

# Comparison of indicators of the use of insulin and oral diabetes medication in a Polish population of patients in urban and rural areas in the years 2008, 2011 and 2012

Andrzej Śliwczyński<sup>1,2</sup>, Melania Brzozowska<sup>2</sup>, Tomasz Czeleko<sup>2</sup>, Waldemar Karnafel<sup>3</sup>, Aleksandra Sierocka<sup>4</sup>, Petre Iltchev<sup>5</sup>, Michał Marczak<sup>5</sup>

<sup>1</sup> Public Health Department, Health Sciences Faculty, Medical University, Łódź, Poland

<sup>2</sup> National Health Protection Fund, Warsaw, Poland

<sup>3</sup> Cathedral and Clinic of Gastroenterology and Metabolic Illnesses, Medical University, Warsaw, Poland

<sup>4</sup> K. Jonscher Hospital, Łódź, Poland

<sup>5</sup> Health Care Policy Department, Medical University, Łódź, Poland

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## Abstract

**Introduction.** Diabetes is one of the 10 most important chronic diseases in the world. According to the data of the International Diabetes Federation, in Poland 9% of the population between the ages of 20–79 suffer from diabetes.

**Objective.** The aim of this study was to investigate the differences in the prevalence of diabetes in urban and rural areas in Poland, and the preparation of a model describing the phenomenon.

**Materials and Method.** Differences between urban and rural areas were studied for the occurrence of patients treated with diabetes per 100,000 inhabitants, the number of patients, structure of treatment per the used products, and the costs of reimbursement of treatment products between 2008–2012. Urban and rural cases were compared using zip codes. The basis for classifying a patient as being an inhabitant of an urban or rural area was an urban zip code of the declared place of residence.

**Results.** Differences were observed both between various areas of Poland, as well as depending on whether the declared place of residence of the patient was urban or rural. Differences between urban and rural areas within the studied period have increased. The difference in the prevalence of diabetes among the inhabitants of Podlaskie, Śląskie or Świętokrzyskie provinces is striking.

**Conclusion.** Differences between urban and rural areas which depend on morbidity and detection of patients in the earlier phase of illness, the structures of medical technologies used in the treatment process, the number of purchased pharmaceuticals, enable better monitoring of effectiveness and quality of politics on prevention and treatment of chronic diseases. It is important for the creation of a health policy to devise a system of indicators, which will enable a decrease in the existing differences between regions, and between the urban and rural areas within the provinces.

## Key words

diabetes mellitus, diabetes medication, health differences, urban, rural

## INTRODUCTION

Diabetes is one of the 10 most important chronic diseases in the world [1]. According to the data of the International Diabetes Federation (IDF), in Poland 9% of population between the ages of 20–79 suffer from diabetes [2]. According to the IDF:

Diabetes was the main cause of death of over 100,000 persons in EU member states in 2011 and is the main cause of deaths in most developed countries (...) additionally, approximately 50% of persons with diabetes die as a result of cardiovascular disease, and 10–20% as a result of renal failure. (IDF, 2011) [2, p. 42].

Diabetes is responsible for 3.5% of worldwide deaths caused by non-infectious diseases [3, p. 35]. In Poland, diabetes is the

cause of 6.3% of deaths [4]. According to the World Health Statistics, in Poland cardiovascular disease and diabetes are responsible for 219 deaths per 100,000 of inhabitants in the age bracket of 30–70 in 2008 [3].

Epidemiological data indicate that currently approximately 366 million people suffer from diabetes, by 2025 their number will increase to over 522 million [5], and during the next 30 years it will increase two-fold. According to the WHO, the incidence of diabetes since 2006 is higher than the incidence of HIV/AIDS infection, which means that this is the first time that an infectious illness is not the most important single cause of mortality worldwide. According to Taton and others, the estimated number of diabetes patients in Poland amounts to over 2.5 million people, whereas approximately 25% of the sick are not aware of their illness [6]. Sobierajski and Czupryniak estimate the number of diabetics in Poland to be '2.6 million, which is 5% of Polish society, and probably 750, thousand of them are not yet aware of this' [7].

In order to avoid complications and costly hospitalization, the treatment of diabetes should be properly managed [2, p. 10].

Address for correspondence: Andrzej Śliwczyński, Departament Gospodarki Lekami, Centrala NFZ, Grójecka 186, 02-390 Warsaw  
e-mail: andrzej.sliwczynski@nfz.gov.pl

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The actions of the Polish National Health Fund (Narodowy Fundusz Zdrowia – NFZ) concerning the financing of medicinal products used in the treatment of diabetes are in accordance with the initiatives of the European Diabetes Leadership Forum, intended to improve the prevention, early detection and intervention, as well as management and control of diabetes [2, p. 42]. The ranking of diabetes as a factor causing lost years of life through earlier death has fallen from 14<sup>th</sup> place in 1990 to 16<sup>th</sup> place in 2010 [8].

In Poland, the total cost of diabetes treatment amounts to approximately 6 billion złoty [9], of which the direct costs in 2011 amounted to about 2.5 billion złoty. Of this amount, 71% applied to the cost of diabetes medication, and 29% were generated by medical care (including primary health care, ca. 225 million złoty, and outpatient treatment and hospitalization – 500 million złoty) [10]. At the same time, it is assumed that the costs of reimbursement of diabetes medication and diagnostic tests for self-diagnosis [11] in 2005–2009 increased by 26%.

In the case of diabetic patients, the financial burden they bear as a result of the necessity of purchasing diabetes medication is a very significant cost element. All substances are reimbursed only to a specific established level of the cheapest medication in the group, with the result that the patients themselves are required to bear part of the expenses [12].

In accordance with Polish regulations [13, 14], diabetes medication is issued to patients based solely on a doctor's prescription. Access to the data of reports of sales based on prescriptions of generally accessible pharmacies for Provincial Departments of the National Health Fund [15, 16, 17, 18] has enabled an analysis of the use of diabetes medication in Poland in the years 2008, 2011 and 2012, in particular:

- A. showing regional (provincial) trends on the use of strips:
  - i. establishing the population of patients using insulin, summary costs of use of insulin, divided into urban and rural areas;
  - ii. establishing the population of patients using oral diabetes medication, summary costs for the use of oral diabetes medication, divided into urban and rural areas;
  - iii. establishing the population of patients using simultaneously insulin and oral diabetes medication, summary costs for the use of insulin and oral diabetes medication, divided into urban and rural areas.
- B. Showing the trends of individual population groups (provinces, urban, rural areas).

Important for planning and implementing the policy on chronic diseases, such as diabetes, is ensuring the accessibility, equality, and ability to finance therapy regardless of the patient's place of residence. Table 2 assesses the effectiveness of insulin treatment [19]. Analysis of the differences in the use of diabetes medication between urban and rural areas will be the initial point for further analysis within the presented study. Further analyses shows the differences between urban and rural areas as basic indicators for monitoring in such fields as:

- diagnosed patients in respect to potentially sick;
- treated vs. diagnosed patients;
- diabetes morbidity rate according to gender and age per 100,000 inhabitants;

- treatment technologies used. Analyses of changes in the treatment process (replacement of insulin with oral medication etc.);
- percentage structure of patients in individual forms of treatment;
- costs of reimbursement and surcharges of domestic households for medicinal and diagnostic products (% division of costs: National Health Fund payer vs. patient, cost of reimbursement of 1 pack; amount of surcharge on 1 pack);
- types of diabetes.

When conducting comparative analysis, it is important to answer the question: What dimensions are important when collecting data? These dimensions, in the future will enable improvement in the quality and detail of data, and may enable better allocation of resources, thus resulting in the resources being more adequate to the needs. Also important from the point of view of urban vs. rural area difference analysis methodology, the following can be indicated:

- patient's gender
- patient's age
- incidence
- morbidity
- detectability (diagnosis)
- direct cost of treatment per 1 patient
- share (% structure) of population and costs
- dynamics of the number of patients in time
- basic statistic measures, e.g. mean, deviation from the mean
- where there is the biggest increase and where there is the biggest decrease in the number of patients (absolute numbers, not taking into account the number of inhabitants).

The number of studies on the differences between diabetes sufferers in urban and rural areas is small [20, 21, 22]. Andrus et al. limit themselves to testing the variety between the urban and rural areas within one state [23]. Weingarten et al. restrict the studied patients to Medicare beneficiaries living in rural USA [24], whereas Kirkbride et al. restrict the scope of patients to Medicaid beneficiaries living in rural areas in the State of Oregon [25]. The studies also included diabetes patients of the Veteran Health Administration and their racial / ethnic variations [26].

## MATERIALS AND METHOD

Data of reports of sales based on doctor prescriptions of generally accessible pharmacies contain a unique patient identifier, an 11 digit number (Universal Electronic System for Registration of the Population – PESEL) which enables establishing the individual data of the patient (e.g. age, gender). Simultaneously, the ensured uniqueness of this number [27] enabled calculation of the number of patients filling prescriptions for specific types of treatment during the analysis. The data was obtained from the Medical Registration System (Rejestru Usług Medycznych – RUM), the National Health Fund IT system, using SQL (Structured Query Language) and BO (Business Object) tools, and then analyzed using MS Office (Excel) and Statistica 10 packages. Data concerning the population of Poland were taken from



the Central Statistical Office (Główny Urząd Statystyczny – GUS) [28].

In the second stage of analysis, to each of the PESEL numbers, for which the filling of a prescription for diabetes medication an ATC (Anatomical Therapeutic Chemical classification system) a code was assigned:

- A10 A\$ [14]<sup>1</sup> – Insulin and analogues;
- A10 B& [15]<sup>2</sup> – Oral diabetes medication.

As a result, 3 sets of data were obtained:

1. patients filling prescriptions for insulin;
2. patients filling prescriptions for oral diabetes medication;
3. patients filling simultaneously prescriptions for insulin and oral diabetes medication.

For each of the above sets it was possible to calculate the population parameters of patients discussed above – province, urban, rural. Subsequently, based on the obtained information, differences were shown between the consumption of diabetes medication (divided into types of medication used) in individual years, provinces, in urban and rural areas.

This method is based on analysis of reports from the reimbursement of prescriptions filed with the National Health Fund, which means that this number does not include all people suffering from diabetes. Some patients are people who have not visited a doctor and do not know that they are ill, but have undiagnosed diabetes. They will most probably visit a doctor only when they will have diabetes-related complications, such as retinopathy, nephropathy, etc.

The presented study on the costs of medical products supplements the publication by Gajewska et al. [29]. Data concerning the number of patients are in 2 main groups, insulin and oral diabetes medication, to eliminate the possibility of repetition. From the sum of the population taking insulin and oral diabetes medication the number of patients taking simultaneously insulin and oral medication was subtracted. Due to the possibility of the purchase of drugs by a patient within the area of the whole Poland, the obtained data divided into provinces should not be added, because this could result in the multiplication of data.

## RESULTS

Based on the data collected in the National Health Fund, the general number of diabetes patients and the number of prescribed diabetes medication (in number of packs) in individual years were established. Additionally, the reimbursement amounts and amount of surcharge on the part of the patient were calculated (Tab. 1–6).

In the period 2008–2012, the number of patients treated for diabetes increased from 2,337,541 to 2,702,903 (Tab. 1). Analyzing the rate of increase of the patients, depending on the method of treatment, it was noted that the biggest increase was observed in the period 2008–2011 for the group of patients treated both with insulin and oral medication – 118.24% (Tab. 1). These numbers include solely patients with

diagnosed and treated diabetes. It should be remembered that there are patients with diabetes who are unaware of their condition, as well as those with pre-diabetes. If these groups are taken into account, the number of people who will require treatment in future years will increase.

Another tendency that can be observed is the slow change in the treatment structure (Tab. 1). In the studied period, there occurred a small decrease in the number of patients treated with insulin in favour of patients taking oral medication.

Analyzing the structure of patients living in urban areas per the used treatment method, a tendency can be noticed of decreasing the percentage of urban patients treated solely with insulin from 15.93% in 2008, a decrease to 14.22% in 2012, and an increase in patients treated with oral medication from 67.8% – 69.53%. A similar tendency can also be observed among patients registered as residents of rural areas. The percentage of patients treated with insulin decreased from 16.8% in 2008 to 14.75% in 2012. One may notice a 0.5% difference between urban and rural areas for patients treated with insulin. The share of patients in rural areas treated with oral medication increases from 65.9% in 2008 to 67.65% in 2012. For patients living in rural areas and treated with a combination of insulin and oral medication an increase was also observed – from 17.30% to 17.60%, in contrast to inhabitants of urban areas.

As noted above, changes in the structures and the reimbursement amount per 1 patient resulted in a decrease of medication reimbursement costs (Tab. 3). In the years 2008–2012, an annual decrease was observed of insulin costs per 1 patient living in an urban area, from 1,042.15 zlotys to 1,018.05 zlotys in 2012, and a large increase to 1,186.28 zlotys in 2011 (Tab. 3). The increase in 2011 is the result of announcing the introduction of the Medicine Reimbursement Act and an observed sale of all groups of medicine. In the studied period, the amount of annual insulin reimbursement per 1 patient living in an urban area decreased significantly, from 920.87 zlotys to 830.74 zlotys, with another large increase in the reimbursement in 2011 – to 1,042.81 zlotys (Tab. 4).

Expenses for the reimbursement by the National Health Fund of products used in direct treatment of diabetes have increased from 954,454,354 zlotys to 971,176,413 zlotys. Prices paid by the patients have increased from 306,044,000 to 391,588,225 zlotys. In the studied period, the patient's share in payment for the medicinal products used in diabetes treatment increased from 24.28% to 28.74%. The total costs of reimbursement of medicinal products used in diabetes treatment have increased from 1,260,498,354 zlotys to 1,362,864,637 zlotys in 2012. They reached the highest value in 2011–1,590,257,996 zlotys.

The analyses shows large differences in insulin reimbursement between individual regions of Poland and between patients with declared residence in urban and rural areas (Tab. 3). The lowest amount of annual insulin reimbursement per 1 patient living in an urban area in 2008, in the Warmińsko-Mazurskie province, amounted to 839.05 zlotys, and the highest in Małopolskie province – 1003.99 zlotys. In 2012, these provinces still had the lowest and highest amounts of insulin reimbursement – 747.15 and 886.55 zlotys, respectively. The amount of annual insulin reimbursement for inhabitants of rural areas is the lowest in Warmińsko-Mazurskie province – 797.31 zlotys, and the highest in Pomorskie province – 945.49 zlotys (Tab. 3). In 2012, the amount of annual insulin reimbursement for

1. \$ – represents the letters B, C, D and E occurring in the ATC classification.

2. '&' – denotes the letters A, B, F, G, H and X occurring in the ATC classification.



**Table 1.** Number of diabetes patients per the place of residence and type of treatment in 2008, 2011 and 2012.

Type of treatment	Urban		Urban		Urban		Urban		Urban		Rural		Rural		Rural		
	Insulin	Insulin and Oral	Insulin	Insulin and Oral	Insulin	Insulin and Oral	Insulin	Insulin and Oral	Insulin	Insulin and Oral	Insulin	Insulin and Oral	Insulin	Insulin and Oral	Insulin	Insulin and Oral	
Province \ year	2008	2011	2012	2008	2011	2012	2008	2011	2012	2008	2011	2012	2008	2011	2012	2012	
Dolnośląskie	33 158	35 113	33 754	95 547	111 789	111 285	18 086	20 570	19 831	10 808	11 724	11 895	28 285	33 619	35 049	5 872	7 010
Kujawsko-pomorskie	24 199	27 393	26 033	51 166	61 822	59 511	10 964	13 422	12 578	12 095	14 016	14 282	24 120	29 557	30 426	5 983	7 341
Lubelskie	13 196	14 908	14 253	41 082	47 792	46 335	6 923	8 116	7 620	11 702	13 256	13 228	35 213	42 354	42 504	5 894	7 122
Lubuskie	10 853	12 084	12 198	24 566	29 097	29 969	5 583	6 510	6 526	5 193	6 016	6 082	10 879	13 359	13 578	2 699	3 257
Łódzkie	31 079	34 134	32 366	82 323	95 953	93 400	16 885	19 859	19 018	12 837	14 410	14 963	31 675	37 904	40 053	6 939	8 876
Małopolskie	28 085	31 086	30 098	74 925	86 396	84 222	13 425	15 821	15 184	18 841	21 588	22 410	46 752	56 862	59 346	9 129	11 675
Mazowieckie	49 657	56 000	53 780	144 602	163 893	158 735	23 925	28 680	27 220	20 561	23 613	24 831	53 429	64 047	67 900	9 593	12 991
Opolskie	8 905	9 957	9 630	24 574	29 677	28 978	4 971	5 903	5 671	6 922	7 750	8 006	18 508	22 126	23 066	3 941	4 899
Podkarpackie	11 631	13 110	12 555	32 913	38 507	37 726	6 027	7 190	6 809	12 336	14 609	15 052	32 902	39 893	41 777	6 468	7 914
Podlaskie	8 206	9 330	9 284	24 664	30 200	29 765	4 358	5 067	5 082	4 081	4 786	5 286	12 225	14 929	16 683	2 244	2 982
Pomorskie	23 162	26 199	25 973	60 794	75 589	76 193	10 652	12 835	12 673	9 548	11 181	11 445	20 042	26 192	27 425	4 530	5 788
Śląskie	69 785	73 128	71 954	175 795	194 176	192 115	37 189	40 657	39 402	17 856	19 121	19 206	40 224	46 300	47 095	9 196	10 686
Świętokrzyskie	11 527	12 586	11 679	28 612	33 128	30 819	6 042	6 841	6 338	8 587	9 838	10 171	21 309	25 335	26 170	4 395	5 475
Warmińsko-mazurskie	12 325	13 803	13 495	30 442	37 078	36 925	5 925	7 015	6 861	6 569	7 565	7 593	16 273	19 416	19 939	3 357	4 063
Wielkopolskie	34 400	37 496	35 716	77 380	92 656	91 696	16 468	19 773	18 862	20 807	23 521	24 002	45 822	55 825	59 278	10 538	13 307
Zachodniopomorskie	19 413	21 801	21 207	47 916	57 316	57 729	9 448	11 295	11 072	7 148	7 890	7 555	15 936	19 229	18 936	3 525	4 171
Total	389 581	428 128	413 975	1 017 301	1 185 069	1 165 403	196 871	229 554	220 747	185 891	210 884	216 007	453 594	546 947	569 225	94 303	117 546

Source: Own work



**Table 2.** Diabetes patients per 100 000 inhabitants, as per the declared place of residence, based on reimbursed prescriptions

Area	Urban		Urban		Urban		Urban		Urban		Rural		Rural		Rural			
	Insulin	Insulin and Oral	Oral	Oral	Oral	Oral	Oral	Oral	Oral	Oral	Oral	Oral	Oral	Oral	Oral	Oral		
Province \ year	2008	2011	2012	2008	2011	2012	2008	2011	2012	2008	2011	2012	2008	2011	2012	2008	2011	2012
Dolnośląskie	1 635	1 726	1 659	4 712	5 494	5 469	892	1 011	975	1 273	1 329	1 349	3 330	3 812	3 974	691	785	795
Kujawsko-pomorskie	1 921	2 162	2 054	4 063	4 878	4 696	871	1 059	993	1 496	1 686	1 718	2 983	3 556	3 661	740	876	883
Lubelskie	1 312	1 477	1 412	4 084	4 736	4 591	688	804	755	1 012	1 140	1 138	3 047	3 643	3 656	510	613	610
Lubuskie	1 688	1 863	1 880	3 820	4 485	4 620	868	1 004	1 006	1 419	1 607	1 624	2 973	3 567	3 626	738	879	870
Łódzkie	1 897	2 113	2 004	5 024	5 940	5 782	1 030	1 229	1 177	1 410	1 569	1 629	3 480	4 128	4 362	762	914	967
Małopolskie	1 737	1 893	1 833	4 633	5 262	5 130	830	964	925	1 128	1 266	1 314	2 800	3 335	3 481	547	657	685
Mazowieckie	1 476	1 650	1 585	4 298	4 830	4 678	711	845	802	1 117	1 248	1 312	2 904	3 384	3 588	521	647	686
Opolskie	1 644	1 877	1 816	4 537	5 595	5 463	918	1 113	1 069	1 409	1 603	1 656	3 766	4 576	4 770	802	984	1 013
Podkarpackie	1 353	1 489	1 426	3 829	4 372	4 283	701	816	773	995	1 171	1 206	2 653	3 197	3 348	522	634	650
Podlaskie	1 156	1 289	1 282	3 473	4 171	4 111	614	700	702	848	1 003	1 108	2 539	3 130	3 498	466	560	625
Pomorskie	1 570	1 748	1 733	4 121	5 045	5 085	722	857	846	1 283	1 424	1 458	2 692	3 336	3 493	609	727	737
Śląskie	1 920	2 035	2 002	4 836	5 402	5 345	1 023	1 131	1 096	1 767	1 853	1 861	3 980	4 486	4 563	910	1 024	1 035
Świętokrzyskie	2 000	2 187	2 029	4 965	5 756	5 355	1 049	1 189	1 101	1 233	1 400	1 448	3 059	3 606	3 725	631	751	779
Warmińsko-mazurskie	1 442	1 601	1 565	3 561	4 299	4 282	693	813	796	1 148	1 282	1 287	2 844	3 290	3 378	587	679	688
Wielkopolskie	1 796	1 949	1 856	4 041	4 816	4 766	860	1 028	980	1 403	1 536	1 567	3 090	3 645	3 871	711	851	869
Zachodniopomorskie	1 668	1 838	1 788	4 116	4 833	4 868	812	952	934	1 351	1 470	1 407	3 013	3 582	3 528	666	777	745
Average	1 673	1 831	1 770	4 368	5 067	4 983	845	982	944	1 252	1 392	1 426	3 055	3 610	3 757	635	756	776

Source: Own work



**Table 3.** Annual treatment costs per 1 patient, independent on the payer

Type of treatment	Urban		Urban		Urban		Urban		Urban		Rural		Rural		Rural		
	Insulin	Insulin and Oral	Oral	Insulin and Oral	Insulin and Oral	Insulin and Oral	Insulin and Oral	Insulin and Oral	Insulin and Oral	Insulin and Oral	Oral	Insulin and Oral	Oral	Insulin and Oral	Oral	Insulin and Oral	
Province \ year	2008	2011	2012	2008	2011	2012	2008	2011	2012	2008	2011	2012	2008	2011	2012	2012	
Dolnośląskie	991.72	1145.94	951.11	221.75	226.61	197.14	1207.45	1365.53	1132.58	927.81	1057.24	905.49	208.54	189.60	1114.87	1258.59	1076.56
Kujawsko-pomorskie	1022.36	1184.06	977.31	199.63	196.63	176.24	1182.53	1367.09	1131.65	1009.96	1161.03	990.29	196.28	171.42	1177.31	1360.08	1158.25
Lubelskie	1012.12	1138.57	951.88	218.45	221.58	199.52	1194.81	1349.98	1118.77	964.15	1075.21	928.26	209.25	184.27	1146.00	1278.48	1086.58
Lubuskie	1063.89	1216.05	982.47	227.26	230.41	190.61	1261.27	1417.04	1165.67	1024.26	1154.05	965.88	214.46	179.87	1213.62	1363.81	1144.08
Łódzkie	1028.07	1184.49	987.04	201.52	205.19	186.90	1236.93	1401.42	1173.37	970.37	1100.06	941.44	189.83	175.96	1157.54	1298.21	1122.59
Małopolskie	1124.97	1231.15	1094.07	217.95	219.05	194.00	1338.01	1465.53	1291.33	1066.97	1175.17	1051.42	205.03	207.11	183.03	1275.73	1393.25
Mazowieckie	1076.99	1174.40	1073.97	242.76	245.19	217.88	1293.71	1408.95	1259.41	1029.12	1154.44	1030.41	215.65	221.25	197.75	1207.69	1349.97
Opolskie	1111.09	1250.56	1022.69	222.91	222.98	196.97	1322.41	1485.95	1228.95	1075.69	1174.31	988.33	217.84	217.81	192.45	1279.00	1402.44
Podkarpackie	1037.05	1189.77	1010.64	213.45	220.04	194.14	1234.37	1392.36	1182.20	1022.21	1137.49	982.25	205.25	209.87	184.16	1202.33	1335.29
Podlaskie	1059.88	1214.57	1041.71	234.51	233.05	206.43	1263.44	1402.48	1186.59	1018.53	1151.24	1004.67	221.65	224.76	196.91	1205.35	1353.90
Pomorskie	1117.42	1217.98	1061.26	214.64	209.10	187.36	1293.73	1410.09	1215.85	1072.89	1182.56	1025.84	195.05	186.66	1242.70	1364.78	1170.64
Śląskie	1030.48	1207.06	1070.84	202.34	214.16	194.25	1218.67	1406.55	1247.29	1009.04	1169.31	1027.94	195.09	203.23	181.36	1211.37	1368.07
Świętokrzyskie	1007.40	1175.67	993.36	196.48	207.92	193.08	1206.62	1386.63	1182.90	951.04	1079.31	927.94	181.32	192.60	175.27	1131.33	1269.36
Warmińsko-mazurskie	966.43	1072.83	924.59	228.37	229.40	205.24	1186.12	1320.95	1128.02	916.51	1001.23	891.34	214.25	219.54	195.67	1127.51	1225.90
Wielkopolskie	1044.35	1209.04	973.77	205.10	199.09	176.98	1231.57	1398.20	1150.00	1009.54	1134.63	952.22	199.44	193.66	171.77	1187.41	1314.50
Zachodniopomorskie	955.83	1126.89	944.74	207.93	205.77	182.57	1135.87	1317.65	1108.91	909.68	1055.66	914.57	194.50	191.43	173.72	1093.68	1242.34
Average	1042.15	1186.28	1018.05	215.57	218.33	194.64	1238.72	1396.19	1195.24	1004.53	1130.31	980.36	203.47	205.30	182.73	1190.87	1329.15

Source: Own work



**Table 4.** Annual treatment costs per 1 patient, reimbursed by the National Health Fund

Type of treatment	Urban		Urban		Urban		Urban		Urban		Rural		Rural		Rural			
	Insulin	Insulin and Oral	Oral	Oral	Insulin and Oral	Insulin and Oral	Oral	Oral	Insulin	Insulin and Oral	Oral	Oral	Insulin and Oral	Insulin and Oral	Oral	Oral		
Province \ year	2008	2011	2012	2008	2011	2012	2008	2011	2012	2008	2011	2012	2008	2011	2012	2008	2011	2012
Dolnośląskie	863.53	980.36	781.17	96.58	94.41	85.29	970.73	1 084.88	871.21	807.96	908.51	755.60	89.15	87.23	83.14	895	1 002.48	843.03
Kujawsko-pomorskie	912.06	1 037.93	793.97	89.97	83.27	77.33	977.87	1 121.67	870.73	900.06	1 015.21	811.20	86.53	79.31	76.09	976	1 114.30	903.23
Lubelskie	923.41	1 051.73	787.35	101.66	99.59	89.03	1 007.64	1 154.37	872.37	870.68	985.86	782.06	95.66	89.94	84.25	956	1 083.11	865.90
Lubuskie	927.86	1 046.28	797.43	108.24	101.33	89.41	1 017.27	1 132.87	889.64	890.11	983.89	787.88	99.89	90.32	83.97	976	1 080.52	879.26
Łódzkie	907.92	1 044.33	825.43	89.13	87.99	80.05	1 023.18	1 159.89	927.60	853.03	962.65	786.42	82.18	80.93	76.81	952	1 066.03	887.68
Małopolskie	1 003.99	1 108.07	886.55	95.62	93.06	83.99	1 114.69	1 236.07	995.87	942.07	1 050.44	859.61	88.29	84.66	78.96	1 054	1 168.58	962.70
Mazowieckie	944.75	1 025.07	877.46	104.42	100.65	91.17	1 043.56	1 135.86	968.26	908.30	1 012.22	855.59	91.62	89.03	83.72	990	1 102.21	938.24
Opolskie	968.01	1 067.12	848.89	101.74	95.70	88.07	1 077.93	1 193.74	966.28	935.56	1 002.07	823.85	95.51	89.01	85.59	1 034	1 118.77	934.78
Podkarpackie	907.00	1 046.83	812.12	94.96	92.81	84.46	996.00	1 138.34	898.48	889.15	997.33	792.16	91.14	86.13	80.93	970	1 088.92	879.36
Podlaskie	927.56	1 066.17	857.91	114.75	106.34	95.19	1 036.70	1 155.74	935.54	890.19	1 006.10	837.03	104.52	96.01	88.91	984	1 106.33	918.41
Pomorskie	979.52	1 054.26	847.49	97.94	91.87	80.42	1 056.71	1 144.24	925.84	945.49	1 029.66	825.83	86.61	80.26	73.80	1 029	1 119.66	900.48
Śląskie	918.97	1 087.01	879.38	91.28	93.84	85.06	1 015.96	1 189.78	973.59	899.20	1 039.64	845.80	86.02	85.38	79.26	1 013	1 143.79	943.87
Świętokrzyskie	892.19	1 034.97	816.15	88.24	87.66	84.55	999.46	1 142.26	922.59	839.47	950.50	770.66	80.07	78.29	75.92	931	1 044.25	855.57
Warmińsko-mazurskie	839.05	926.64	747.15	106.72	101.77	92.16	942.92	1 049.22	853.91	797.31	865.68	730.04	99.53	95.85	89.83	901	974.82	821.11
Wielkopolskie	925.18	1 047.30	780.18	88.81	83.17	75.02	1 014.15	1 136.32	868.90	895.23	987.96	770.32	85.82	78.97	74.67	980	1 074.69	857.68
Zachodniopomorskie	845.61	976.49	765.31	94.71	89.11	79.85	928.55	1 065.18	847.34	806.67	922.18	743.78	88.70	82.86	78.06	896	1 012.57	815.03
Average	920.87	1 042.81	830.74	96.24	93.39	84.48	1 016.70	1 146.15	922.91	886.57	992.37	806.07	89.51	85.23	80.24	978	1 090.03	895.73

Source: Own work



Table 5. Annual number of packs per 1 patient

Province \ year	Urban		Urban		Urban		Urban		Rural		Rural		Rural		Rural	
	Insulin	Insulin and Oral	Oral	Insulin and Oral	Oral	Insulin and Oral	Oral	Insulin and Oral	Oral	Insulin and Oral	Oral	Insulin and Oral	Oral	Insulin and Oral	Oral	Insulin and Oral
2008	2012	2008	2012	2008	2012	2008	2012	2008	2012	2008	2012	2008	2012	2008	2012	2012
Dolnośląskie	8.85	8.05	15.74	16.71	8.84	8.84	18.03	18.85	7.96	7.96	18.85	18.85	16.12	16.12	8.15	18.34
Kujawsko-pomorskie	9.35	8.22	15.45	16.60	9.09	9.09	16.80	18.04	8.17	8.17	18.04	18.04	16.04	16.04	9.10	17.60
Lubelskie	9.46	8.11	17.01	18.02	9.18	9.18	19.50	20.18	7.96	7.96	20.18	20.18	16.60	16.60	8.73	18.70
Lubuskie	9.52	8.24	16.66	16.72	9.26	9.26	17.97	18.57	8.14	8.14	18.57	18.57	16.05	16.05	8.97	17.41
Łódzkie	9.35	8.56	15.16	16.52	9.60	9.60	16.81	18.45	8.72	8.72	18.45	18.45	15.71	15.71	8.97	17.25
Małopolskie	10.31	9.16	16.01	16.68	10.46	10.46	17.02	17.89	9.41	9.41	17.89	17.89	15.97	15.97	9.93	17.07
Mazowieckie	9.73	9.07	17.81	19.15	9.55	9.55	20.17	21.10	8.99	8.99	21.10	21.10	17.48	17.48	9.25	18.81
Opolskie	9.95	8.80	16.44	16.75	10.00	10.00	17.90	18.53	9.01	9.01	18.53	18.53	15.99	15.99	9.61	17.57
Podkarpackie	9.31	8.39	16.26	17.31	9.16	9.16	18.24	19.16	8.36	8.36	19.16	19.16	16.17	16.17	8.99	17.62
Podlaskie	9.50	8.83	18.47	18.77	9.26	9.26	20.23	21.03	8.47	8.47	21.03	21.03	17.80	17.80	8.85	19.79
Pomorskie	10.01	8.71	16.27	16.29	9.67	9.67	18.86	19.40	8.52	8.52	19.40	19.40	15.30	15.30	9.64	17.59
Śląskie	9.45	9.13	15.14	17.01	9.49	9.49	16.77	18.42	9.18	9.18	18.42	18.42	15.67	15.67	9.54	16.70
Świętokrzyskie	9.18	8.46	14.25	16.46	9.35	9.35	15.16	17.45	8.65	8.65	17.45	17.45	13.17	13.17	8.72	16.07
Warmińsko-mazurskie	8.60	7.71	17.63	18.47	8.44	8.44	19.68	20.99	7.65	7.65	20.99	20.99	17.69	17.69	8.09	19.57
Wielkopolskie	9.52	8.08	15.53	16.23	9.53	9.53	17.07	17.81	8.22	8.22	17.81	17.81	14.82	14.82	9.23	17.06
Zachodniopomorskie	8.65	7.89	15.80	16.53	8.49	8.49	17.26	18.00	7.86	7.86	18.00	18.00	15.97	15.97	8.19	17.33
Average	9.46	8.59	16.10	17.17	9.40	9.40	17.80	18.92	8.60	8.60	18.92	18.92	16.19	16.19	9.10	17.66

Source: Own work





**Table 6.** Differences urban – rural areas: diabetes patients per 100 000 inhabitants, as per the declared place of residence, based on reimbursed prescriptions

Type of treatment	Insulin	Insulin	Insulin	Oral	Oral	Oral	Insulin and Oral	Insulin and Oral	Insulin and Oral
Province/year	2008	2011	2012	2008	2011	2012	2008	2011	2012
Dolnośląskie	363	396	310	1 382	1 682	1 495	201	190	149
Kujawsko-pomorskie	425	475	336	1 079	1 322	1 035	130	183	109
Lubelskie	299	337	275	1 037	1 093	936	178	191	145
Lubuskie	269	256	256	847	918	994	131	124	136
Łódzkie	486	544	374	1 544	1 812	1 420	268	315	211
Małopolskie	608	627	519	1 833	1 927	1 649	283	306	240
Mazowieckie	358	403	273	1 394	1 446	1 091	190	197	116
Opolskie	236	275	160	771	1 020	693	116	128	56
Podkarpackie	358	318	219	1 176	1 175	936	180	181	123
Podlaskie	308	285	174	934	1 041	613	148	139	77
Pomorskie	288	324	276	1 429	1 708	1 591	114	129	108
Śląskie	153	182	141	856	916	782	113	106	61
Świętokrzyskie	768	787	582	1 906	2 150	1 630	418	437	322
Warmińsko-mazurskie	293	319	278	716	1 010	903	106	134	107
Wielkopolskie	393	413	289	951	1 171	895	149	175	111
Zachodniopomorskie	316	368	381	1 103	1 251	1 340	145	175	189
Average	421	439	345	1 313	1 458	1 227	210	224	168

Source: Own work

inhabitants of rural areas was again the lowest in Warmińsko-Mazurskie – 730.04 złotych, and the highest in Małopolskie province – 859.61 złotych.

Analysis of the annual insulin reimbursement amount differences for the urban and rural area inhabitants shows that in 2008 the lowest differences were in the Kujawsko-Pomorskie province – 12 złotych, and the highest in Małopolskie province – 61.92 złotych. Similar tendencies prevailed concerning the number of insulin packs per 1 patient treated, oral medication and combination of insulin and oral medication, as well as patient surcharge amounts. In 2008, the lowest surcharges were paid by urban area inhabitants in Lubelskie province – 88.71 złotych annually per patient, and the highest in Opolskie province – 143.09 złotych. In 2012, the highest surcharges were paid by urban area inhabitants in Pomorskie province – 213.77 złotych, and the lowest in Łódzkie province – 161.61 złotych. Annual surcharges by rural area inhabitants for insulin in 2008 were the lowest in Lubelskie province – 93.47 złotych, and highest in Opolskie province – 140.13 złotych. In 2012, rural area inhabitants in Pomorskie province paid the highest amount for insulin annually – 200.01 złotych, and the lowest in Lubelskie province – 146.19 złotych. The presented study shows a decreasing amount of annual reimbursement for insulin and increasing annual surcharges paid by patients.

Concerning the amounts of annual refunds and surcharges of patients for oral medication, similar differences between regions can be observed. In 2012, the urban dwellers in Wielkopolska province had the lowest amounts of annual reimbursement – 75.02 złotych, and in Podlaskie province the highest – 95.19 złotych. The urban inhabitants of Kujawsko-Pomorskie district paid the least in 2012, and of Mazowieckie district the most – 98.91 and 126.71 złotych, respectively.

Annual average surcharges of patients for oral medication in the period of 2008–2012 decreased, which should be considered a positive phenomenon. This condition results

from the presence of more manufacturers on the market, including generic drug manufacturers, which resulted in higher competition and lower prices, a phenomenon opposite to that observed on the insulin market. Due to the fact that these data were not analyzed on the level of the international name of the main active substance, it was not possible able to establish the impact on the value of reimbursement paid out by the public body and the patient surcharges of the difference in the market share of generic and innovative medicine.

In 2008–2011, a significant increase was observed of the prevalence of diabetes treated patients per 100,000 inhabitants (Tab. 2). In 2008, the lowest number of urban patients per 100,000 treated with insulin occurred in Podlaskie province – 1,156, and the highest in Świętokrzyskie province – 2,000. In 2012, the same provinces had the lowest and highest ranking – 1,289 and 2,187, respectively. It can be noted that between the inhabitants of individual regions treated with insulin there is a difference, from 1.7–1.73 times. It is worth analysing what basic factors (including environmental and social) result in such a large differentiation.

In the case of oral medicine, as for insulin per 100,000 urban inhabitants, the lowest number of patients from urban areas using oral medication in the studied period of 2008–2012 and in Podlaskie province, amounted to 3,473 and 4,111. Per 100,000 of urban area inhabitants the majority of patients were in Łódzkie province – 5,024 and 5,782 (Tab. 2). If the ratio of the highest number of patients per 100,000 of urban area inhabitants is compared with the lowest, it will be noticed that in case of insulin the ratio is 1.7–1.73, in case of oral medication 1.42–1.45, and in case of insulin and oral medication from 1.71–1.76 (Tab. 2). This ratio may be used to analyse differences between regions over time, and will be used as the basis to decrease them.

There was a rapid increase in the number of patients taking oral medication and insulin in urban areas in 2011, compared to 2008, and the decrease in the number



of patients in 2012 compared with 2011 (196,871 in 2008, 229,325 in 2011 and 220,747 in 2012 in urban areas) [Tab. 2]. To facilitate the analysis and comparison of the presented results, the obtained amounts were presented in the form of indicators of drug consumption per 1 inhabitant of a given area (annual number of packs per 1 patient). The highest and lowest values were distinguished by using different colours. The patient's surcharge for insulin and oral medication was similar, approximately 100 złotych, regardless of the different amounts of reimbursement and cost of the medical product.

The change of the price of oral medication within the analyzed period confirms the role of negotiation (Economic Committee of the Minister of Health) of the prices for reimbursed medical products, intended to decrease the direct costs of reimbursed medical products in the treatment of diabetes.

Table 2 enables the comparison of differences in the number of diabetes treated patients per 100,000 inhabitants of urban and rural areas, as well for individual provinces – this is the essence of earlier data. The causes for differences in the prevalence of diabetes, the amount of reimbursement and patient surcharge, both over time (between 2008–2012) and between provinces have to be looked for. The difference in the prevalence of diabetes between Kujawsko-Pomorskie, Świętokrzyskie, Łódzkie province and the Podlaskie province is striking, as well as the difference between urban and rural areas between Świętokrzyskie and Lubuskie province. Between the area with the highest morbidity – Świętokrzyskie, Łódzkie, Opolskie, Kujawsko-Pomorskie provinces – and the lowest – Podlaskie and Podkarpackie provinces – there is a big difference (emphasized with colours [shading] in Tab. 2).

During the studied period, 2008–2012, an increase was observed within the national scale in the scope of patients using reimbursement of medicinal products, and observed differences between urban and rural area inhabitants and reimbursement costs. The Świętokrzyskie province remained the region with the highest difference. The lowest diversification occurred in Lubuskie and Warmińsko-Mazurskie province.

To improve the presentation of differences between areas we propose attaching a map of Poland illustrating the differences in the number of patients per 100,000 inhabitants.

Analysing the results of evolutions (changes) of differences between urban and rural areas within the 2008 to 2012 period, it can be noticed that: in the Mazowieckie, Podlaskie and Świętokrzyskie provinces the differences are decreasing the most (Fig. 1). The next regions where a positive tendency to decrease the differences occurred during the tested period include Małopolskie and Podkarpackie provinces. Pomorskie and Warmińsko-Mazurskie provinces may be indicated as regions where a reverse tendency is occurring, that is, an increase in differences between urban and rural areas. During the 2008–2012 period, the largest increase of differences between urban and rural areas can be observed in the Zachodniopomorskie province.

## DISCUSSION

In the situation of limited financial resources, both in the health protection system and in the wallets of the patients themselves, it is worth considering what costs are generated by chronic diseases which are the heaviest burden on society.

Due to its prevalence and course, diabetes takes a special place in these analyses. It is estimated that the diabetes treatment expenditures consume annually about 15% of the resources allocated to health protection in all developed countries worldwide [30]. In 2011, the approximate global diabetes-related expenditure amounted to at least 465 billion USD, and by 2030 they should exceed the amount of 595 billion USD [31].

Analysis of differences between urban and rural areas should also take into account differences in income, average wage (minimum wage), pensions and the budget loads resulting thereof.

Salinas et al., when studying the variance based on the use of health benefits between urban and rural areas, noted the biggest differences in relation to diabetes:

In terms of need factors, the most prominent difference between urban and rural dwellers was the incidence of diabetes. In urban localities, the prevalence of diabetes was 18.7%. As the size of locality decreased, the prevalence of diabetes gradually declined, so that the prevalence in rural localities was 7.2% ( $\chi^2 = 42.3$ ,  $p < .0001$ ) [32].

Comparing the results of the presented study with these conducted by O'Connor et al., it can be seen that in Poland an inverse tendency is observed to that in the United States. In accordance to O'Connor et al., in the United States diabetes occurs more frequently among the inhabitants of rural areas than urban areas [33]. O'Connor connects the prevalence of type 2 diabetes with socioeconomic factors: 'Using markers of income, education, occupation and insurance type, persons of lower socio-economic status living in the USA are more likely to suffer from type 2 diabetes than persons of higher socio-economic status.' [33]

The presented study is limited to the prescribed, refunded medicinal products, and lacks such detailed data in order to analyse the impact of the aforementioned factors.

Salinas et al. indicate the possession of health insurance as a factor of differentiation of the use of healthcare services

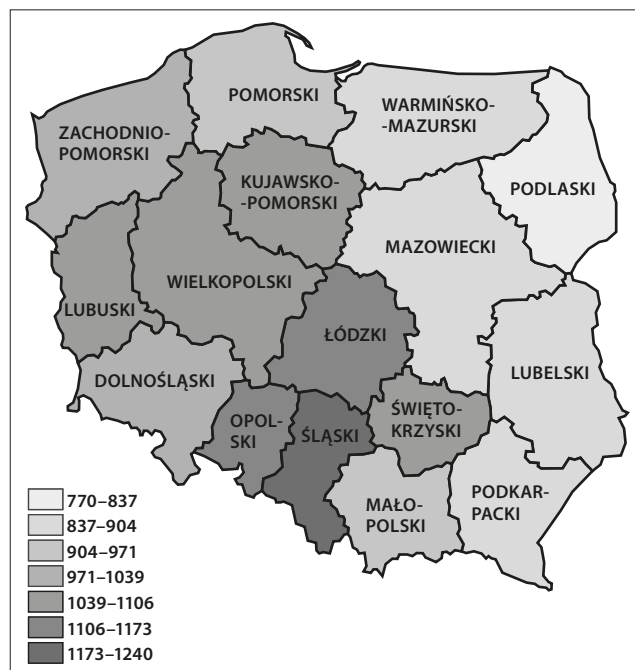


Figure 1. Differences in the number of patients per 100 000 inhabitants

between the urban and rural area inhabitants in Mexico. This factor does not have a significant impact to the differentiation due to the healthcare system in Poland [32].

While analysing the rate of change of differences between urban and rural areas within the 2008–2012 period, it can be noticed that in two areas – Zachodniopomorskie and Warmińsko-mazurskie provinces – the biggest increasing of differences is taking place. The Lubuskie province is next in line, while in Podlaskie and Mazowieckie provinces the biggest decrease of differences between urban and rural areas has occurred. The factors which have an impact on the improvement of results in the Mazowieckie province include proximity to clinics, higher income per inhabitant, tendency to work in the capital while living outside it. Weeks et al. state that the distance to the healthcare provider is a factor impacting on the frequency of using specialist advice [34].

In the Świętokrzyskie, Śląskie and Łódzkie provinces, areas where there are more inhabitants suffering from diabetes, the prevalence of diabetes among the inhabitants of rural areas is also larger when compared to urban areas in regions where are the lowest numbers of diabetes patients per 100,000 inhabitants, that is, Podlaskie and Podkarpackie provinces.

## CONCLUSIONS

Restricting risk factors is the most effective strategy for restricting the financial losses (effects) caused by diabetes [35]. Differences between urban and rural areas which depend on morbidity and detection of patients in the earlier phase of illness, the structures of medical technologies used in the treatment process, availability of medical products, number of purchased pharmaceuticals, reimbursement, and possibility of purchasing the products without excessive burden on the household budget, enable better monitoring of the effectiveness and quality of politics on prevention and treatment of chronic diseases.

Data of the Central Statistical Office of Poland indicate that people from rural areas are younger than those from urban areas (average age 36.6), and that urban inhabitants are older (average age 39.6) [36]. Regardless of the fact that this difference amounted only 3 years in 2011 (?), it may have an impact on the morbidity indicators.

Modelling the use of healthcare services by the inhabitants of urban and rural areas and taking risk factors into account, is the key to explaining the differences and forecasting the health of the population. The construction of such a model requires the collection of not only medical data, but also data on access to health care services, socio-economic data, natural environment data, etc.

Screening will enable establishing whether the differences between urban and rural areas result from the risk factors, or are a result of more difficult access to doctors in the rural areas and lower inclination for being tested. The analyses presented may be the basis for a decision concerning the areas where such screening should be conducted – in the proposed areas with largest differences, or most rapidly increasing differences.

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