

Economic aspects of hypertension treatment in Poland

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Abstract

Introduction: The aim of this study was to assess the costs associated with mild hypertension (HTN) in Poland and to compare the costs of 3-year ambulatory care for those diagnosed with mild HTN (group A) and those diagnosed with mild HTN and comorbidities (group B).

Material and methods: The researchers undertook a retrospective study of a group of 120 patients treated for 3 years (2006-2008) (60%, $n = 72$ women and 40%, $n = 48$ men), taking into account the broadest possible social perspective. Medical and non-medical direct costs as well as indirect costs were calculated.

Results: The total costs of the 3-year pharmacotherapy in group A equalled 49,985.65 EUR, or 833.09 EUR per patient, whereas in group B the costs were twice as high: 105,691.55 EUR in total or 1,761.53 EUR per patient. Indirect costs for group A patients totalled 3,468.80 EUR (578.13 EUR per patient) and 4,579.20 EUR for group B patients (572.40 EUR per patient). Total direct costs (medical and non-medical) and indirect costs for group B patients were much higher, amounting to 130,228.14 EUR and 2,666.55 EUR per patient, which was double the costs in group A, where costs were 74,184.96 EUR and 1,756.73 EUR per patient.

Conclusions: The costs of HTN treatment in Poland are very high and are growing, like in other countries. Potential solutions include developing better patient-doctor communication to improve compliance, and increasing the chances of more effective and less expensive therapy by prescribing cheaper generic drugs, limiting polypharmacy and improving availability of novel therapeutic methods.

Key words: hypertension, cost analysis, direct costs, indirect costs.

Introduction

In the past years medical science has undergone a series of considerable transformations. The ultimate goal of medicine is to recover, maintain and improve health and to improve society's quality of life. Among a variety of conditions with an impact on the quality and length of life there is hypertension (HTN).

Hypertension is a chronic disease whose initial symptoms do not provide a sufficient basis for diagnosis. It constitutes a major problem in most

countries as a cause of morbidity and mortality, especially as a result of inadequate prevention and diagnostics. The most common cause of sudden death in menopausal women is due to complications from underlying risk factors such as arterial HTN (including isolated systolic HTN) [1].

Cardiovascular diseases, including HTN, account for nearly half of deaths among Poland's population and over a quarter of premature deaths among those aged over 65 [2].

According to the WHO definition of HTN, systolic/diastolic pressure of 140/90 mm Hg is borderline, < 120/80 mm Hg is optimal, whereas mild HTN is diagnosed when the pressure is 140–159/90–99 mm Hg [3].

Arterial HTN is an epidemic disease [4]; this problem does not affect Poland alone but has an international scope, which is evidenced by statistics. The 2003 global report showed that 7 million people die of HTN each year, and approximately 4.5% of serious diseases are caused by it [5]. According to the WHO, about 600 million people are afflicted by HTN. Only half of them have been diagnosed, a mere 20% undergo treatment and only 12% of the affected are treated adequately [6].

The findings of the Polish NATPOL III PLUS cardiology programme showed that incidence of HTN in the adult population of Poland totalled 29%, which means that 8.6 million people were affected [7]. The treatment indicator for HTN in Poland averages 331/10,000 residents [8]. In all likelihood, it can be stated that in 10 years' time the number of people suffering from HTN will rise, reaching as much as 50% of the adult population. It can be explained by the ageing of Polish society and recent negative lifestyle changes.

Despite pharmacological treatment, HTN control in different populations is unsatisfactory and ranges from 9% to 30% [9]. There are many negative effects of inadequate control for the affected and their families as well as for the entire population. Its consequences often include ischaemic heart disease, heart and kidney failure, stroke and sudden death. They all worsen the quality of life and the economic situation of the sick person and his/her family. In a population, they contribute to a rise in disability and premature death rates, which translates into increasing indirect costs associated with the chronic nature of the disease (workplace absences, lower productivity), rapid loss of ability to work and a necessity to engage third persons to assist in everyday life of the patients suffering severe complications. In turn, a properly conducted HTN therapy requires a lot of involvement from the patient and the lead doctor alike. It generates high direct costs for the health care system, patients and their families. As a result of population ageing and stricter diagnosis criteria, devel-

oped countries increase their budgets for HTN therapy every year. In 2003, 21% of health care costs in the US went to direct high blood pressure therapy and a further 27% to treating cardiovascular complications and other ailments connected with HTN [10].

The aim of this study was to assess the costs connected with the incidence of mild HTN in Poland and to compare the costs of 3-year ambulatory care for those diagnosed with mild HTN and those diagnosed with mild HTN and comorbidities. An assessment of direct medical and non-medical costs of ambulatory treatment in selected groups of patients has been completed for this purpose. Reliable collection and processing of data regarding the costs of HTN treatment are an important step towards further pharmacoeconomic analysis of this problem.

Material and methods

Study population

The researchers undertook a retrospective study, taking into account the broadest possible social perspective. Having analysed medical documentation of about 1,250 patients, they included in the study a group of 120 patients treated for 3 years (2006–2008) by a team of HTN specialists and cardiologists in the Clinic for Internal Medicine, Metabolic Disorders and Arterial HTN of the Poznan University of Medical Sciences (60%, $n = 72$ women and 40%, $n = 48$ men). The patients' age averaged a little over 61 years (61.22) – the youngest person was 23, the oldest was 92. The standard deviation was ± 14.48 years, which means that average subjects came from the group between 47 and 75 years old.

Selection criteria for the group of patients under investigation included:

- 1) being over 20 years of age,
- 2) being diagnosed with mild HTN, according to ICD-10 classification criteria,
- 3) being diagnosed with a maximum of two comorbidities,
- 4) being under regular care of a medical specialist from the beginning of January 2006 to the end of December 2008.

The patients' data were obtained from case history forms, doctor order sheets and medical treatment records. A range of different information about the patients was collected, including their present therapy as well as demographic (e.g. age, sex) and clinical data (e.g. presence of comorbidities, the number of ambulatory visits to a specialist clinic, hospital treatment, types of pharmacological therapy applied).

An indirect result of treatment – lowering arterial blood pressure – was established as the assessment criterion for its effectiveness.

The study period encompassed 3 years (2006–2008). The study was conducted from the perspective of the health care provider and from the societal perspective.

Calculation of costs

Direct and indirect costs connected with HTN treatment were evaluated. The following direct costs were included: medical costs (costs of laboratory and diagnostic tests, costs of medical consultation, costs of additional specialist consultations, costs of pharmacotherapy and costs of hospitalization) and non-medical costs (costs of transport).

Data regarding pharmacotherapy were obtained on the basis of the price list of the pharmacy wholesaler PGF Urtica. Costs of patient hospitalization were calculated on the basis of the refund rate established by NHF (National Health Fund) and binding in the time frame under investigation, according to the procedure code. The rate was treated as a market price of this service.

In this study, only costs of work absences were calculated; they did not include the costs of lost productivity of people who started to claim early retirement benefits or disability pension due to diagnosed HTN, because there were no such individuals in the groups under investigation.

Statistical analysis

The analysis used Student's *t*-test (for independent data and for a single sample) and GLM analysis of variance for repeated measurements.

Values of *p* of 0.05 or less were assumed to be statistically significant. Calculations were made using Statistica 7.0 PL software.

Results

Following the analysis of the medical documentation, those selected to take part in the study were divided into two groups: A (60) – patients with mild HTN without comorbidities and B (60) – patients with mild HTN diagnosed with comorbidities (a maximum of 2). The following comorbidities were present in group B: rheumatoid arthritis, asthma, chronic obstructive pulmonary disease, Parkinson's disease, hypercholesterolaemia, obesity, diabetes type 2, hypothyroidism, heart failure and ischaemic heart disease. Demographic, clinical and socio-economic data of the patients are presented in Table I.

Effectiveness of treatment

The participants' arterial pressure was monitored during every visit throughout the study period, at irregular intervals and with varying frequency. As the basis for the analysis (analysis of differences in therapies using GLM analysis of variance [general linear model – repeated measurements]) only six readings were taken; if a patient was monitored more often, six random readings in relatively equal intervals were qualified. No difference in treatment scenario was noted between patients in groups A and B. Then the blood pressure reading at entry to the programme was established as a reference point and significance between the groups was calculated using Student's *t*-test. As no significant

Table I. Demographic, clinical and socio-economic data of patients in ambulatory care due to arterial hypertension

Information	Group A			Group B		
	Employment	Disability pension	Retirement benefits	Employment	Disability pension	Retirement benefits
1. Number of patients	60			60		
2. Women/men	32/28			40/20		
3. Average age ± SD [years]	61.33 ±15.13			61.10 ±15.05		
4. Youngest/oldest patient [years]	26/92			23/92		
5. Number of hospitalisations	35			38		
6. Source of income	20	8	32	22	8	30
7. Number of sick leave days	64			68		
8. Number of ambulatory visits:	516			524		
Average/patient 2006	3.10 ±1.49			3.57 ±1.05		
Average/patient 2007	2.77 ±0.80			2.57 ±0.99		
Average/patient 2008	3.98 ±0.73			2.60 ±0.80		
9. Living outside town/in town	20/40			28/32		
10. Average disease history [years]	4.93			5.87		

Group A – patients with mild arterial hypertension, group B – patients with mild arterial hypertension and comorbidities (maximum of 2)

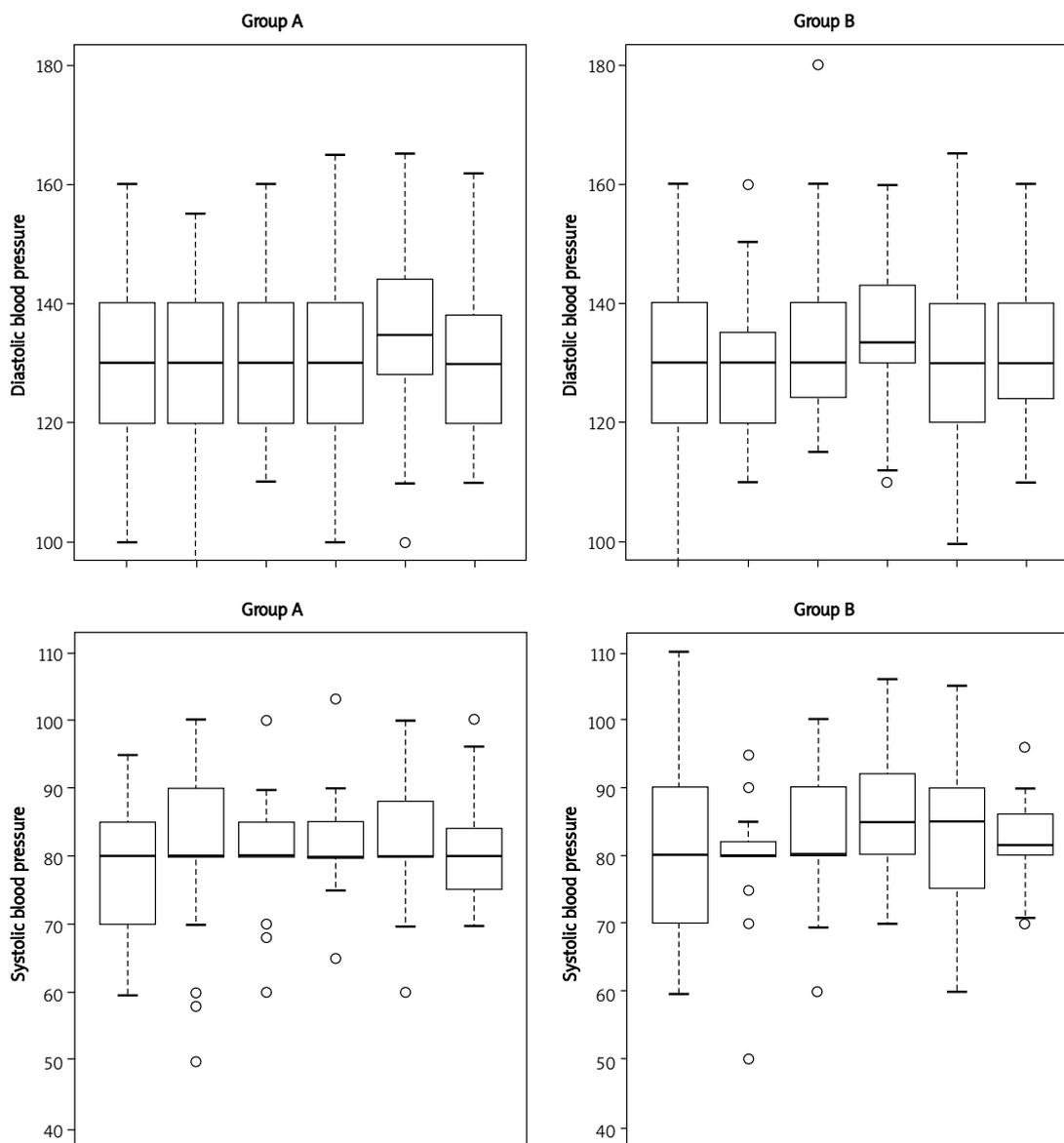


Figure 1. Distribution of results in groups A and B

difference between the groups was recorded, the average value of 130/80 was established as the reference point. The distribution of the results is presented in Figure 1. Next, significance of differences in the following readings in relation to the entry (initial) reading was calculated (Table II) and the averages together with significant differences were visually presented in Figure 2.

Costs

The largest component of direct medical costs (Table III) was drugs, followed by hospitalization costs. Mean annual costs per hypertensive patient were more than two-fold higher in subjects with comorbidities compared to those without and resulted mainly from the costs of HTN pharma-

cotherapy and secondary prevention of comorbidities being two times higher. In the analysed period, the highest increase was related to this group of costs – 190% (B, year 2006 to 2008). In the study period, 1040 consultation sessions were held by cardiologists and HTN specialists during ambulatory treatment; the total cost of doctor consultation for A and B was similar. The most frequent laboratory medical tests conducted in both groups were complete blood count, biochemical analysis, urinalysis and then lipid profile. Diagnostic testing was done for an average of 42% patients (A) and 31% (B). Doctors ordered the following types of tests most often: ECG, chest radiography, abdominal ultrasound and cardiac ECHO. The analysis of the costs of specialist consultations shows that both the

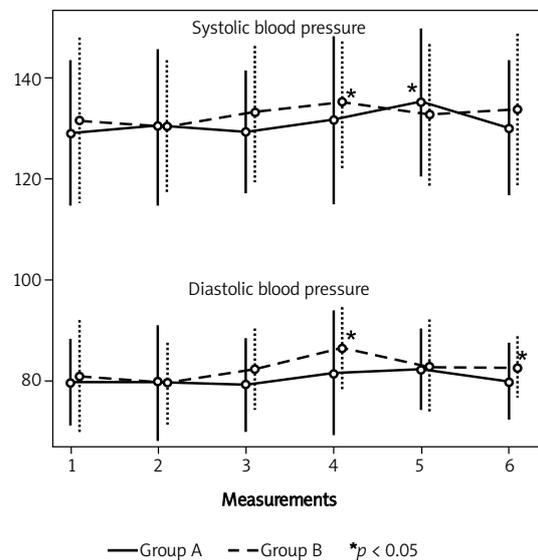
Table II. Mean results in the following readings and difference significance in relation to the entry value = 130 and = 80 (Student's *t*-test for one sample)

Group		N	Mean	Standard deviation	t	df	Significance (two-sided)	
130	A	2	60	130.50	15.500	0.177	59	0.861
		3	60	129.27	12.069	-0.333	59	0.742
		4	60	131.63	16.548	0.541	59	0.593
		5	58	135.97	14.001	2.294	57	0.029
		6	60	129.90	13.210	-0.041	59	0.967
	B	2	60	130.33	13.202	0.138	59	0.891
		3	58	133.52	13.922	1.360	57	0.185
		4	56	135.32	13.118	2.147	55	0.041
		5	56	132.96	14.382	1.091	55	0.285
		6	60	133.60	15.117	1.304	59	0.202
80	A	2	60	79.80	11.324	-0.097	59	0.924
		3	60	79.27	9.244	-0.435	59	0.667
		4	60	81.50	12.448	0.660	59	0.514
		5	58	82.52	8.038	1.686	57	0.103
		6	60	79.93	7.515	-0.049	59	0.962
	B	2	60	79.77	8.299	-0.154	59	0.879
		3	58	82.48	8.283	1.614	57	0.118
		4	56	86.57	8.925	3.896	55	0.001
		5	56	82.71	9.809	1.464	55	0.155
		6	60	82.50	6.141	2.230	59	0.034

Group A – patients with mild arterial hypertension, group B – patients with mild arterial hypertension and comorbidities (maximum of 2)

number and cost of consultations between 2007 and 2008 were higher in group A, whereas in 2006 they were higher in group B (Table III). Mean annual direct non-medical costs (connected with transport to a specialist health centre, Table IV) per patient in the analysed groups were very close and amounted to a relatively small financial burden because the average monthly costs were between 0.05% and 0.07% of the average monthly salary in Poland (which, according to the Central Statistical Office, was 611.13 EUR in 2006, 663.88 EUR in 2007, and 726.26 EUR in 2008) in the study period. The analysis of indirect costs (connected with work absences as a result of sick leaves) showed that in the group with an additional burden (B) inability to work occurred more frequently, which generated higher general costs for the whole studied population, but indirect costs per patient in both groups in the study period were similar (Table IV).

The greatest part of the total cost of the 3-year therapy in the studied group of patients was direct medical costs (Table V), including drug and treatment costs. Mean 3-year costs per hypertensive patient were around 50% higher in subjects with comorbidities compared to those without. The greatest increment in per patient costs occurred in

**Figure 2.** Averages with significant differences

group A in the year 2008 in the category of hospitalization costs (increase of 178.5%) and in group B in the year 2007 in the category of pharmacotherapy costs (increase of 161.1%).

Table III. Direct medical costs for patients in ambulatory treatment due to arterial hypertension (EUR)

Type of cost	Group A [$\bar{x} \pm \text{SEM}$]			Group B [$\bar{x} \pm \text{SEM}$]		
	2006					
	Total	% of total costs	Per patient	Total	% of total costs	Per patient
Costs of pharmacotherapy	12,875.66	57.2	214.59 \pm 166.34	16,230.29	69.6	270.50 \pm 177.67
Costs of doctor consultation (X = number of visits \times 8.14*)	1,514.04 (186 visits)	6.7	25.23 \pm 12.14	1,741.96 (214 visits)	7.5	29.03 \pm 8.59
Laboratory tests	412.38	1.8	6.87 \pm 8.14	681.93	2.9	11.37 \pm 11.64
Diagnostic tests	547.18	2.4	9.12 \pm 13.93	526.46	2.4	8.77 \pm 16.18
Specialist consultations	34.54	0.2	0.58 \pm 3.10	57.23	0.2	0.95 \pm 3.65
Hospitalisation costs (number of hospitalisations)	7,114.82 16 (n = 16)	31.7	444.68 \pm 365.30 1.00	4,065.60 12 (n = 12)	17.4	338.80 \pm 197.82 1.00
Total cost	22,498.62	100.0	374.98	23,303.47	100.0	388.39
2007						
Costs of pharmacotherapy	18,278.43	82.2	304.64 \pm 198.35	42,382.16	90.5	706.37 \pm 177.67
Costs of doctor consultation (X = number of visits \times 8.63*)	1,432.58 (166 visits)	6.4	23.88 \pm 6.94	1,329.02 (154 visits)	2.8	22.15 \pm 8.54
Laboratory tests	280.00	1.3	4.67 \pm 6.99	514.62	1.1	8.58 \pm 10.47
Diagnostic tests	436.17	2.0	7.27 \pm 17.28	100.16	0.2	1.67 \pm 4.47
Specialist consultations	21.71	0.1	0.36 \pm 1.95	0.00	0.0	0.00 \pm 0.00
Hospitalisation costs (number of hospitalisations)	1,776.24 6 (n = 6)	8.0	296.04 \pm 0.00 1.00	2,516.34 14 (n = 6)	5.4	419.39 \pm 191.32 2.33
Total cost	22,225.13	100.0	370.42	46,842.30	100.0	780.71
2008						
Costs of pharmacotherapy	18,831.56	75.8	313.86 \pm 198.65	47,079.10	86.7	784.65 \pm 1270.33
Costs of doctor consultation (X = number of visits \times 9.87*)	1,618.68 (164 visits)	6.5	26.98 \pm 7.18	1,539.72 (156 visits)	2.8	25.66 \pm 7.89
Laboratory tests	314.30	1.3	5.24 \pm 5.62	496.60	0.9	8.28 \pm 7.12
Diagnostic tests	729.25	2.9	12.15 \pm 3.38	82.89	0.2	1.38 \pm 2.90
Specialist consultations	57.53	0.2	0.96 \pm 2.91	0.00	0.0	0.00 \pm 0.00
Hospitalisation costs (number of hospitalisations)	3,297.90 10 (n = 4)	13.3	824.48 \pm 29.05 2.50	5,074.14 11 (n = 8)	9.4	634.27 \pm 341.27 1.38
Total cost	24,849.22	100.0	414.15	54,272.45	100.0	904.54
Total	69,572.97		1,159.55	124,418.22		2,073.64

*The price of a doctor appointment for a given year (average price according to the price list of medical services in three health care centres in the Wielkopolska region which had a contract with the NHF). Group A – patients with mild arterial hypertension, group B – patients with mild arterial hypertension and comorbidities (maximum of 2)

Discussion

Arterial HTN is one of the most important health problems of the 21st century. This condition is difficult to diagnose and its therapy aims to normalise arterial pressure without worsening the overall quality of life. Many clinical studies prove that medical interventions applied in treatment of this disease bring tangible therapeutic effects, but untreated or badly controlled HTN leads to the development of various complications in the cardiovascular system and kidneys, which has serious economic implications [12].

The unit cost of HTN treatment is rather low. In 2001, it averaged 1 USD per day in the United States [13] and in our study (2006–2008) it was established as averaging approximately 1.60 EUR per day (1.82 USD). However, considering the number of patients who need therapy (over 20% of the population, 36% of women and 46% of men aged 35–64 [14]) the total cost of HTN treatment constitutes a considerable burden for both the payer (NHF) and society [15]. The attempt to estimate total costs connected with HTN incidence in Poland in 2001 showed that they could reach as much as 14 bn PLN

Table IV. Direct non-medical costs and indirect costs for patients in ambulatory treatment due to arterial hypertension (EUR)

Direct non-medical costs										
Groups	Parameter	Transport of patients from Poznan to a specialist health centre (number of visits × p*)				Transport of patients from outside Poznan to a specialist health centre (number of visits × p**)				Total (I + II)
		2006	2007	2008	Subtotal I	2006	2007	2008	Subtotal II	
A	Costs for 60 patients	166.40 (130 visits)	145.92 (114 visits)	202.92 (114 visits)	515.24 (358 visits)	235.65 (56 visits)	184.63 (52 visits)	207.67 (50 visits)	627.95 (158 visits)	1,143.19 (516 visits)
	Ave. cost per patient	4.16 (40 people)	3.65 (40 people)	5.07 (40 people)	12.88 (40 people)	11.78 (20 people)	9.23 (20 people)	10.38 (20 people)	31.39 (20 people)	19.05 (60 people)
B	Costs for 60 patients	148.48 (116 visits)	107.52 (84 visits)	156.64 (88 visits)	412.64 (288 visits)	300.68 (98 visits)	259.43 (70 visits)	257.97 (68 visits)	818.08 (236 visits)	1,230.72 (524 visits)
	Ave. cost per patient	4.64 (32 people)	3.36 (32 people)	4.90 (32 people)	12.90 (32 people)	10.74 (28 people)	9.27 (28 people)	9.21 (28 people)	29.22 (28 people)	20.51 (60 people)
Indirect costs										
Groups	Parameter	Days of absence				Absence from work (X = days of absence × N*)				
		2006	2007	2008	Subtotal	2006	2007	2008	Subtotal	
A	Group subtotal	64 (n = 6)	– (n = 0)	– (n = 0)	64 (n = 6)	3,468.80	–	–	3,468.80	–
	Ave. per patient	10.67	–	–	10.67	578.13	–	–	578.13	–
B	Group subtotal	54 (n = 4)	18 (n = 2)	10 (n = 2)	82 (n = 8)	2,926.80	1,039.50	612.90	4,579.20	–
	Ave. per patient	13.50	9.00	5.00	10.25	731.70	519.75	306.45	572.40	–

NOTE: to calculate the costs of transport the following have been used: p* – flat rate for Poznan's public transportation (return): 2006 = 1.28 EUR, 2007 = 1.28 EUR, 2008 = 1.78 EUR; p** – the average price of the ticket in accordance with the fares of the state bus transportation system (PKS) in a given year, calculated proportionately to the distance (in km) between town of residence and Poznan, per kilometre (return) in EUR; N* – GDP per day per person in employment according to the Central Statistical Office: 2006 = 54.20 EUR, 2007 = 57.75 EUR, 2008 = 61.29 EUR. Group A – patients with mild arterial hypertension, group B – patients with mild arterial hypertension and comorbidities (maximum of 2)

Table V. Direct and indirect costs for patients in treatment due to arterial hypertension throughout the study period (EUR)

Type of cost	Group A			Group B		
	Group subtotal	% of total costs	Cost per patient	Group subtotal	% of total costs	Cost per patient
Direct medical costs	69,572.97	93.8	1,159.55	124,418.22	95.5	2,073.64
Direct non-medical costs	1,143.19	1.5	19.05	1,230.72	1.0	20.51
Total direct costs	70,716.16	95.3	1,178.60	125,648.94	96.5	2,094.15
Indirect costs	3,468.80	4.7	578.13	4,579.20	3.5	572.40
Total	74,184.96		1,756.73	130,228.14		2,666.55

Group A – patients with mild arterial hypertension, group B – patients with mild arterial hypertension and comorbidities (maximum of 2)

per year, which equalled 1,570 PLN (423.5 EUR, using the average 2001 EUR exchange rate of the National Bank of Poland) for therapy per year per patient [13]. In our study, this cost 5 years later was 585.6 EUR. In the USA, treatment of HTN and its complications in 2003 consumed approximately 37.2 bn USD [16]. In Brazil according to the study model, the 2005 annual estimated cost to society

of treating HTN was about 671.6 million USD [17]. Scholze *et al.* [18] estimating in 2008 the epidemiological and economic burden of metabolic syndrome and its consequences in patients with HTN in Germany, Spain and Italy reported that the total annual costs of HTN without MetS amounted to 5,341 EUR, 2,682 EUR and 5,957 EUR million respectively. In consequence, it seems justified to seek

better value for money in economic evaluations in order to rationalise treatment of arterial HTN. Despite the fact that economic aspects of preventive measures in the case of this condition are extremely difficult to assess, it is known that aborting hypotension therapy is a much larger burden for the state budget and the patient [19]. Experts are in agreement that striving for the reduction of arterial pressure values according to the guidelines of JNC VI and WHO is a desirable investment both in medical and economic terms [19, 20]. When a substantial group of patients avoids the development of heart failure, stroke, ischaemic heart disease or kidney failure as a result of successful treatment, costs of intensive pharmacotherapy will in effect bring considerable savings, especially in the long run [21].

What follows from an analysis by many authors is that economic effectiveness of arterial HTN treatment depends on age, sex and the pre-treatment readings for blood pressure [22–25]. Decisions about implementation of specific health programmes depend to a large extent on health results, but information about disease costs are equally useful, e.g. in price negotiations with payers regarding therapeutic scenarios, hospital medication lists, planned health investments or development of prevention programmes [26]. Thus pharmaco-economic evaluations should serve as a decision-making tool for people who have an influence on both the management of financial resources and patient pharmacotherapy.

The present study has shown that most of the total costs of mild HTN treatment in Poland are direct medical costs: A – 93.8%, B – 95.5%. Similar conclusions were drawn by the researchers analysing the costs of HTN treatment in Poland in 2001, who calculated them to be 73.4% [27]. Our study findings were supported by the results of the research in other countries [17, 28, 29] identifying drugs as the costliest component in HTN treatment. In the United States in 2003 the isolated cost of anti-HTN drugs was 47.8% of the estimated direct total expenses for health care, an increase of 14.8% from the previous year [28]. In the Brazilian public healthcare system, the largest cost component was also drugs, which accounted for 32.73% in 2002 [30] and for 52.3% of the total in 2005 [17]. In an Italian study [29] the most significant direct cost component in treating HTN was anti-HTN drugs (42.7% of the total cost), followed by hospitalization (28.4%). In Greece in 2005 a study comparing the costs of treatment with the use of first-line agents from each of the five recommended classes of antihypertensive agents (chlorthalidone, propranolol, amlodipine, enalapril, losartan) demonstrated that medications accounted for 24% to 77% of the total direct health care

costs of treating mild-to-moderate uncomplicated HTN for 5 years [31].

Our findings, namely the fact that the biggest share in total HTN treatment costs was direct costs, are partly confirmed also by a team of other authors [13]. Cost data were collected for a population of 9286 patients receiving pharmacological treatment due to HTN for the last year. A specially compiled “Arterial HTN Cost Assessment Form” was used and the lead doctor filled it in on the basis of patient interviews and medical documentation [13]. The calculation included direct medical costs of pharmacological treatment, doctor consultations, laboratory and diagnostic testing and hospitalization; indirect costs were calculated based on the number of days off work due to HTN [13]. A significant difference can be observed when comparing the share of medication costs in the total costs (2001 – 10%, our study: group A 67.38%, group B 81.16%, an increase of 64% on average) and indirect costs (2001 – 26.6%, our study: group A 4.68%, group B 3.52%). As can be seen, 7 years later medication expenses constituted a much larger percentage of total HTN treatment costs in Poland than in 2001, while – simultaneously – the costs connected with loss of productivity fell (a decrease of 22.5% on average). These findings are very similar to the research results of HTN cost analysis in Sweden in the 1990s [32–36].

Most likely, this increase was due to demographic changes (population ageing), an increase in prices of antihypertensives, better access to new technologies, more frequent cases of recommending pharmacological treatment [37], increasingly frequent cases of abandoning monotherapy in favour of polytherapy and changes in the behaviour of patients, who – as a result of intensified education – are growing more and more aware of the treatment process, the role of medications and medication compliance. This change in resource allocation, namely bigger pharmacotherapy expenses, had an impact on the costs of hospitalization (in group A, a decrease of as much as 12.05%) and indirect costs (a decrease of 22.5% on average). By lowering the number of necessary hospital stays, more effective pharmacotherapy reduced societal and system expenses connected with HTN treatment in Poland, because effectively administered pharmacotherapy leads to reduced frequency of organ complications, resulting in reduced indirect costs, that is income lost by the patient as a result of disease, disability and premature death. Reducing expenses connected with indirect costs is critical for global calculations, because the experience of other countries shows that indirect costs tend to be as high or even higher than direct costs [38, 39].

One pharmaco-economic study carried out in Brazil in 2002 showed that also in that country

the costs of HTN care were mainly dependent on the expenditure on blood pressure-lowering drugs [30]; monthly costs of ambulatory care for patients with arterial HTN totalled 89.90 USD. Treatment of HTN consumed 22.9% of the per-capita income, corresponding to 392.76 USD spent per year exclusively on antihypertensive drugs. Another Brazilian publication (2009) revealed monthly medication costs of 87.10 USD for treatment alone, 159.00 USD for treatment with two drugs (combined treatment), and 294.00 USD for combined treatment of three or more drugs, with cost-effectiveness in favour of diuretics for blockers and ACEIs [40]. In our study, the annual cost of pharmacotherapy for 1 patient in group A was 342.15 USD and 723.46 USD in group B, based on the exchange rate of 22 June 2010 published by the National Bank of Poland.

Comparing our findings with the cost analysis for treatment of chronic diseases, including HTN (1,351 USD), carried out in the United States in 2005 [41], it has to be stated that the total per patient treatment costs of mild HTN with comorbidities in Poland are similar (group B: 1,499.90 USD), whereas in group A (no comorbidities) they are half this value (721.48 USD). The cost of pharmacotherapy, in turn, is similar to group A – 494 USD.

The paper by Wang *et al.* [42] of 2010 provides detailed data on hospitalization costs in the USA. The authors suggest that HTN-associated hospitalization costs are substantial among insured US patients aged 18-64 years; the estimated average annual hospitalization cost per patient with HTN was 2,734 USD in 2005. It has to be noted that absolute price levels vary among countries [43]. Costs of medicaments, rates for doctor consultations and charges for tests are lower in Poland and other countries than in the US.

In relation to the costs of pharmacotherapy, rates for doctor consultations and laboratory tests are quite low in Poland [44]. In the United States, the cost of physician's care in 2003 was 24.7% and the diagnostician's cost was an additional 8.5% of the total HTN treatment costs [9,28]; in Brazil in 2005 these figures were 20.6% and 16.5% respectively [17], and in Italy 15.1% and 10.6% [29], compared to 4.85% and 2.76% in Poland. However, this difference is no cause for optimism since such low rates are not enough to cover the costs of depreciation, which means that a substantial increase of the hypotensive therapy cost, independent of the prices of blood pressure-lowering medications, should be expected [9, 20].

This study meets the guidelines for pharmaco-economic studies according to which the minimum size of the sample should be 60 people. The study included 120 patients diagnosed with HTN; the difficulty in selecting a larger group resulted from the need to find patients with mild HTN

without comorbidities (such patients being much less numerous than those with comorbidities), who visited their lead specialist doctor regularly for 3 years. Patients often change doctors and clinics they attend for various reasons, for example when they feel that treatment fails to bring positive results or when their perceived health improvement makes them abandon specialist care in favour of general health care. It was assumed that costs should be evaluated within a group of patients attending one clinic only so as to take into account all cost components (e.g. costs of additional visits or tests) connected with HTN. This assumption limited the size of sample A to only 60 patients out of the 1250 patient files available for the study. In order to make a valid comparison, an identical sample size was selected for group B.

Moreover, it should be noted that the cost calculation covers the costs generated in the years 2006-2008. Given the progressive character of the disease, the results obtained in the study may fail to provide reliable information concerning the actual costs incurred in the present year.

Within the schedule of further actions to be taken in the area discussed here, the costs of adverse drug reactions and costs of comorbidities should be included in the structure of the analysed costs. This would emphasise the widespread character of HTN. In addition, further stages of research would include conducting a study of the patients' quality of life in the context of their pharmacotherapy, which would provide useful indications regarding its effectiveness.

In conclusion, lack of constant monitoring of population health and negative effects of HTN could be significantly more expensive in the long-term. Given the results of the study, it has to be stated that the costs of HTN treatment in Poland are very high, as in other countries. Taking advantage of the experiences of other countries, Poland should also strive to rationalize the costs of medical care in HTN [9].

It seems that developing better patient-doctor communication and increasing the chances of more effective and less expensive therapy by suggesting cheaper generic drug treatment might be a positive solution of this problem. Another possibility for reducing the high cost of treatment might be limiting polypharmacy in selected groups of patients (obviously, not in the groups where it would be impossible, i.e. the groups with high risk of acute complications such as a stroke in men aged over 55 years) and better availability of novel therapeutic methods. It is known that the risk of drug interaction increases rapidly when 3 or more medicines are used simultaneously. Polypharmacy may cause adverse effects, which are very costly to treat, and which may be then identified as symptoms of oth-

er conditions and treated with further medications. Given the growing number of elderly patients with HTN (and comorbidities) in Polish society, it seems reasonable to increase expenditure on educating geriatrics consultants, who could provide patients with comprehensive health care and thus reduce the health risk and costs associated with polypharmacy.

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