland and worldwide [2, 20–23].

Polish and global epidemiological forecasts unequivocally prove and predict a constant increase in the incidence of diabetes in the pediatric population, in post-communist countries, and an increase in the number of hospitalizations of patients with diabetes [24–28].

Poland can serve as an example, with its annual increase rate estimated at 9%, 3-fold higher than the

Table 3. Principal statistics concerning the number and structure of pediatric hospitalizations due to diabetes for each province

Province	Total number of hospitalized patients (in thousand)	Total number of hospitalizations (in thousand)	Proportion of one-day hospitalizations (%)	Number of hospitalizations per 100,000 children	Number of hospitals providing 80% of the hospitalisations	Proportion of hospitalizations of patients from outside the province (%)	Number of patients with diabetes below the age of 18 years from this province hospitalized in other provinces
Lower Silesia	0.6	0.8	57.7	162	1	7.8	28
Kujawy-Pomerania	0.3	0.3	3.3	86	3	5.7	31
Lublin	0.2	0.4	10.8	92	1	2.2	142
Lubusz	0.1	0.2	0.6	86	2	2.5	49
Łódź	0.5	0.6	4.3	142	1	5.5	17
Lesser Poland	0.6	0.7	44.9	108	1	5.1	54
Mazovia	1.7	2.1	6.1	210	2	12.5	37
Opole	0	0.1	9.1	34	1	5.5	28
Podkarpackie	0.2	0.2	4.3	51	1	4.3	35
Podlasie	0.2	0.3	3.5	135	1	10.8	17
Pomerania	0.6	0.8	24.3	168	1	6.5	26
Silesia	0.5	0.7	6.1	85	1	11.4	16
Świętokrzyskie (Holy Cross)	0.3	0.3	1.9	146	1	3.5	30
Warmia-Masuria	0.1	0.2	5.5	60	1	4.9	64
Greater Poland	0.6	0.8	24.0	125	1	4.7	86
West Pomerania	0.3	0.3	0.2	111	2	10.5	20
Poland	**6.9**	**8.6**	**17.1**	**125**	**12**	**7.9**	**680**

Table 4. Statistics on the length of pediatric hospitalization for diabetes for each province

Province	MLOS (median length of hospital stay in days)	ALOS (average length of hospital stay in days) for the following age groups of patients				
		0–4 years	5–9 years	10–14 years	15–17 years	Total
Lower Silesia	1	4.0	3.3	3.1	3.3	3.3
Kujawy-Pomerania	4	8.2	5.7	5.9	4.8	5.9
Lublin	5	7.3	6.4	7.4	6.1	6.9
Lubusz	4	6.1	5.3	5.7	5.5	5.5
Łódź	4	6.7	5.1	4.8	4.6	4.9
Lesser Poland	2	5.7	3.4	3.0	2.8	3.2
Mazovia	3	6.3	4.4	4.2	4.0	4.3
Opole	6	5.0	5.6	5.3	3.4	5.1
Podkarpackie	10	8.6	11.4	9.6	8.9	9.6
Podlasie	4	7.7	5.6	5.4	4.5	5.5
Pomerania	2	6.0	4.0	3.2	2.7	3.5
Silesia	4	5.4	4.7	4.0	4.3	4.4
Świętokrzyskie (Holy Cross)	3	8.8	5.7	5.1	4.4	5.3
Warmia-Masuria	5	7.6	6.7	6.6	5.6	6.4
Greater Poland	2	5.3	3.8	4.1	3.8	4
West Pomerania	4	8.4	5.7	4.8	5.2	5.6
Poland	**3**	**6.3**	**4.7**	**4.4**	**4.1**	**4.6**

European average [25, 26]. This is no surprise, given that diabetes mellitus is a chronic disease of a societal scale. Moreover, according to multiple reports from Poland and abroad, the highest trend in the increased incidence of diabetes in the pediatric population is observed in the age group 0 to 9 years [29]. The systematic review published in 2007 documents the common fact of both: a high number — at least three times higher — as well as an extended time of children hospitalization — at least twice — with diabetes compared to the children without diabetes [28].

According to the Sayers et al. in the United Kingdom, the high number of hospitalizations of children with diabetes (480% compared to the population of children without diabetes) has remained for more than a decade. Authors of this widely quoted article from BMJ (2015) indicate: annual increase in sickness (3–4%) and socioeconomic status and care in a smaller diabetic center as one of the chief reasons for this trend [30].

The current, similar population data was presented by a group of German researchers. According to the German Information System for health care diabetes (n = 12030242), it has been documented that the number of hospitalizations for children with diabetes is 4–5 times higher, especially in the group of young children and adolescents [31].

At the same time, it should be noted that the diabetology education model in these countries is different. Diabetes education is separated in outpatient care. The educator is mobile, accompanying the child and family (often with close cooperation of social workers) both at home and at school (fires days at home after completing hospitalization of a child with newely diagnosed diabetes).

Poland, with its centralized pediatric diabetes care, is illustrated by the number of hospitalizations under healthcare services related to diabetes provided mainly in provincial and university facilities (Table 3). Regionalization of care has long been believed to be the best systemic solution for both Poland and the rest of the world; in terms of the quality and the economics of diabetes care. The 2017 International Diabetes Society for Pediatric and Adolescent Diabetes (ISPAD) provided new evidence to support that large pediatric diabetes centers achieve significantly superior treatment effects [32, 33]. Larger diabetes care centers allow to provide continuous, holistic, multidisciplinary care using new technologies to severely and chronically sick child and the child's family. On the other hand, while the accessibility to the services is similar, there are marked differences in diabetes care [23, 34]. To eliminate the differences, among the proposed solu-

Table 5. Distribution of pediatric hospitalization for acute diabetic complications for each province

Province	Number of all hospitalizations (thousands)	Number of hospitalizations for acute complications (thousands)	Proportion of hospitalizations for acute complications (%)	Number hospitalizations of new patients (thousands)	Number of hospitalizations of new patients for acute complications (thousands)	Proportion of hospitalizations of new patients for acute complications (%)
Opole	0.06	0.02	36.4	0.04	0.02	44.7
Greater Poland	0.84	0.28	33.0	0.25	0.11	42.7
Warmia-Masuria	0.16	0.04	26.4	0.07	0.03	44.9
Kujawy-Pomerania	0.33	0.08	25.7	0.18	0.05	25.5
West Pomerania	0.33	0.06	18.6	0.12	0.04	33.6
Podkarpackie	0.21	0.04	17.4	0.14	0.03	20
Lubusz	0.16	0.03	16.9	0.06	0.01	23.3
Lublin	0.36	0.05	14.8	0.14	0.04	26.7
Silesia	0.66	0.09	13.3	0.26	0.06	21.9
Lesser Poland	0.69	0.09	13.2	0.18	0.04	22.7
Podlasie	0.29	0.03	9.1	0.1	0.02	19.8
Pomerania	0.75	0.07	8.8	0.44	0.04	10.1
Lower Silesia	0.79	0.07	8.6	0.22	0.04	18.1
Mazovia	2.08	0.11	5.4	0.58	0.06	9.6
Świętokrzyskie (Holy Cross)	0.31	0.01	3.5	0.08	0.01	10.5
Łódź	0.6	0.02	2.8	0.15	0.01	4.5
Poland	**8.62**	**1.09**	**12.6**	**2.99**	**0.59**	**19.7**

Table 6. Pediatric hospitalizations for diabetes in individual provinces according to DRG (%)

Province	P24 Diabetes mellitus	K28 Congenital metabolic disorders	K27B Eating disorders < 18 years of age	Other	Number of hospitalizations DRG (thousands)
Lower Silesia	93.3%	6.4%	0.0%	0.3%	0.78
Kujawy-Pomerania	82.4%	17.0%	0.6%	0.0%	0.33
Lublin	98.6%	1.4%	0.0%	0.0%	0.35
Lubusz	98.7%	1.3%	0.0%	0.0%	0.16
Łódź	99.3%	0.0%	0.2%	0.5%	0.60
Lesser Poland	96.8%	2.6%	0.3%	0.3%	0.69
Mazovia	80.3%	17.4%	0.4%	1.9%	2.07
Opole	98.2%	1.8%	0.0%	0.0%	0.06
Podkarpackie	97.1%	1.5%	1.0%	0.5%	0.21
Podlasie	93.2%	4.3%	1.1%	1.4%	0.28
Pomerania	58.2%	41.2%	0.3%	0.4%	0.75
Silesia	94.1%	5.1%	0.6%	0.2%	0.63
Świętokrzyskie	95.5%	3.8%	0.0%	0.6%	0.31
Warmia-Masuria	89.3%	2.5%	6.9%	1.3%	0.16
Greater Poland	96.7%	2.6%	0.7%	0.0%	0.82
West Pomerania	94.3%	5.1%	0.3%	0.3%	0.33
Poland	**88.2%**	**10.6%**	**0.5%**	**0.7%**	**8.51**

tions, is the implementation of facility benchmarks in terms of treatment effects, and adaptation to national and international guidelines for diabetes care provided to children.

In Poland, a high number of hospitalizations of children and adolescents for diabetes at specialized facilities varies from province to province. In individual provinces, a high number of one-day hospitalizations (financial policy of regional branches of the National Health Fund) impact both: the number of general hospitalizations and the high differences between voivodships. Moreover, the number of hospitalizations often overlaps with the net migration rate. It is likely that those service-providing facilities where the proportion hospitalizations of patients from outside the province is high, and the number of patients from this particular province hospitalized in other provinces is low, are resilient facilities with a vast potential for providing treatment, education and psychological support. They are usually large diabetic centers, thus the facilities that provide holistic diabetes care and high quality, with a wider access and use of new technologies for the monitoring and treatment of the disease [30].

Rapid technological progress and social media are both important and common elements of pediatric diabetes care [35, 36]. Young parents and caregivers actively browse Polish and international websites in search of the best possible and most effective treatment solutions for their children. As a consequence, they share their experiences on various forums, recommend diabetes facilities and support one another in their everyday lives with diabetes. Based on the above, it may be concluded that in the Mazovia, Silesia, Lower Silesia, Podlasie, Pomerania, Łódź and West Pomerania Provinces, large-scale pediatric diabetes care and the scope of services provided "attract" children, adolescents and their caregivers from smaller provinces. A particularly high outflow of patients is observed for the Lublin, Lubusz, Warmia-Masuria, Opole, Świętokrzyskie (Holy Cross), Greater Poland and Podkarpackie Provinces. This finding should be interpreted carefully and with caution, and on two levels; in terms of regional health policy (e.g. extent of commissioning by the National Health Fund, number of diabetes beds) and the quality of medical care (e.g. number of diabetes specialists, nurses, educators, dietitians, psychologists, compliance with the current standards of diabetes care, treatment efficacy and the number of available insulin pumps) [4, 5, 37].

The duration of the diabetic child's stay (defined as the average length of hospitalization) at a hospital ward varies from province to province, averaging 4.6 days for the whole of Poland (Table 4). As mentioned above another difficulty in this assessment is the diversity in hospitalization contracts between individual diabetes facilities and the National Health Fund, both

Table 7. Hospitals providing 80% of all the pediatric hospitalizations for diabetes in Poland

Health service provider	Number of patients (thousand)	Number of hospitalizations (thousand)	% of hospitalizations in Poland	Cumulative % of hospitalizations
Independent Public Pediatric Teaching Hospital in Warsaw	1.0	1.2	14.2	14.2
Karol Jonscher Teaching Hospital, Poznań University of Medical Sciences, Poznań	0.6	0.7	8.6	22.7
Independent Public Teaching Hospital No. 1 in Wrocław	0.6	0.7	8.5	31.3
Children's Memorial Health Institute in Warsaw	0.6	0.7	8.5	39.8
University Children's Hospital in Kraków	0.6	0.6	7.4	47.2
University Clinical Centre in Gdańsk	0.5	0.6	7.4	54.6
Independent Public Teaching Hospital No 6 of the Upper Silesian Medical University in Katowice, Upper Silesian Children's Health Institute	0.5	0.6	6.8	61.4
Maria Konopnicka University Teaching Hospital No. 4, Medical University in Łódź	0.4	0.5	6.3	67.7
University Children's Hospital in Lublin	0.2	0.3	3.9	71.7
Władysław Buszkowski Provincial Specialist Children's Hospital in Kielce	0.3	0.3	3.6	75.2
Ludwik Zamenhof University Children's Teaching Hospital in Białystok	0.2	0.3	3.2	78.4
Professor Tadeusz Sokołowski Independent Public Teaching Hospital No. 1, Pomeranian Medical University, Szczecin	0.2	0.2	2.8	81.3

in terms of score value and the presence/absence of the so-called one-day hospitalization. However, the longest average lengths of stay (ALOS) values are quite striking, with the highest ALOS values of 9.6 days in the Podkarpackie Province and 6.9 days in the Lublin Province, where the proportion of one-day hospitalizations is quite considerable (58% for the Lower Silesia, 45% for the Lesser Poland, 24% for the Greater Poland and 24% for the Pomerania Provinces). It may be hypothesized that such extreme differences result from the fact that diabetes care is organized in specialist inpatient departments providing hospital services in diabetes care (apart from one-day hospitalization) as well as, for instance, social and economic (poverty) or communication factors (difficult remote access), area and urbanization of the province. In all the facilities, the longest duration of hospitalization was observed among the youngest children, which is understandable and is directly associated with the low stability of a young child's body.

Acute diabetic complications are a manifestation of many elements, with the following being the most important: awareness in the society, education of healthcare professionals on the signs and symptoms of diabetes and on the need for rapid medical intervention, extent of diabetes care and social care (e.g. frequent occurrence of emotional problems and depression in adolescents). The process requires ongoing and consistent activity in all the above, wide fields. The proportion of acute admission to hospital in Poland is 12.6%. In four provinces, the Opole, Greater Poland, Warmia-Masuria and Kujawy-Pomerania Provinces, this proportion is at least twice as high. Again, while the reporting is correct in these provinces, it should, however, be assumed that this finding poses a challenge to these regions, their specialist pediatrics diabetes care and the improvement of the overall awareness in the society and among the primary care physicians regarding the initial manifestations of diabetes mellitus [38, 39].

With regard to the acute complications occurring in first-ever patients with diabetes, this value averaged 20%, similarly to the total number, with a wide variation of results (Table 5). While the objections about the reporting remain the same, the high value, exceeding 40%, requires interventions of the appropriate structures of healthcare. It is assumed that 30% rate of acute complications, namely diabetic ketoacidosis, in children recently diagnosed with type 1 diabetes mellitus is considered high [40].

Results of the analysis of the reporting of all the pediatric hospitalizations for diabetes to the National Health Fund according to DRGs have shown that the group P24 directly dedicated to diabetes was utilized in nearly 90%. Only in several provinces, the code K28, which refers to congenital metabolic disorders and often includes extended diagnostic evaluation in pediatric diabetes care, was additionally used in reconciliation. For example, extending the diagnostic evaluation to include genetic testing for monogenic forms of diabetes or hypoglycaemia, often requires indicating the code K28 to have the costs paid for. This case is difficult to interpret due to the considerable difference in score pricing of the hospitalization under both codes. It may, however, be alleged that hospitals that provide services qualifying under this code offer a wider range of medical services, especially given the fact that in many cases, this findings remains consistent with the net migration rate. However, in the analysis above, in addition to considering incorrect coding, the value of the diabetes score contract between a given facility and the National Health Fund should be taken into account.

As already mentioned, several limitations of this study exist. The first limitation is the absence of a supplementary analysis based on the extended database with information on, for example, typical medicines (insulin, glucagon), test strips assigned to individual ICD-10 diagnoses. Unfortunately, the authors had no access to the medicines database at the time of developing the maps of health needs in 2016. The second limitation refers to the coding of hospitalization services, which are often routine, given the same pricing by the National Health Fund. Another limitation refers to the differences in the commissioning of hospitalization services by individual facilities in individual provinces (e.g. presence or absence of contracts commissioning one-day hospitalizations, access to new technologies). In addition, the authors did not analyze medical procedures due to the absence of appropriate reporting (procedures are not scored or priced voluntarily). Nevertheless, the present publication is the first so extensive scientific analysis of this topic for Poland.

Summary

In Poland, specialized diabetes care for children and adolescents is regionalized. Nevertheless, there are significant differences in the number of hospitalizations per 100,000. children and in the average length of stay of patients in the hospital.

High number and differences in the numbers, duration of hospitalization of children with diabetes require further monitoring at a coordinated system of pediatric care. It is crucial to create coordinated care system for children — by identifying reference centers and supporting cooperation with outpatient specialist care facilities. In addition, significant patient

migrations point to the need to align pediatric diabetes care standards.

It is necessary to improve the societal and medical awareness regarding the signs and symptoms of diabetes to reduce the number of acute complications, including those at the time of diagnosis.

An absolute requirement is to increase the quality of reporting in terms of both coding and procedures performed in patients, so that, in the future, reference centers that can be added to bear the additional costs of diagnosis and care of a difficult patient. This would cause the introduction of new JGP groups that better reflect the specificity of treatment. It would be very important to regularly (at least once a year) monitor the path of patients, including medicines and glucose test strips, based on the latest data. This could be done by appropriate cooperation of National Health Fund bases or through the appropriate clinical registry. Due to the between provinces differences in children's hospitalizations related to diabetes, we should make every effort to provide equal access to specialists diabetes care in order to provide specialist care in accordance with the standards.

In addition, constant cooperation with provincial and national consultants in the area of problems related to pediatric diabetology in Poland is necessary.

Conclusions

Due to the differences between provinces in the number of children hospitalizations due to diabetes, one it is crucial to strive to equalize access to specialist diabetes care in order to ensure its compliance with its standards.

Conflict of interests statements

The authors do not declare any conflict of interests.

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