

Directions for optimizing the therapy of bronchial asthma and status asthmaticus based on cross-sectional analysis of real-world data (RWD) from National Health Fund (NFZ) and Social Insurance Institution (ZUS)

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Authors:

Jakub Gierczyński¹
Andrzej Śliwczyński²
Karina Jahnz-Różyk³

1 - European Health Network

2 - POLON Scientific Data Administrator,
Head of the Patient Service Department, Medical
Institute of the Ministry of Interior and Adminis-
tration, National Research Institute

3 - Head of the Clinic of Internal Medicine,
Pneumology, Allergology, Clinical Immu-
nology and Rare Diseases, Military Institute of
Medicine, National Research Institute

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Corresponding author: Jakub Gierczyński j.gier@hotmail.com

Abstract

Objectives

The aim is to analyse the health and systemic effects of effective therapy for bronchial asthma and status asthmaticus in Poland for the purpose of assessing the possibility of introducing a model of coordinated care for patients with bronchial asthma and analysing the limitations resulting from the introduction of a coordinated care model.

Methods

The analysis was carried out based on actual data from the National Health Fund (NFZ) from 2013-2023 in the scope of the medical problem of bronchial asthma, defined by the codes of the main diagnosis ICD-10: asthma J45 and status asthmaticus J46.

Results

After the introduction of the first medicinal products for financing under the drug program for asthma treatment in 2013, a decrease in the number of patients registered for hospital treatment was observed at the level of: -2.79%, including, negative dynamics are observed in AOS and POZ. This means better disease control in patients, this conclusion is confirmed by the stable and maintained similar level of the distribution of the number of patients, taking into account the mode of admission to the hospital.

Conclusions

The introduction of the drug program for the treatment of bronchial asthma and the financing of medicinal product reduces the number of hospitalizations. After the introduction of the drug program, the number of benefits provided for incapacity for work due to bronchial asthma and the number of medical certificates have remained at a constant level. The number of days of sickness absence due to bronchial asthma has decreased.

Introduction

Bronchial asthma is a chronic, heterogeneous inflammatory disease of the respiratory tract.^[1] The disease affects over 350 million patients worldwide. Modern care for patients with bronchial asthma is managed dynamically, using modern technologies, molecular biology and care integration. Therapeutic success requires active patient participation and close interdisciplinary cooperation, and coordinated care becomes the key to effective treatment. According to GINA 2024, the modern approach to the diagnosis and treatment of asthma involves a transition from symptomatic treatment to a personalized and proactive strategy.^[2] It is recommended to avoid monotherapy with short-acting inhaled β 2-agonists (SABA), such as salbutamol or fenoterol. The preferred treatment regimen is inhaled corticosteroids (ICS) plus formoterol as needed, starting from the lowest degree of asthma severity. It is recommended to gradually treat bronchial asthma:

Step 1–2: inhaled corticosteroids (ICS) + formoterol as needed

Step 3–4: inhaled corticosteroids (ICS) + long-acting inhaled β 2-agonists (LABA) + long-acting anticholinergics (LAMA) on a regular schedule

Step 5: biological therapy, systemic glucocorticosteroids (GCS), as a last resort

As part of biological treatment in the drug program B.44 Treatment of patients with severe asthma, the following drugs are currently reimbursed: Omalizumab (anti-IgE - allergic phenotype), Mepolizumab and Benralizumab (anti-IL-5 - eosinophilia), Dupilumab (anti-IL-4/13) and Tezepelumab (independent of the level of eosinophilia). The effects of biological treatment include a reduction in exacerbations, improvement in lung function and a reduction in the dose of glucocorticosteroids (GCS). In the years 2016-2024, the number of patients treated in the drug program B.44 Treatment of patients with severe asthma increased, from 438 people in 2016 to 3,457 people in 2023 and 4,729 people in 2024. In 2024, the largest number of patients in the drug program B.44 Treatment of patients with severe asthma were treated with: benralizumab - 1,554 patients, then mepolizumab - 1,398 patients, omalizumab - 718 patients, dupilumab - 597 patients and tezepelumab - 462 patients. Patients were treated in 69 clinical centers implementing the B.44 drug program. In 2024, the National Health Fund allocated PLN 183,477,537 in total for contracts for the B.44 Treatment of patients with severe asthma drug program, of which PLN 158,813,984 for active substances and PLN 24,663,553 for medical services. The National Health Fund's expenditures under contracts for drug programs in 2024 amounted to PLN 12.8 billion, i.e. the B.44 drug program accounted for 1.4% of total expenditures for drug programs.

The effects of coordinated care for patients with bronchial asthma include a reduction in disease exacerbations and hospitalizations, better matching of therapy to the patient's needs, higher levels of satisfaction and adherence to recommendations, and the possibility of early detection of deterioration of health. Challenges and directions of development of coordinated care for patients with bronchial asthma in Poland include reimbursement availability of biological therapies, integrated registers and data systems (including registers of patients with asthma and collection of real data (RWE) in order to optimize therapy, and psychological and rehabilitation support for the patient.

An element of the implementation of these assumptions is the preparation of the following report, by collecting actual data (RWE) from the resources of the National Health Fund and the Social Insurance Institution and analyzing the health and systemic effects of effective therapy for bronchial asthma and status asthmaticus in Poland in recent years.

Materials and methods

Data were obtained from the National Health Fund (NHF) from the years 2013-2023 (at the time of data generation by the NHF, the year 2024 was not yet available) regarding the medical problem of bronchial asthma, defined by the main diagnosis codes ICD-10: asthma J45 (entire group) and status asthmaticus J46 (entire group).^[3] The data received were depersonalized and aggregated by the NHF, maintaining the principles of protection of particularly sensitive data. A retrospective analysis of the dynamics of asthma morbidity in the Polish population in several organizational cross-sections was performed on the obtained data set. Results were obtained for the entire population with treated asthma and for the population treated under the drug program. The number of patients and the number of reported health services were analyzed.

Results were obtained for:

1. Number of patients, including:
number of patients treated in the main segments of healthcare, i.e. hospital care, outpatient specialist care, primary health care;
dynamics of the number of patients in the above types of services year/year and in the periods before the pandemic (2019-2013) and after the pandemic (2023-2019) and in the entire analyzed period (2013-2013)
2. Number of health services provided in each main type of service
3. Patient admission mode into categories: urgent mode and stable mode.

Data were obtained from the Social Insurance Institution (SII) from the years 2019-2023 (at the time of data generation by SII, the year 2024 was not yet available) in the scope of the statistics of SII benefits for incapacity for work resulting from the medical problem of bronchial asthma, defined by the codes of the main diagnosis ICD-10: asthma J45 (the entire group) and status asthmaticus J46 (the entire group). An analysis was made of the number and value of reported benefits.^[4] Results were obtained for:

Benefit values for disability pensions, social pensions, sickness absence, rehabilitation benefits and medical rehabilitation for bronchial asthma (J45) and status asthmaticus (J46).

The number of persons insured with ZUS who were issued a medical certificate for bronchial asthma (J45) and status asthmaticus (J46) at least once in the years 2019-2024.

Number of sick leave days due to bronchial asthma (J45) and status asthmaticus (J46) in 2012-2024.

Results

Services provided with a diagnosis of asthma settled by the National Health Fund in the years 2013-2023

In the years 2013-2019, the number of patients diagnosed with ICD-10 J45 Bronchial asthma mainly due to allergic causes and J46 Status asthmaticus remained at a stable level - an average of 1,100 thousand patients. In the years 2020-2021, the number of patients with the diagnosis was less than 1,100 thousand patients and increased again in the years 2022-2023. The largest number of patients with the diagnosis of ICD-10 J45 Bronchial asthma mainly due to allergic causes and J46 Status asthmaticus was observed in the years 2013-2023 at the level of Ambulatory Specialist Care (AOS), then at the level of Primary Health Care, and the fewest patients with the diagnosis occurred in hospital treatment.

In 2020, the largest change was observed in the number of patients diagnosed with ICD-10 J45 Bronchial asthma mainly due to allergic causes and J46 Status asthmaticus at any level of care compared to the number of patients in the previous year. Within Specialist Outpatient Care, the number of patients decreased by 14% compared to the previous year. Within Primary Health Care, also by 14%, while within hospital treatment, the number of patients decreased by as much as 42% year-on-year (**Figure 1**), (**Table 1**, **Table 2**).

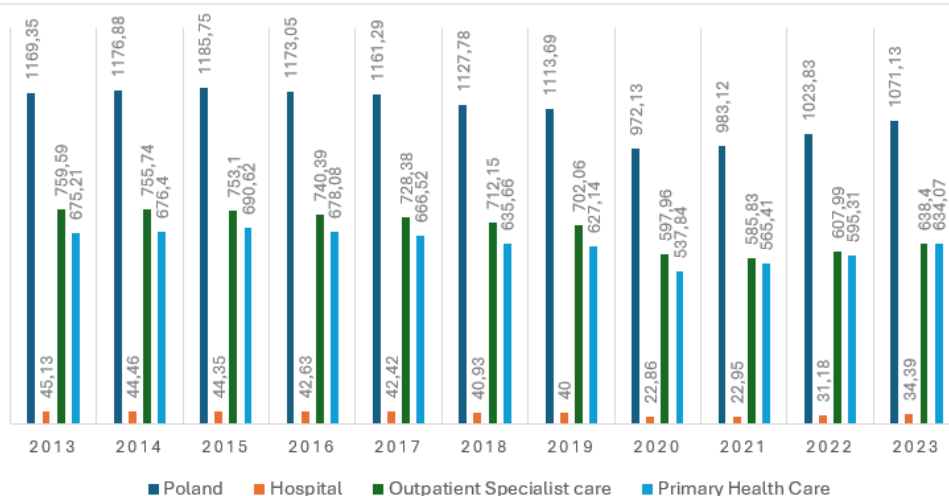


Figure 1. Number of patients with ICD-10 diagnosis J45 Bronchial asthma mainly due to allergic causes and J46 Status asthmaticus in the years 2013-2023, thou.

Table 1. Number of patients with ICD-10 diagnosis J45 Bronchial asthma mainly due to allergic causes and J46 Status asthmaticus in the years 2013-2023, thou.

Year	Poland	Hospital care	Outpatient Specialist care	Primary Health Care
2013	1169.35	45.13	759.59	675.21
2014	1176.88	44.46	755.74	676.4
2015	1185.75	44.35	753.1	690.62
2016	1173.05	42.63	740.39	678.08
2017	1161.29	42.42	728.38	666.52
2018	1127.78	40.93	712.15	635.66
2019	1113.69	40	702.06	627.14
2020	972.13	22.86	597.96	537.84
2021	983.12	22.95	585.83	565.41
2022	1023.83	31.18	607.99	595.31
2023	1071.13	34.39	638.4	634.07

Table 2. Dynamics of the number of patients with the diagnosis ICD-10 J45 Bronchial asthma mainly due to allergic causes and J46 Status asthmaticus year on year in the years 2013-2023, thou.

Detail, comparison	Poland	Hospital care	Outpatient Specialist care	Primary Health Care
2014/2013	0.64%	-1.48%	-0.51%	0.18%
2015/2014	0.75%	-0.25%	-0.35%	2.10%
2016/2015	-1.07%	-3.88%	-1.69%	-1.82%
2017/2016	-1.00%	-0.49%	-1.62%	-1.70%
2018/2017	-2.89%	-3.51%	-2.23%	-4.63%
2019/2018	-1.25%	-2.27%	-1.42%	-1.34%
average 2019-2013	-0.81%	-1.99%	-1.30%	-1.22%
2020/2019	-12.71%	-42.85%	-14.83%	-14.24%
2021/2020	1.13%	0.39%	-2.03%	5.13%
2022/2021	4.14%	35.86%	3.78%	5.29%
2023/2022	4.62%	10.30%	5.00%	6.51%
average 2023-2019	-0.97%	-3.71%	-2.35%	0.28%
average 2023-2013	-0.87%	-2.68%	-1.72%	-0.63%

The number of services provided with the diagnosis ICD-10 J45 Bronchial asthma mainly due to allergic causes and J46 Status asthmaticus has been systematically decreasing since 2013. In 2013, the total number of services provided amounted to 3750.49 thousand. In 2018, the number of such services amounted to 3146.96 thousand. In 2020, the number of services provided decreased by 12% compared to the previous year. In 2023, it amounted to 2854.92 thousand.

In the years covered by the analysis, the largest number of services were provided as part of outpatient specialist care - 2125.26 thousand services in 2013, 1778.47 thou-

sand in 2018 and 1467.43 thousand in 2023. The next in line in terms of the number of services provided is Primary Health Care - 1,545.67 thousand services in 2013, 1,286.29 thousand services in 2018 and 1,467.43 thousand in 2023. The fewest services were provided as part of hospital care - less than 50 thousand services each year, with the largest reduction in the number of services provided observed in 2020 - by as much as 45% compared to the previous year. On average, in the years 2013-2023, the number of services provided decreased by 2.69% (Figure 2), (Table 3, Table 4).

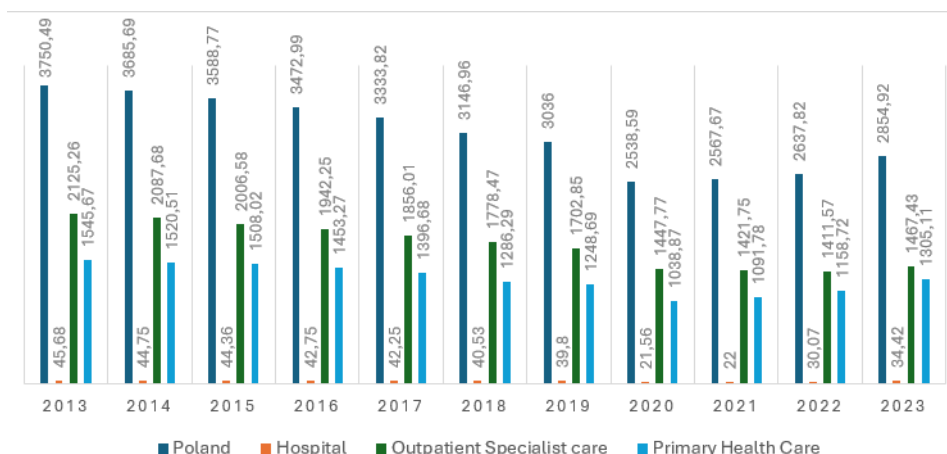


Figure 2. Number of services provided with the ICD-10 diagnosis J45 Bronchial asthma mainly due to allergic causes and J46 Status asthmaticus in the years 2013-2023, thou.

Table 3. Number of services provided with the ICD-10 diagnosis J45 Bronchial asthma mainly due to allergic causes and J46 Status asthmaticus in the years 2013-2023, thou

Year	Poland	Hospital	Outpatient Specialist care	Primary Health Care
2013	3750.49	45.68	2125.26	1545.67
2014	3685.69	44.75	2087.68	1520.51
2015	3588.77	44.36	2006.58	1508.02
2016	3472.99	42.75	1942.25	1453.27
2017	3333.82	42.25	1856.01	1396.68
2018	3146.96	40.53	1778.47	1286.29
2019	3036	39.8	1702.85	1248.69
2020	2538.59	21.56	1447.77	1038.87
2021	2567.67	22	1421.75	1091.78
2022	2637.82	30.07	1411.57	1158.72
2023	2854.92	34.42	1467.43	1305.11

Table 4. Dynamics of the number of services provided with the ICD-10 diagnosis J45 Bronchial asthma mainly due to allergic causes and J46 Status asthmaticus year on year in the years 2013-2023, thou.

Detail, comparison	Poland	Hospital	Outpatient Specialist care	Primary Health Care
2014/2013	-1.73%	-2.04%	-1.77%	-1.63%
2015/2014	-2.63%	-0.87%	-3.88%	-0.82%
2016/2015	-3.23%	-3.63%	-3.21%	-3.63%
2017/2016	-4.01%	-1.17%	-4.44%	-3.89%
2018/2017	-5.60%	-4.07%	-4.18%	-7.90%
2019/2018	-3.53%	-1.80%	-4.25%	-2.92%
average 2019-2013	-3.46%	-2.27%	-3.63%	-3.49%
2020/2019	-16.38%	-45.83%	-14.98%	-16.80%
2021/2020	1.15%	2.04%	-1.80%	5.09%
2022/2021	2.73%	36.68%	-0.72%	6.13%
2023/2022	8.23%	14.47%	3.96%	12.63%
average 2023-2019	-1.53%	-3.57%	-3.65%	1.11%
average 2023-2013	-2.69%	-2.79%	-3.64%	-1.68%

Analyzing the course of variables, a serious decrease in the number of patients and services provided was observed during the pandemic period, with the highest decreases in hospital treatment. These decreases are balanced by dynamic increases in the number of patients and services in the drug program. The implementation of services in the drug program additionally confirms the decrease in services provided as part of hospitalization.

Analysis of the dynamics of variability for both the number of patients and the number of services provided is quite similar. Assessing the compliance of average rates, the values of the convergence index (correlation coefficient) in individual periods were obtained in terms of the module in the range of 0.49-0.99. The periods 2018-2019, 2013-2019, where the analyzed categories were practically non-convergent, and the period 2014-2015, where the relationship of the analyzed changes is very low, which is also visible from the course of the dynamics.

In the years 2013-2023, the average number of patients and the number of services provided decreased year by year, both in total and by place of service provision: Specialist Outpatient Care, Primary Health Care and hospital (Table 5).

The largest number of hospitalizations with the diagnosis ICD-10 J45 Bronchial asthma mainly due to allergic causes and J46 Status asthmaticus of adult patients, excluding hospitalizations under the drug program and hospitalizations started and ended on the same day, were provided as part of emergency admissions. In 2013, the number of such hospitalizations amounted to 16.27 thousand, in 2018 it decreased to 14.27 thousand, and in 2023 it amounted to 8.8 thousand. In turn, the number of hospitalizations due to planned admissions amounted to 10.83 thousand in 2013, 9.35 thousand in 2018 and 7.46 thousand in 2023 (Table 6).

Table 5. Correlation coefficient of changes in the number of services provided and the number of patients with ICD-10 diagnosis J45 Bronchial asthma mainly due to allergic causes and J46 Status asthmaticus in the years 2013-2023

Period	Coefficient ρ
2014/2013	0.87
2015/2014	0.49
2016/2015	0.69
2017/2016	0.84
2018/2017	0.78
2019/2018	- 0.80
average 2019-2013	- 0.85
2020/2019	0.99
2021/2020	0.96
2022/2021	0.99
2023/2022	0.80
average 2023-2019	0.93
Average 2023-2013	0.54

Table 6. Number of hospitalisations in inpatient treatment with the ICD-10 diagnosis J45 Bronchial asthma mainly due to allergic causes and J46 Status asthmaticus of adult patients, excluding hospitalisations under a drug programme and hospitalisations started and ended on the same day, broken down by admission mode in the years 2013-2023, thou.

Year	Emergency admissions	Planned receptions
2013	16.27	10.83
2014	16.05	10.67
2015	16.45	10.13
2016	15.43	9.84
2017	15.48	9.82
2018	14.27	9.35
2019	13.06	9.15
2020	6.89	4.42
2021	5.48	4.18
2022	7.72	6.21
2023	8.8	7.46

If not for the pandemic, the course would be practically linear with a decreasing trend. In its current form, the course of the curves can be described by a trend function in the form of a polynomial of degree 3 or higher. In the final periods of observation, an upward trend is noticeable in all types of admissions, which would indicate a return of the phenomenon to the level before the pandemic period (Figure 3), (Table 7)

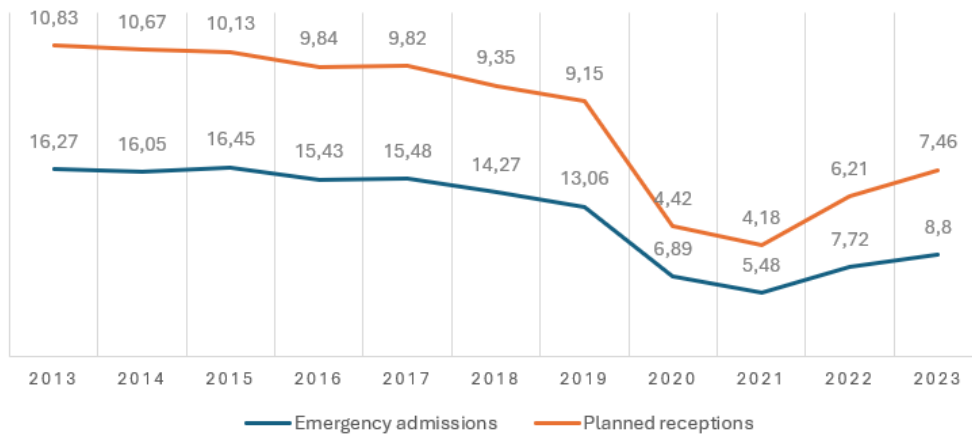


Figure 3. Comparison of the time courses - the number of hospitalizations in inpatient treatment with the ICD-10 diagnosis J45 Bronchial asthma mainly due to allergic causes and J46 Status asthmaticus of adult patients excluding hospitalizations under the drug program and hospitalizations started and ended on the same day, broken down by admission mode in the years 2013-2023, thou.

Table 7. Trend function in the form of a polynomial of degree 3 for the change in the time courses of the number of hospitalizations in hospital treatment with the ICD-10 diagnosis J45 Bronchial asthma mainly due to allergic causes and J46 Status asthmaticus	
Emergency admissions	; R2=0.7793
Planned receptions	; R2=0.0.8865

t= 1.....11.

Comparing the share of emergency admissions to the share of planned admissions, this ratio oscillates around 40% to 60%, with a noticeable increase in the share of planned admissions and a decrease in emergency admissions, which indicates an increase in patient safety and a decrease in the number of sudden disease events, which is assessed positively in the long term (Figure 4).

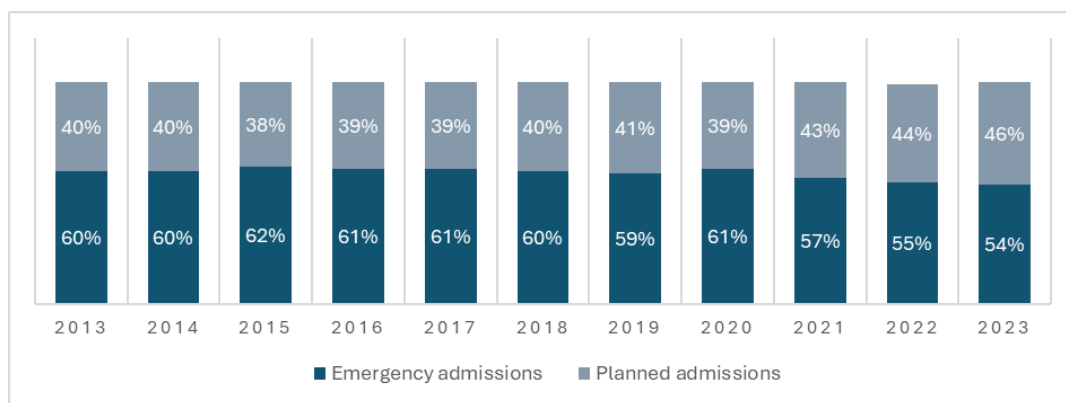


Figure 4. Relationship between the share of emergency admissions and the share of planned admissions with the ICD-10 diagnosis J45 Bronchial asthma mainly due to allergic causes and J46 Status asthmaticus of adult patients, excluding hospitalizations under the drug program and hospitalizations started and ended on the same day, broken down by admission mode in the years 2013-2023

The simulation models below allow for the assessment of the consequences of treating a given group of patients and provide the possibility of potential transfers of patients from Specialist Outpatient Care to hospital treatment and vice versa. If, for example, 10 patients were transferred from Specialist Outpatient Care to hospital treatment, this would result in a decrease of 1 patient in emergency admissions and an increase of almost 3 patients in planned admissions.

Simulation model:

Emergency admissions

$$PN_t = -30.367 + 0.0619 * LP_AOS; R^2 = 0.9904$$

Planned admissions

$$PP_t = -2.462 + 0.289 * LP_SZPITAL; R^2 = 0.9935$$

Drug program B.44 Treatment of patients with severe asthma

Number of patients in the drug program B.44 Treatment of patients with severe asthma

Under the B.44 Treatment of patients with severe asthma drug program, the number of patients under treatment increased year by year in the years 2013-2023. In 2013, the number of patients in the drug program was 247 people. In 2018, this number increased to 764 people. In 2019, the number of patients under treatment increased by as much as 41% compared to the previous year. In 2013, the number of patients in the drug program was 3,426. The average rate of increase in the number of patients in the drug program in the years 2013-2023 was 30% (Figure 5).

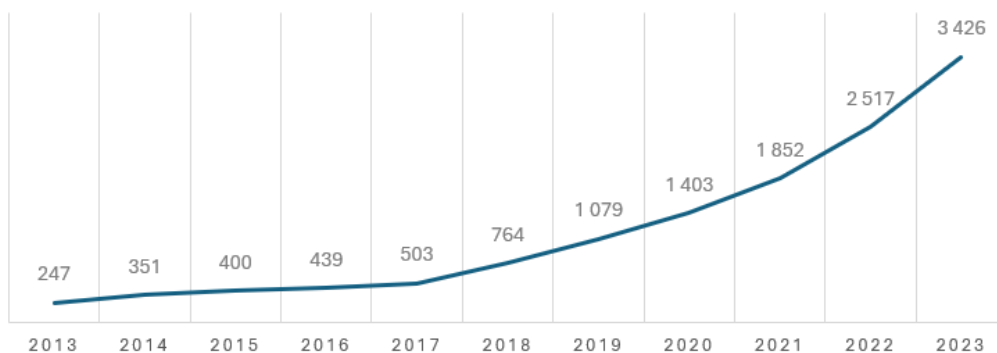


Figure 5. Number of patients who were provided with services under the drug program B.44 – Treatment of patients with severe asthma in 2013-2023.

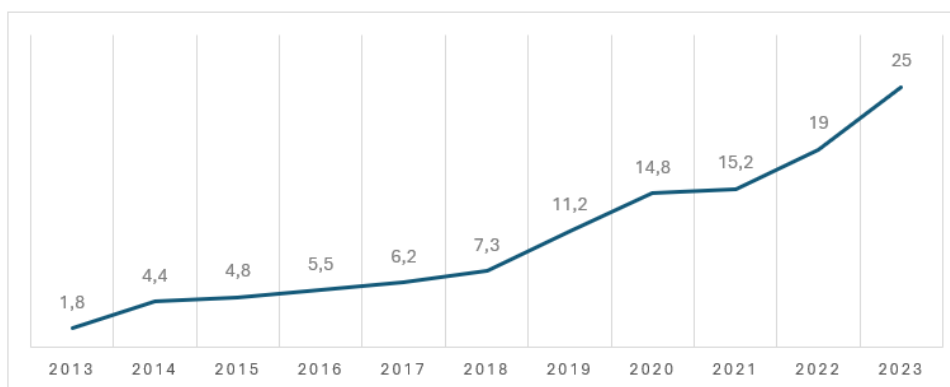


Figure 6. Number of services provided under the drug program B.44 – Treatment of patients with severe asthma in 2013-2023.

The number of services provided under the B.44 drug program – Treatment of patients with severe asthma increased proportionally year on year – analogously to the number of patients in the program. In 2013, the number of services provided amounted to 1.8 thousand. In 2018, this number increased to 6.2 thousand, and in 2023 it was already 25 thousand. Similarly, the average rate of increase in the number of services provided under the drug program in the years 2013-2023 was 30% (Figure 6).

As the number of patients treated under the drug program and the number of services provided to them increased, the share of services provided as part of hospital treatment decreased. In 2013, the share of hospital treatment as part of services provided under the drug program was over 12%, in 2018 this share was already 1.2%, and from 2019 this share was less than 1% until 2023 (Figure 7).

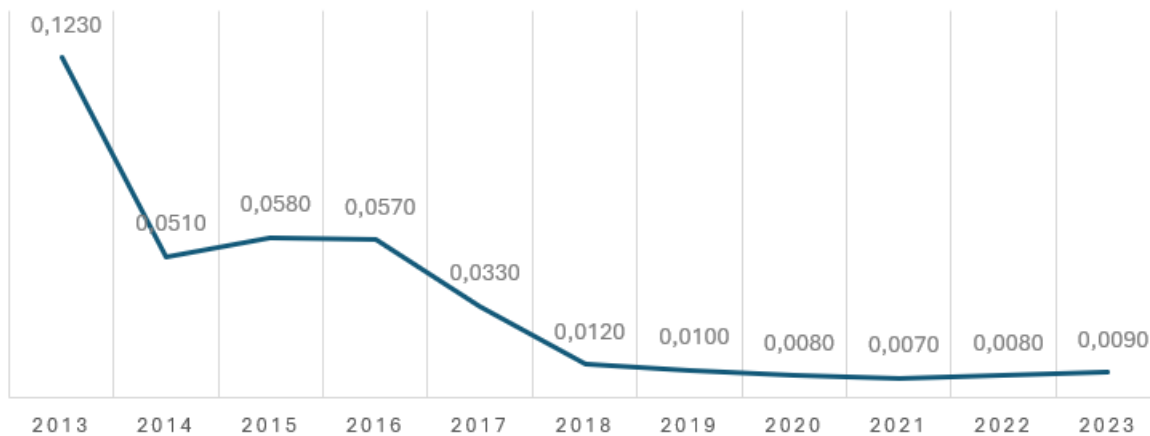


Figure 7. Share of services provided as part of hospitalization under the B.44 drug program – Treatment of patients with severe asthma in 2013-2023.

In 2013, the value of services provided under the B.44 drug program – Treatment of patients with severe asthma amounted to PLN 8.27 million. In the following year, this value increased to PLN 20.72 million. Until 2018, the value of services in the drug program was systematically growing, reaching PLN 30 million in 2018. In subsequent years, an upward trend was observed – PLN 77.99 million in 2021, and PLN 143.39 million in 2023 (Figure 8).

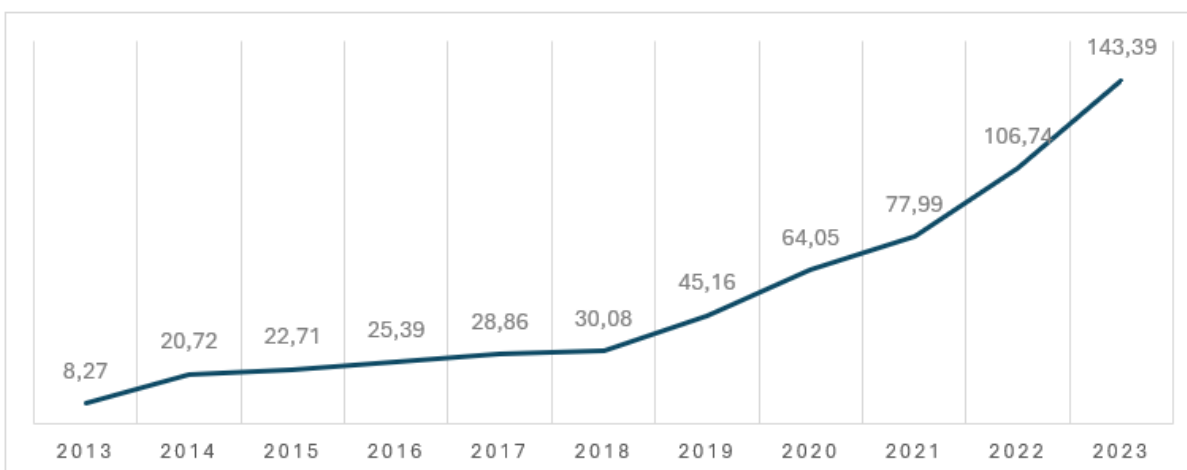


Figure 8. Value of services provided under drug program B.44 – Treatment of patients with severe asthma in 2013-2023.

Table 8. Number of patients, number of services provided, share of services provided during hospitalization and the value of services under the drug program B.44 – Treatment of patients with severe asthma in 2013-2023.

Year	Number of patients	Number of benefits (thou.)	Percentage of services provided during hospitalization	Value of benefits (PLN million): Total
2013	247	1.8	12.3%	8.27
2014	351	4.4	5.1%	20.72
2015	400	4.8	5.8%	22.71
2016	439	5.5	5.7%	25.39
2017	503	6.2	3.3%	28.86
2018	764	7.3	1.2%	30.08
2019	1 079	11.2	1.0%	45.16
2020	1 403	14.8	0.8%	64.05
2021	1 852	15.2	0.7%	77.99
2022	2 517	19.0	0.8%	106.74
2023	3 426	25.0	0.9%	143.39

Table 9. Dynamics of changes in the number of patients, the number of services provided, the share of services provided during hospitalization and the value of services under the drug program B.44 – Treatment of patients with severe asthma year-on-year in 2013-2023.

Detail, comparison	Number of patients	Number of benefits (thou.)	Percentage of services provided during hospitalization	Value of benefits (PLN million)
2014/2013	42.11%	144.44%	-58.54%	150.54%
2015/2014	13.96%	9.09%	13.73%	9.60%
2016/2015	9.75%	14.58%	-1.72%	11.80%
2017/2016	14.58%	12.73%	-42.11%	13.67%
2018/2017	51.89%	17.74%	-63.64%	4.23%
2019/2018	41.23%	53.42%	-16.67%	50.13%
average 2019-2013	27.86%	35.62%	-34.18%	32.70%
2020/2019	30.03%	32.14%	-20.00%	41.83%
2021/2020	32.00%	2.70%	-12.50%	21.76%
2022/2021	35.91%	25.00%	14.29%	36.86%
2023/2022	36.11%	31.58%	12.50%	34.34%
average 2023-2019	33.49%	22.23%	-2.60%	33.49%
Average rate of change 2013-2023	30.08%	30.10%	-23.01%	33.02%

The largest number of patients were treated under the B.44 drug program – Treatment of patients with severe asthma in a one-day mode – out of 300 patients in the drug program in 2013, as many as 226 patients were treated in a one-day mode. In 2018, out of 896 patients, 741 patients were treated in a one-day mode. In 2023, the number of patients in a one-day mode was 2,896, while the number of all patients in the drug program was 3,835 (Figure 9).

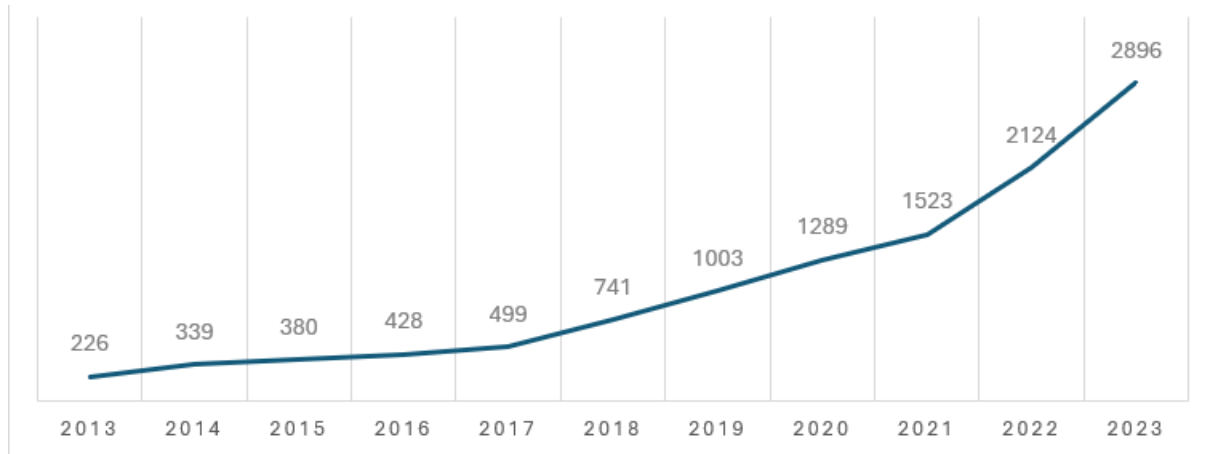


Figure 9. Number of patients treated as part of one-day treatment under drug programme B.44 – Treatment of patients with severe asthma in 2013-2023.

In 2013, there were 4 patients receiving outpatient treatment. In 2018, this number increased to 89 patients. Since 2019, the number of patients receiving outpatient treatment has been systematically increasing, reaching 731 patients in 2023 (Figure 10).

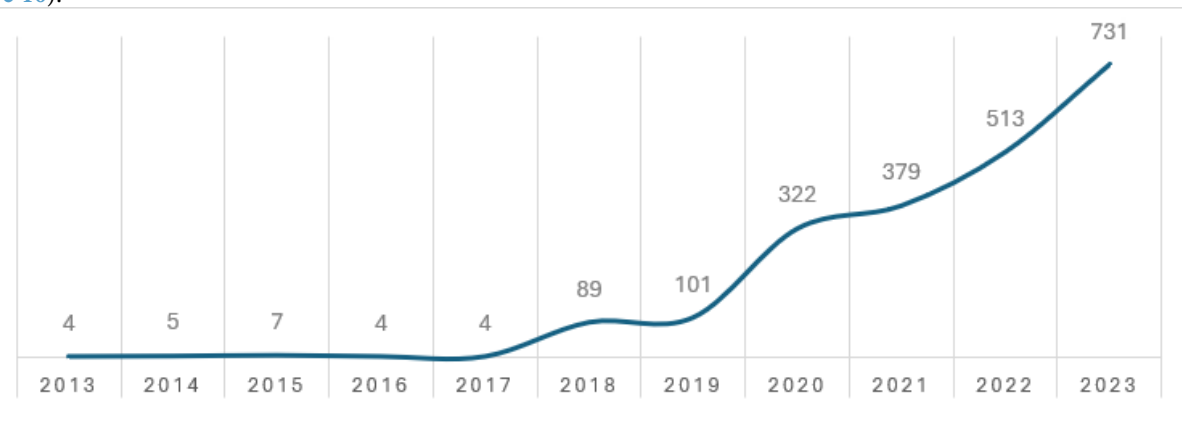


Figure 10. Number of patients treated on an outpatient basis under drug programme B.44 – Treatment of patients with severe asthma in 2013-2023.

The fewest patients were provided with services under the B.44 drug program – Treatment of patients with severe asthma in full hospitalization mode – 70 patients out of 300 in 2023. In 2018, 66 patients, and in 2023, 208 patients (Figure 11).

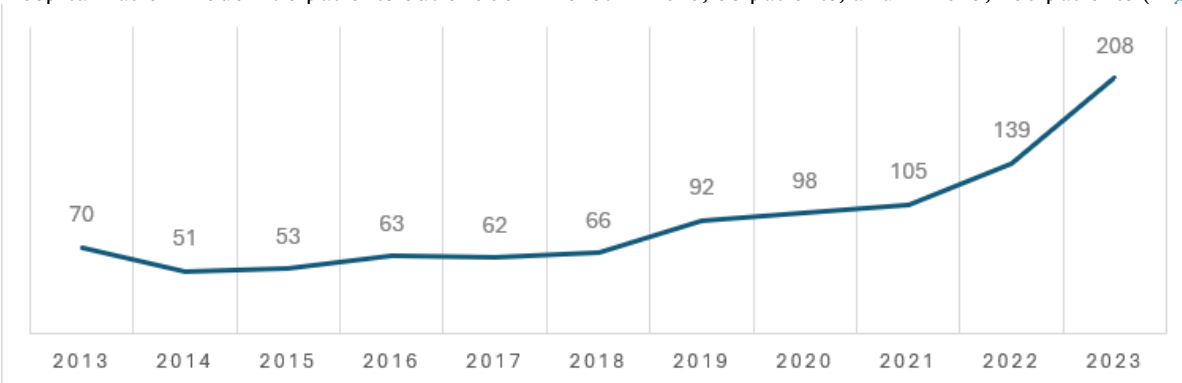


Figure 11. Number of patients treated as part of full hospitalization under drug program B.44 – Treatment of patients with severe asthma in 2013-2023.

Table 10. Number of patients under drug programme B.44 – Treatment of patients with severe asthma by admission mode in 2013–2023.

Year	Number of patients drug program	Number of patients - hospitalization	Number of patients - one-day mode	Number of patients - outpatient mode
2013	300	70	226	4
2014	395	51	339	5
2015	440	53	380	7
2016	495	63	428	4
2017	565	62	499	4
2018	896	66	741	89
2019	1196	92	1003	101
2020	1709	98	1289	322
2021	2007	105	1523	379
2022	2776	139	2124	513
2023	3835	208	2896	731

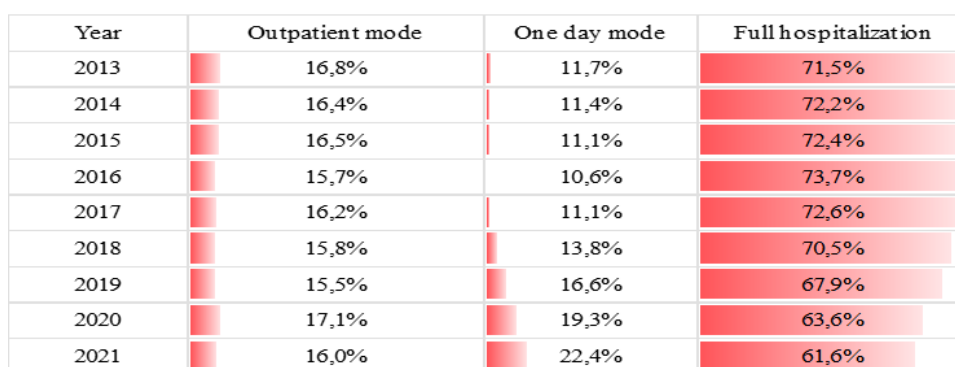


Figure 12. Assessment of the variability of the structure of treatment modes over time.

Analyzing the values of the correlation coefficients, it is possible to conclude about the direction of changes in the structure of admission modes. The changes occurred in the same direction for the outpatient mode and the full hospitalization mode – the convergence can be assessed at an average level of 52%. An inverse relationship of variability was observed in the case of full hospitalization and one-day mode, and one-day mode and outpatient mode. The compliance was assessed at the level of 98% and 67%, respectively. While the hospitalization mode is quite stable, for about 60-70% of the share, it will be noticed that the share of the feature in the total structure decreases in favor of an increase in one-day admissions, for which the coefficient of variation was noted at the level of $V_s=34.29\%$. Over the analyzed period, the number of one-day admissions was doubled (Table 11).

Table 11. Correlation coefficient for the structure of admission modes under drug programme B.44 – Treatment of patients with severe asthma by admission mode.

Outpatient mode	One day mode	Hospitalization
1	-0.67	0.52
-0.67	1	-0.98
0.52	-0.98	1

The share of patients in full hospitalization under the drug program B.44 – Treatment of patients with severe asthma amounted to 72% in 2013 and remained at a similar level until 2018. In subsequent years, the share of hospitalized patients decreased – in 2019 it amounted to 68%, and in 2023 already 61%. The share of patients treated in outpatient mode amounted to 17% in 2013, 16% in 2018, and increased in subsequent years, up to 26% in 2023. In turn, the share of patients covered by full hospitalization under the drug program amounted to 12% in 2013 and remained at this level until 2017. In 2018 it increased to 14%. By 2022 this share amounted to an average of 16%. In 2023, however, a decrease in the share of hospitalized patients was observed to 13% (Figure 13).

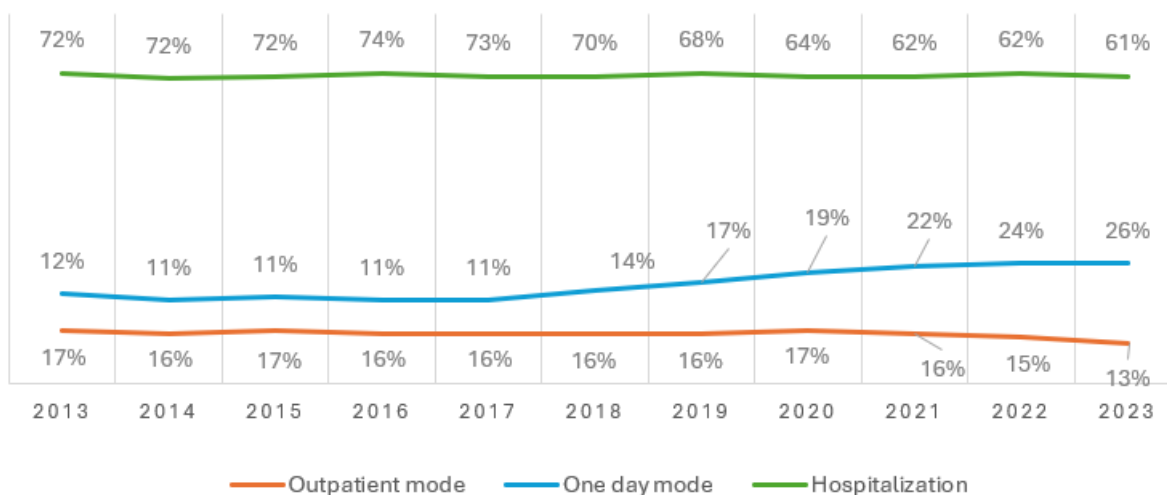


Figure 13. Share of the number of patients by the level of the structure of admission modes under the drug programme B.44 – Treatment of patients with severe asthma in 2013-2023.

Table 12. Dynamics of changes in the number of patients by the level of the structure of admission modes under the drug program B.44 – Treatment of patients with severe asthma in 2013-2023.

Detail, comparison	Number of patients drug program	Number of patients - full hospitalization	Number of patients - one day mode	Number of patients - outpatient mode
2014/2013	31.67%	-27.14%	50.00%	25.00%
2015/2014	11.39%	3.92%	12.09%	40.00%
2016/2015	12.50%	18.87%	12.63%	-42.86%
2017/2016	14.14%	-1.59%	16.59%	0.00%
2018/2017	58.58%	6.45%	48.50%	2125.00%
2019/2018	33.48%	39.39%	35.36%	13.48%
average 2019-2013	25.92%	4.66%	28.19%	71.28%
2020/2019	42.89%	6.52%	28.51%	218.81%
2021/2020	17.44%	7.14%	18.15%	17.70%
2022/2021	38.32%	32.38%	39.46%	35.36%
2023/2022	38.15%	49.64%	36.35%	42.50%
average 2023-2019	33.82%	22.62%	30.35%	64.02%
average 2023-2013	29.02%	11.51%	29.05%	68.34%

Number of services provided under the drug program B.44 Treatment of patients with severe asthma

As part of full hospitalization, the number of services provided under the drug program B.44 – Treatment of patients with severe asthma amounted to 1,783,000 in 2013. In the following year, the number of services increased by over 400% to 4,362,000 services. In subsequent years, the number of services grew systematically. In 2019, an increase in the number of services of over 54% was observed compared to the previous year. In 2023, the number of services amounted to 25,034,000 (Figure 14).

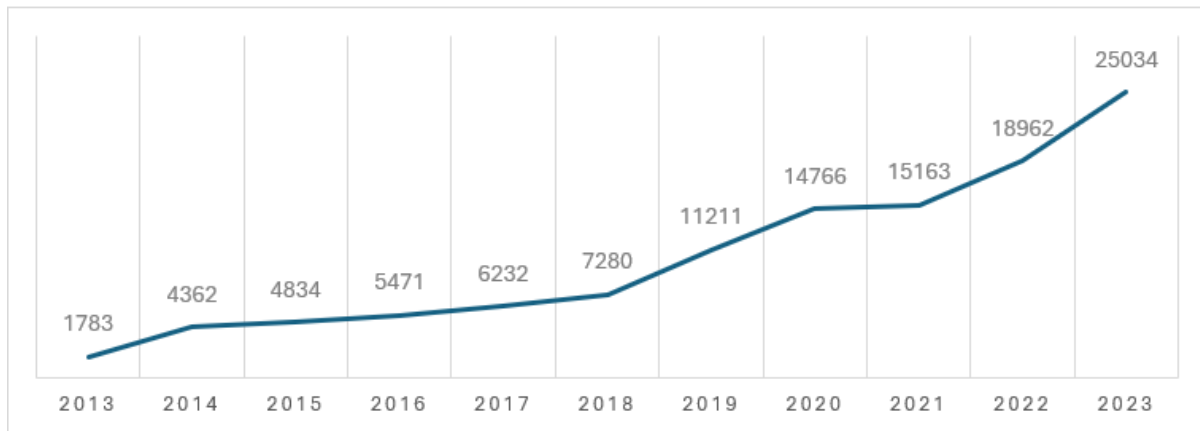


Figure 14. Number of services provided under the drug program B.44 – Treatment of patients with severe asthma in 2013–2023, thou

The largest number of services in the drug program B.44 – Treatment of patients with severe asthma were provided as part of the one-day procedure. In 2013, 1,561 thousand services were provided in this mode. In 2018, the number of services provided as part of the one-day procedure increased to 6,799 thousand services. In 2023, the number of services provided amounted to 20,608 thousand (Figure 15).

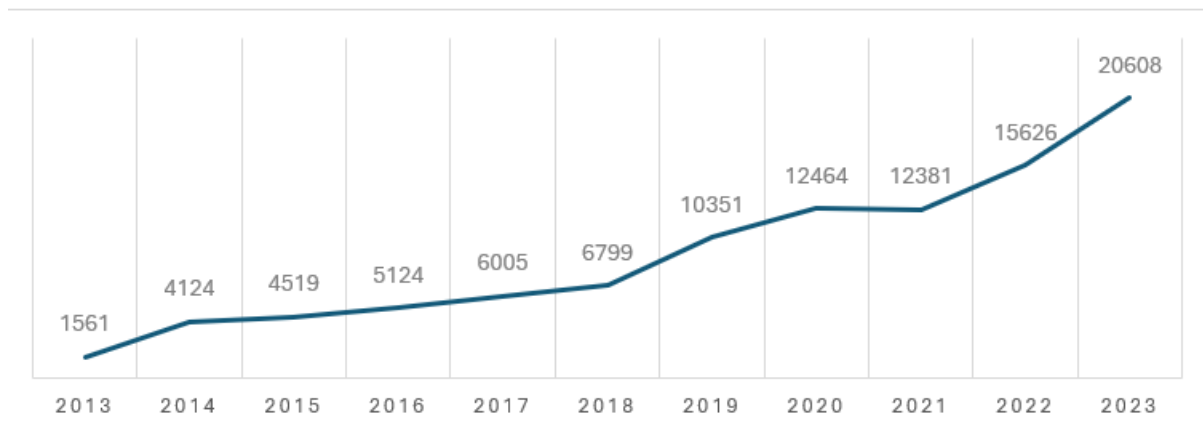


Figure 15. Number of services provided on a one-day basis under the drug programme B.44 – Treatment of patients with severe asthma in 2013–2023, thou.

In outpatient mode, under the drug program B.44 – Treatment of patients with severe asthma, 4 thousand services were provided in 2013, 398 thousand services in 2018 and 4,200 thousand services in 2023 (Figure 16).

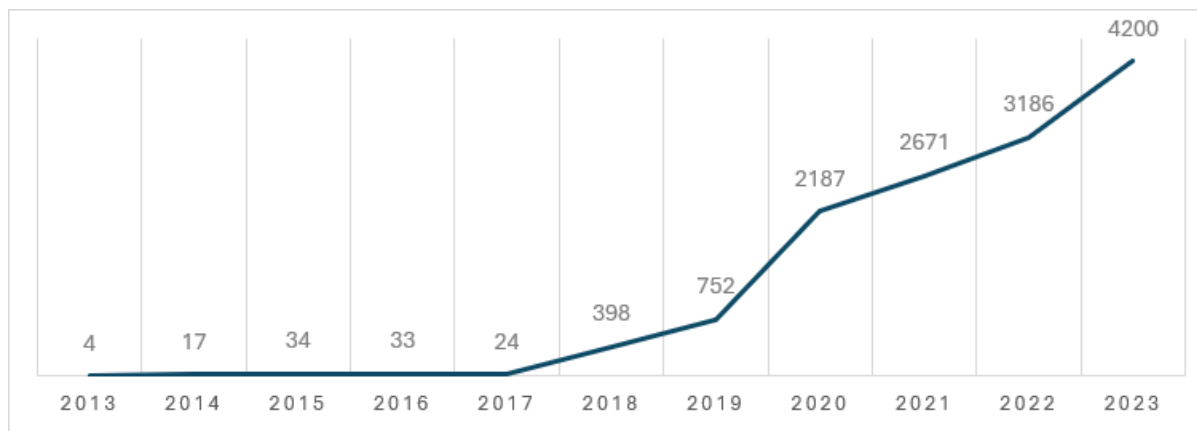


Figure 16. Number of outpatient services provided under drug programme B.44 – Treatment of patients with severe asthma in 2013–2023, thou.

The number of services provided as part of full hospitalization was characterized by a downward trend in the years covered by the analysis. The number of services amounted to 218 thousand in 2013. In the following years, this number decreased until 2016. In 2016, it amounted to 314 thousand. In 2018, only 83 thousand services were provided. In the following years, the number of services provided as part of full hospitalization increased, and in 2023 it amounted to 226 thousand services (Figure 17).



Figure 17. Number of services provided in full hospitalization mode under drug program B.44 – Treatment of patients with severe asthma in the years 2013-2023, thou.

Table 13. Number of services provided as part of hospitalisation and the value of services under the drug programme B.44 – Treatment of patients with severe asthma in the years 2013-2023, thou.

Year	Number of patients drug program	Number of patients - full hospitalization	Number of patients - one day mode	Number of patients - outpatient mode
2013	1783	218	1561	4
2014	4362	221	4124	17
2015	4834	281	4519	34
2016	5471	314	5124	33
2017	6232	203	6005	24
2018	7280	83	6799	398
2019	11211	108	10351	752
2020	14766	115	12464	2187
2021	15163	111	12381	2671
2022	18962	150	15626	3186
2023	25034	226	20608	4200

Table 14. Dynamics of changes in the number of services provided as part of hospitalisation and the value of services under the drug programme B.44 – Treatment of patients with severe asthma year on year in the years 2013-2023, thou.

Year	Number of patients drug program	Number of patients - full hospitalization	Number of patients - one day mode	Number of patients - outpatient mode
2014/2013	144.64%	1.38%	164.19%	325.00%
2015/2014	10.82%	27.15%	9.58%	100.00%
2016/2015	13.18%	11.74%	13.39%	-2.94%
2017/2016	13.91%	-35.35%	17.19%	-27.27%
2018/2017	16.82%	-59.11%	13.22%	1558.33%
2019/2018	54.00%	30.12%	52.24%	88.94%
average 2019-2013	35.86%	-11.05%	37.07%	139.35%
2020/2019	31.71%	6.48%	20.41%	190.82%
2021/2020	2.69%	-3.48%	-0.67%	22.13%
2022/2021	25.05%	35.14%	26.21%	19.28%
2023/2022	32.02%	50.67%	31.88%	31.83%
average 2023-2019	22.24%	20.27%	18.79%	53.73%
Average 2023-2013	30.24%	0.36%	29.44%	100.50%

Analysis of the benefits of the Health Insurance Institution for incapacity for work resulting from the medical problem of bronchial asthma, defined by the ICD-10 main diagnosis codes: asthma J45 and status asthmaticus J46

Total Social Insurance Institution benefits for incapacity for work resulting from the medical problem of bronchial asthma for the years 2019-2023

The Social Insurance Institution expenditure on benefits for incapacity for work resulting from the medical problem of bronchial asthma, defined by the ICD-10 main diagnosis codes: asthma J45 (entire group) and status asthmaticus J46 (entire group) for the years 2019-2023 was analyzed.

In the years 2019-2023, a stable level of total benefits for incapacity for work resulting from the medical problem of bronchial asthma, defined by the ICD-10 main diagnosis codes: asthma J45 (entire group) and status asthmaticus J46 (entire group) was recorded from PLN 193,241.50 thousand in 2019 to PLN 200,469.70 thousand in 2023 (Figure 18).

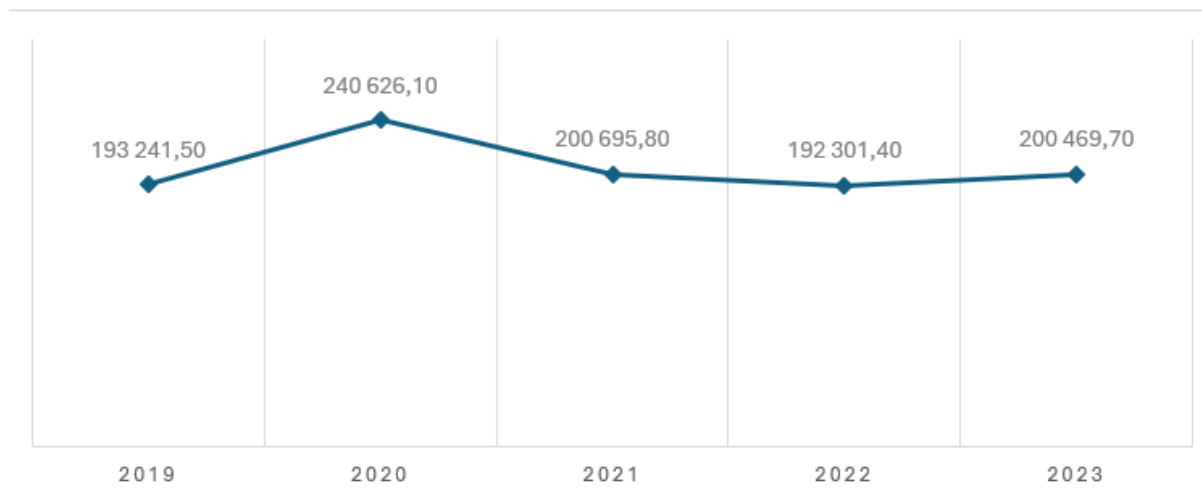


Figure 18. Total Social Insurance Institution benefits for incapacity for work resulting from the medical problem of bronchial asthma for the years 2019-2023, PLN, thou.

Table 15. Social Insurance Institution benefits for incapacity for work resulting from the medical problem of bronchial asthma, specified by the ICD-10 main diagnosis codes: asthma J45 (entire group) and status asthmaticus J46 (entire group) for the years 2019-2023, PLN, thou.

Specification	Total	Disability pensions	Social pensions	Absence due to illness	Rehabilitation benefit	Therapeutic rehabilitation	
amount in thousands PLN							
2019	TOTAL	193 241,50	123 370,70	6 829,70	54 842,90	5 808,80	2 389,30
J45	Asthma	192 620,40	122 914,30	6 829,70	54 693,80	5 798,30	2 384,30
J46	Status asthmaticus	621,1	456,4	-	149,1	10,5	5
2020	TOTAL	240 626,10	120 718,70	7 137,50	104 469,70	7 638,90	661,2
J45	Asthma	239 824,90	120 154,50	7 137,50	104 257,30	7 616,90	658,7
J46	Status asthmaticus	801,2	564,2	-	212,4	22	2,5
2021	TOTAL	200 695,80	117 738,40	7 255,10	67 225,90	7 896,10	580,3
J45	Asthma	200 003,10	117 170,90	7 255,10	67 100,70	7 896,10	580,3
J46	Status asthmaticus	692,7	567,5	-	125,2	-	-
2022	TOTAL	192 301,40	117 270,40	7 345,60	59 166,50	6 361,10	2 157,70
J45	Asthma	191 490,40	116 676,00	7 345,60	58 970,40	6 340,70	2 157,70
J46	Status asthmaticus	811	594,4	-	196,1	20,4	-
2023	TOTAL	200 469,70	124 356,90	8 173,70	58 889,60	7 118,70	1 930,90
J45	Asthma	199 976,40	124 014,30	8 173,70	58 738,80	7 118,70	1 930,90
J46	Status asthmaticus	493,3	342,6	-	150,8	-	-

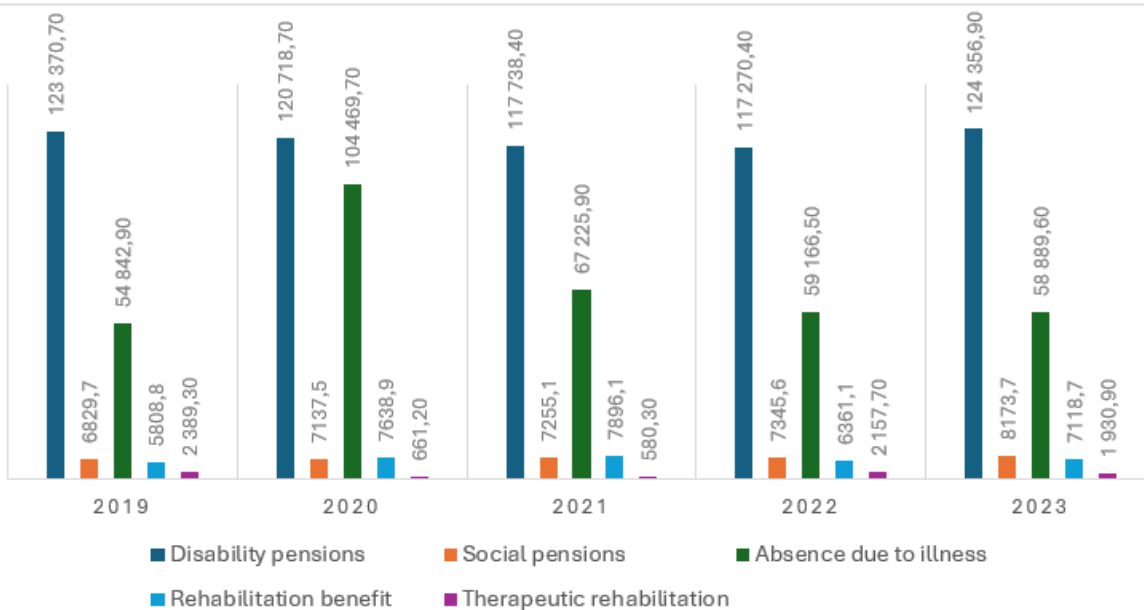


Figure 19. Social Insurance Institution benefits for incapacity for work resulting from the medical problem of bronchial asthma, specified by the ICD-10 codes of the main diagnosis: asthma J45 (the entire group) and status asthmaticus J46 (the entire group) for the years 2019-2023, PLN thou.

Number of persons insured with the Social Insurance Institution who were issued a medical certificate for bronchial asthma (J45) and Status asthmaticus (J46) at least once in the years 2019-2024

In the years 2019-2024, the number of people insured with ZUS who were issued a medical certificate for bronchial asthma (J45) and status asthmaticus (J46) at least once in the years 2019-2024 remained at a constant level. In 2019, there were 37,964 people with asthma and 192 people with status asthmaticus, while in 2024, the numbers were 37,543 and 156 people, respectively (Table 16).

Table 16. Number of persons insured with the Social Insurance Institution who were issued a medical certificate for bronchial asthma (J45) and status asthmaticus (J46) at least once in the years 2019-2024

Disease entities	Number of people					
	2019	2020	2021	2022	2023	2024
Bronchial asthma (J45)	37 964	45 562	32 845	34 676	34 612	37 543
Status asthmaticus (J46)	192	170	150	145	146	156

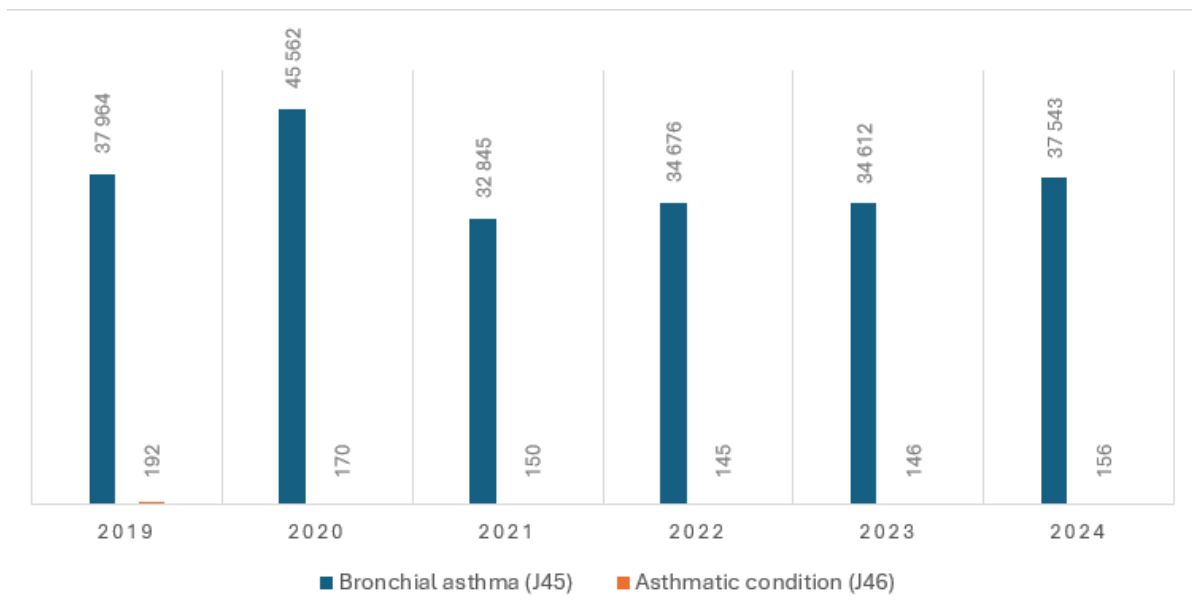


Figure 20. Number of persons insured with ZUS who were issued a medical certificate for bronchial asthma (J45) and status asthmaticus (J46) at least once in the years 2019-2024

Number of absence due to bronchial asthma (J45) and Status asthmaticus (J46) in 2012-2024

In the years 2012-2024, a decrease in the number of absence days due to bronchial asthma (J45) and status asthmaticus (J46) was noted. In terms of the number of sick leave days due to bronchial asthma (J45), there was a decrease from 735,410 days in 2012 to 532,352 days in 2024. Therefore, a 28% decrease was noted (203,058 fewer sick leave days) comparing 2012 to 2024 (Figure 21).



Figure 21. Number of days of absence due to bronchial asthma in 2012-2024

In terms of the number of days of sickness absence due to status asthmaticus (J46), there was a decrease from 7,919 days in 2012 to 1,602 days in 2024. Therefore, an 80% decrease was recorded (6,317 days of sickness absence less) when comparing 2012 to 2024 (Figure 22).

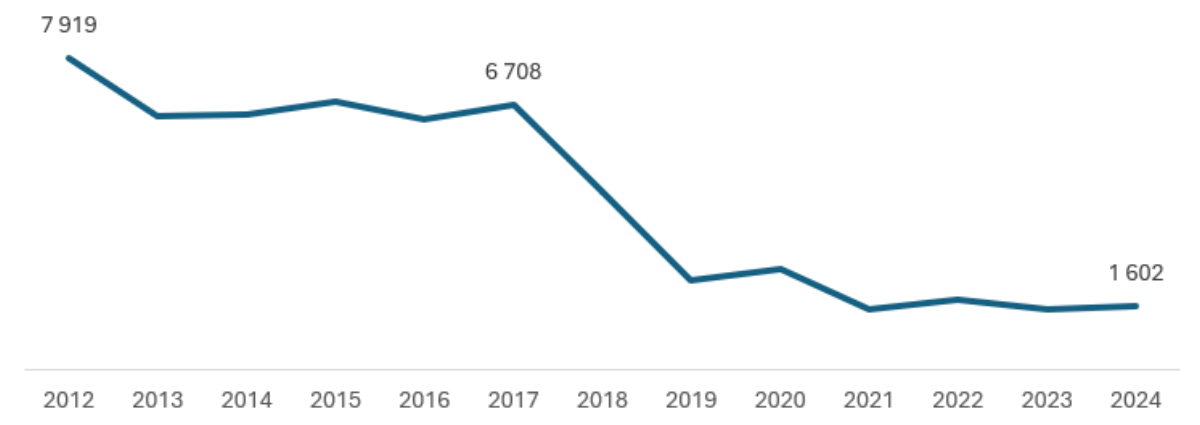


Figure 22. Number of days of absence due to status asthmaticus in 2012-2024

Table 17. Number of days of sickness absence due to bronchial asthma (J45) and status asthmaticus (J46) in 2012-2024

Year	ICD10	Disease entity	Number of days of sickness absence
2024	J45	Bronchial asthma	532 352
	J46	Status asthmaticus	1 602
2023	J45	Bronchial asthma	513 138
	J46	Status asthmaticus	1 518
2022	J45	Bronchial asthma	550 028
	J46	Status asthmaticus	1 763
2021	J45	Bronchial asthma	618 561
	J46	Status asthmaticus	1 521
2020	J45	Bronchial asthma	1 098 859
	J46	Status asthmaticus	2 547
2019	J45	Bronchial asthma	664 711
	J46	Status asthmaticus	2 272
2018	J45	Bronchial asthma	718 978
	J46	Status asthmaticus	4 491
2017	J45	Bronchial asthma	755 612
	J46	Status asthmaticus	6 708
2016	J45	Bronchial asthma	741 095
	J46	Status asthmaticus	6 355
2015	J45	Bronchial asthma	758 591
	J46	Status asthmaticus	6 822
2014	J45	Bronchial asthma	713 979
	J46	Status asthmaticus	6 464
2013	J45	Bronchial asthma	748 474
	J46	Status asthmaticus	6 444
2012	J45	Bronchial asthma	735 410
	J46	Status asthmaticus	7 919

4. Discussion

Systemic aspects of bronchial asthma are primarily regular and cyclical assessment of the delivery of health value, expressed by the ratio of health effects to total costs incurred, taking into account the patient's quality of life (QoL, PROM, PREM). In the case of achieving remission (value of remission) or alleviating the course of this disease, it is important to reduce steroid doses, inhibit exacerbations requiring expensive hospitalizations and the quality of life of patients. The key to this process is the analysis of actual data from clinical practice (RWD), NFZ and ZUS data. A very important indicator is the reimbursement access to drugs registered in the European Union included in the current therapeutic standards.

Thanks to access to effective treatment within the framework of pharmacy reimbursement and the B.44 drug program, patients with severe asthma do not have/or have fewer exacerbations, are not/or are hospitalized less often. According to data from the National Health Fund, the number of hospitalizations has decreased by half in the last decade due to effective treatment. The value of reimbursement of hospitalizations due to asthma of adult patients carried out in hospital treatment, excluding hospitalizations under the drug program and hospitalizations started and ended on the same day, remained at a constant level. Data on the effectiveness of biological drugs show a remission rate of approx. 70%, and a drop-out rate of several percent. Considering the priority of optimizing the healthcare system in Poland towards an outpatient model of care, the number of patients with severe asthma treated under the drug program should be increased.

The recommended model of care for patients with bronchial asthma is coordinated care, i.e. a system based on cooperation between a primary care physician, an allergist and pulmonologist, a nurse, an educator and the patient. The goals of coordinated care are to improve the continuity of care, reduce system costs and improve the effects of treatment and the quality of life of the patient. The elements of coordinated care for a patient with bronchial asthma are:

Patient education: self-control, correct inhalation technique.

- Action plan: description of symptoms of deterioration and therapeutic recommendations.
- Fast diagnostic and therapeutic path: primary care–specialist–hospital.
- Telemedicine: contact with a doctor and nurse via e-consultation.
- Therapeutic team: joint documentation and therapeutic decisions.

5. Conclusions

Since introduction of the first medicinal products for financing under the asthma treatment drug programme in 2013, the following has been observed:

1. Decrease in the number of patients registered for hospital treatment at the level of: -2.79% (-2.27% pre-pandemic period, -3.57% post-pandemic period), similar negative dynamics are observed in outpatient care and primary healthcare.
2. This means better disease control in patients, a conclusion confirmed by the stable and similar distribution of the number of patients, taking into account the mode of admission to hospital.
3. The impact of the pandemic on the number of patients with asthma (not related to COVID infection) is clearly visible; after the acute phase of the pandemic (2020-2021), an increase in the number of patients is observed, but their number does not return to the previous level, which is explained by effective therapy under the drug program.

In the scope of Social Insurance Institution benefits for incapacity for work due to bronchial asthma and status asthmaticus:

1. In the years 2019-2023, a stable level of total benefits for incapacity for work resulting from the medical problem of bronchial asthma, defined by the ICD-10 main diagnosis codes: asthma J45 (the entire group) and status asthmaticus J46 (the entire group) was recorded from PLN 193,241.50 thousand in 2019 to PLN 200,469.70 thousand in 2023.
2. In the years 2019-2024, the number of people insured with Social Insurance Institution who were issued a medical certificate for bronchial asthma (J45) and Status asthmaticus (J46) at least once in the years 2019-2024 remained at a constant level. In 2019, there were 37,964 people with asthma and 192 people with Status asthmaticus, while in 2024 there were 37,543 people with asthma and 156 people with Status asthmaticus.
3. In the years 2012-2024, a decrease in the number of sick leave days due to bronchial asthma (J45) and Status asthmaticus (J46) was noted. In terms of the number of days of sickness absence due to bronchial asthma (J45), there was a decrease from 735,410 days in 2012 to 532,352 days in 2024. This means a 28% decrease (203,058 days of sickness absence less) when comparing 2012 to 2024. In terms of the number of days of sickness absence due to Status asthmaticus (J46), there was a dramatic decrease from 7,919 days in 2012 to 1,602 days in 2024. This means a 80% decrease (6,317 days of sickness absence less) when comparing 2012 to 2024.

Conflict of Interest and Influence Statement:

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