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## Analysis of hospital management of chronic respiratory diseases in light of the “Maps of Health Needs” project in Poland

### Abstract

**Introduction:** The “Maps of Health Needs” project has been carried out in Poland since 2016 and its purpose is to implement quality-promoting and organisational solutions in the Polish healthcare system. This paper is the analysis of hospitalisations for chronic respiratory diseases recorded in Polish National Health Fund databases in 2014.

**Material and methods:** The study included 122,000 hospitalisations of adults and 22,000 hospitalisations of children. Epidemiological parameters (incidence and prevalence) and major hospitalisation parameters were determined through statistical analysis.

**Results:** The highest registered incidence was observed in asthma patients (548 per 100,000 inhabitants) followed by COPD patients (233 per 100,000 inhabitants). Asthma patients were also characterised by the highest prevalence, with lower values being observed in COPD patients. In the group of adults, patients aged 65 years or older and 80 years or older accounted for 44% and 14% of hospitalised adults respectively. The analysis also revealed that 66% of hospitalisations of adults included patients with asthma, COPD and respiratory failure. The development of respiratory failure prolongs hospitalisation and increases both in-hospital and post-discharge mortality. In children, 90% of the identified hospitalisations were for asthma, chronic inflammatory lung diseases and cystic fibrosis.

**Conclusions:** The results of the study demonstrate that pulmonary obstructive diseases are associated with a considerable burden. Therefore, corrective actions within the Polish healthcare system are required to decrease the number of hospitalisations for these diseases.

**Key words:** Maps of Health Needs, hospitalisations, chronic respiratory diseases

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### Introduction

According to the “European Lung White Book” 600,000 people die from respiratory diseases in Europe each year, meaning that one in eight deaths is caused by them [1]. A total of 6 million hospitalisations due to respiratory diseases are recorded each year.

Epidemiological studies have shown that at least 1/3 of the population aged 5–80 years is at an increased risk of asthma, a lifetime risk for developing COPD in smokers is 40–50%, and lung

cancer causes 20% of cancer-related deaths [1]. Until recently, cystic fibrosis (CF), a multi-organ genetic disease, was considered a childhood disease. Currently, however, as many as 42% of CF patients survive until the age of 18, and 5% — until 40 years of age.

The “Maps of Health Needs” project ([www.mpz.mz.gov.pl/](http://www.mpz.mz.gov.pl/)), co-financed by the European Social Fund (ESF) as part of the Operational Programme Knowledge Education Development, is a project whose goals to implement quality-promoting activities and organisational solutions in

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the Polish healthcare system are in line with the trend of health promotion, in accordance with the Ottawa Charter [2].

The project resulted in the creation of a system for mapping health needs within 30 groups of diseases and in the development of a base for systemic and implementation analyses within this scope.

The aim of this study was to analyse hospital management of selected chronic respiratory diseases.

## Material and methods

### Study population

The study population comprised all patients in Poland in whom a hospitalisation was reported in 2014 due to the following diagnoses (ICD-10) being part of chronic respiratory diseases:

1. Asthma (J45, J46);
2. COPD (J43, J44);
3. Cystic fibrosis (CF) (E84);
4. Interstitial lung disease (ILD) (D86, J60–J67, J70, J82, J84, J99);
5. Sleep-disordered breathing (SDB) (G47);
6. Chronic inflammatory lung diseases (J40–J42, J47);
7. Respiratory failure (J96).

Patients treated in the drug programme were excluded from the analysis of asthma. While an additional group of persons hospitalised for lung cancer was distinguished, it was not further analysed in detail since these patients often undergo diagnostic evaluation in respiratory wards, but in the Polish healthcare system they are treated in surgical and cancer wards.

### Data collection

The data used in this study were derived from the payment reconciliation database of the public payer in the Polish healthcare system [NFZ (Narodowy Fundusz Zdrowia) — National Health Fund]. In Poland, payments for healthcare services are settled by the NFZ in accordance with the principles of Diagnosis-Related Groups (DRGs). In cases of non-surgical treatment, classifications into appropriate groups are primarily based on the ICD-10 diagnosis.

In addition to providing information about the diagnosis and the healthcare product paid for, the analysed database contained the following information used to create aggregated data concerning individual diseases of the respiratory system:

- Patient ID (enabling the same patient to be identified during different hospitalisations), including age, sex, and address;

- Type and date of admission; type and date of hospital discharge;
- Comorbidities;
- Healthcare provider's ID and geographical location;
- Type of ward providing hospitalisation;
- ICD-9 code procedure reported;
- Post-discharge mortality rate, which was determined using the database of deaths by the Ministry of Internal Affairs and Administration.

### Statistical analysis

Statistical analysis was conducted using R software, version 0.99.902, and was mainly based on the `data.table` package.

Epidemiological statistics included the following parameters:

- Registered incidence — defined as the number of new patients with a specific diagnosis appearing in the public healthcare system. This parameter was calculated for 2014 on the basis of the NFZ data covering the period between 2009–2014;
- Registered prevalence — defined as the number of individuals with a specific disease, estimated as from 31 December 2014. Individuals with a specific disease were defined as all patients classified as new cases of that specific disease in the public healthcare system since 2009, who were still alive on 31 December 2014.

This publication also includes an analysis of hospitalisation-related parameters, such as:

- Number of hospitalisations;
- Cumulative percent of the number of hospitalisations;
- Number of patients;
- Number of hospitalisations per patient;
- ALOS (average length of stay);
- MLOS (median length of stay);
- Number of patient-days of hospitalisation;
- Average patient age;
- Percentage of adult patients aged 65 years or older and aged 80 years or older (in the case of children, it is the percentage of children aged up to 1 year)
- Percentage of in-hospital deaths;
- 30-day post-discharge mortality;
- 90-day post-discharge mortality.

## Results

The population analysed in detail consisted of 122,000 adult patients [55,000 women and 67,000 men; mean age — 64 years; median

**Table 1. Registered incidence and prevalence (2014)**

	Registered incidence [thousand]	Registered incidence per 100,000 inhabitants	Registered prevalence [thousand]	Registered prevalence per 100,000 inhabitants
Asthma	209	548	1854	4878
COPD	89	233	730	1920
ILD	19	51	136	357
SDB	20	53	122	320
Chronic inflammatory lung diseases	73	191	612	1611
Respiratory failure	22	56	61	161

COPD — *chronic obstructive pulmonary disease*; ILD — *interstitial lung disease*; SDB — *sleep-disordered breathing*

age — 65 years; standard deviation (SD) — 15.3] and 22,000 children (aged up to 18 years; mean age — 6 years; median age — 5 years; SD — 4.6). The patients aged 65 years or older accounted for 44% (63,000) of the analysed group, and those aged 80 years or older — 14% (20,000).

Nearly half of the hospitalised patients (48.6%) were in lung disease and tuberculosis wards.

### Incidence and prevalence

The highest registered incidence values were observed in patients with asthma, and the lowest ones in individuals with respiratory failure (Table 1). The highest registered prevalence values were also observed in patients with asthma, followed by patients with COPD and patients with chronic inflammatory lung diseases.

### Hospitalisations of adults

The patients with COPD, respiratory failure and asthma accounted for 66% of the hospitalisations (Table 2). The subjects with COPD were characterised by the highest number of hospitalisations, the highest number of hospitalisations per patient (1.2) and the highest mean patient age, while as many as 29% of the hospitalised patients were those aged 85 years or older. The development of respiratory failure increased ALOS to 11.4 days.

The highest ALOS (12 days) was observed in the group of patients with CF, while the average number of hospitalisations per patient with CF was 2.2. This was the youngest and the smallest group among all hospitalised persons.

### Hospitalisations of children

The cumulative percent of the number of hospitalisations showed that the reason for ad-

mission to hospital was asthma, chronic inflammatory lung diseases and CF in 90% of the hospitalised children (Table 3). The highest number of hospitalisations per patient was observed in patients with CF. The highest ALOS was found in patients with respiratory failure.

### Deaths in adults

The development of respiratory failure led to 23% of in-hospital deaths, while 30% of the patients died within 30 days and 36% within 90 days after hospital discharge (Table 4). In the case of COPD patients, in-hospital deaths constituted 3%, whereas 6% of the patients died within 30 days and 10% within 90 days after hospital discharge (Table 4).

### Deaths in children

The development of respiratory failure in children was also associated with the highest in-hospital mortality (5%), while 7% and 9% of them died within 30 and 90 days after hospital discharge, respectively. With regard to CF patients, 1% of deaths within 30 days after hospital discharge was observed.

### Discussion

This publication discusses the burden of hospitalisations for chronic respiratory diseases on the Polish healthcare system.

The analysed data concerned hospitalisations for which the diagnosis of chronic respiratory disease was the first to be reported with an ICD-10 code.

It should, however, be emphasised that the method and order of ICD-10 coding may be the source of a reporting error [3] — an example can be the reporting of pneumonia in a patient with COPD using only one code.

**Table 2. Hospitalisations in adults**

Adults	Number of hospitalisations	Cumulative percent of the number of hospitalisations*	Number of patients	Number of hospitalisations per patient	Number of patient-days	ALOS	MLOS	Mean patient age	Percentage of patients aged 65+	Percentage of patients aged 80+
COPD (J43, J44)	43,134	28%	35,957	1.20	350,512	8.1	7	70.3	86%	29%
Respiratory failure (J96)	29,514	47%	25,004	1.18	335,893	11.4	8	69.1	81%	29%
Asthma (J45, J46)	28,870	66%	24,586	1.17	207,276	7.2	7	59.5	49%	13%
ILD (D86, J60–J67, J70, J82, J84, J99)	18,670	78%	13,751	1.36	126,242	6.8	5	56.8	46%	10%
SDB (G47)	17,816	90%	15,243	1.17	24,240	1.4	1	54.8	25%	1%
Chronic inflammatory lung diseases (J40–J42, J47)	14,425	99%	13,340	1.08	112,113	7.8	7	65.4	61%	19%
CF (E84)	838	100%	381	2.20	10,074	12.0	13	25.2	1%	0%

\*Sum of the percentage of each category from the top of the table to the bottom, designed to total it up to 100 percent  
 CF — cystic fibrosis; COPD — chronic obstructive pulmonary disease; ILD — interstitial lung disease; SDB — sleep-disordered breathing

**Table 3. Hospitalisations in children**

Children	Number of hospitalisations	Cumulative percent of the number of hospitalisations*	Number of patients	Number of hospitalisations per patient	Number of patient-days	ALOS	MLOS	Mean patient age	Percentage of children aged up to 1 year
Asthma (J45, J46)	17,508	71%	15,760	1.11	63,922	3.7	3	7.2	8%
Chronic inflammatory lung diseases (J40–J42, J47)	2,705	82%	2,577	1.05	11,417	4.2	3	4.6	25%
CF (E84)	1,805	90%	1,055	1.71	10,342	5.7	2	8.1	29%
Respiratory failure (J96)	1,372	95%	1,163	1.18	5,162	13.1	3	4.3	47%
ILD (D86, J60–J67, J70, J82, J84, J99)	773	98%	665	1.16	5,162	6.7	6	4.5	39%
SDB (G47)	409	100%	386	1.06	616	1.5	1	7.6	6%

\*Sum of the percentage of each category from the top of the table to the bottom, designed to total it up to 100 percent  
 CF — cystic fibrosis; COPD — chronic obstructive pulmonary disease; ILD — interstitial lung disease; SDB — sleep-disordered breathing

**Table 4. Analysis of deaths in adults**

Adults	Number of patients	Number of in-hospital deaths	In-hospital deaths as a percentage of all deaths	30-day post-discharge mortality	90-day post-discharge mortality
Asthma (J45, J46)	24,586	146	1%	1%	2%
COPD (J43, J44)	35,957	1,304	3%	6%	10%
CF (E84)	381	8	1%	2%	4%
ILD (D86, J60–J67, J70, J82, J84, J99)	13,751	366	2%	4%	6%
SDB (G47)	15,243	2	0%	0%	0%
Chronic inflammatory lung diseases (J40–J42, J47)	13,340	115	1%	3%	5%
Respiratory failure (J96)	25,004	6,684	23%	30%	36%

CF — cystic fibrosis; COPD — chronic obstructive pulmonary disease; ILD — interstitial lung disease; SDB — sleep-disordered breathing

The highest registered incidence was observed in patients with asthma, followed by subjects with COPD. Patients suffering from asthma were also characterised by the highest prevalence, while lower values were observed in individuals with COPD.

The cumulative percent of the number of hospitalisations showed that asthma, COPD and respiratory failure were responsible for 66% of hospitalisations of adults. The highest number of adult patients was hospitalised for COPD. Regardless of the underlying disease, the development of respiratory failure leads to the deterioration of the prognosis, prolongation of hospitalisation and increase in both in-hospital and post-discharge mortality.

Asthma, chronic inflammatory lung diseases and CF accounted for 90% of children's hospitalisations. Asthma was the reason for the highest number of hospitalisations. In children with CF, there was a relatively lower number of hospitalisations per patient. Respiratory failure prolonged the length of hospital stay significantly and was associated with higher mortality.

Respiratory system diseases are a complex, medical and economic problem in every country [1, 4–6]. The analysis of respiratory diseases, conducted in the United Kingdom, demonstrated that 12.7 million British individuals had a history of asthma, COPD or another chronic respiratory disease [6]. It is widely accepted that 50% of deaths and 25% of hospitalisations are caused by tobacco-related diseases, including lung cancer or COPD.

In 2011, a total of 694,000 hospitalisations were reported, 8% of which were for diseases of the respiratory system. Respiratory system diseases were the reason for 703,116 (8.3%) of hospital-

isations, which translated into 6,167,509 patient days (10%).

The authors of the publication noted that the patient age significantly affected the percentage of hospitalisations in relation to a given diagnosis. Therefore, in children aged up to 14 years, 23.4% of the hospitalisations resulted from congenital anomalies and respiratory complications associated with them — 18% were for asthma and 1.9% were for CF.

At ages 15–64 years, asthma accounted for 15.5% of the hospitalisations, COPD — 18.2%, CF — 3.1%, and lung cancer — 7.1%. In patients aged 65 years or older, asthma accounted for as little as 2.2% of the hospitalisations, COPD — 26.5%, and lung cancer — 7.8%.

The number of hospitalisations for COPD was 43,134, which corresponded to 350,512 patient days, while ALOS was 8.1 days. In the UK analysis, there were 204,798 hospitalisations (2.4%), which corresponded to 2,346,324 (3.8%) patient days [6].

Many foreign analyses point to the burden of hospitalisations for COPD on healthcare systems even though incidence and hospital morbidity rates vary considerably. For instance, Oceania and, particularly, Australia and New Zealand, have a more considerable burden of hospitalisation than Poland [7, 8].

In New Zealand, the burden of hospitalisations for COPD varies by region and ranges from 410 per 100,000 inhabitants to 1,144 per 100,000 inhabitants [7].

In 2010, prevalence in Australia constituted 317 hospitalisations per 100,000 inhabitants [8].

In the Australian and New Zealand statistics alike, there was a significant impact of socio-economic status on hospital morbidity, longer

hospitalisations and more frequent hospital re-admissions [7, 8].

It should be emphasised that patients aged 65 years or older are a significant burden on hospitals. This paper reveals that the percentage of patients aged 65 years or older as well as patients reaching 80 years or older accounted for 86% and 29%, respectively.

In addition, this study showed that hospitalisations for COPD translated into 3% of in-hospital deaths, 6% of deaths within 30 days and 10% of deaths within 90 days after hospital discharge. The development of respiratory failure increases these percentages to 23%, 30% and 36%, respectively.

The issue of increased mortality after acute exacerbations of COPD was already considered several years ago [9–11]. A previous acute exacerbation requiring hospitalisation is known to be a significant risk factor for hospital readmission, whereas the risk of death increases seven-fold [11]. The study by Groenwegen et al. found that 8% of acute exacerbations of COPD led to in-hospital deaths and 23% of such patients died within one year after hospital discharge [9]. Respiratory failure leading to hospitalisation in an intensive care unit increases the death rate within one year after hospital discharge to 35%. The risk factors include: treatment with oral corticosteroids; hypercapnia; old age.

Even though a Danish study conducted between 2002–2008 demonstrated the reduction of the annual hospitalisation rate from 460 per 100,000 inhabitants in 2002 to 410 per 100,000 inhabitants in 2008 [10], the increase in in-hospital mortality [odds ratio (OR) — 1.16] and increased post-discharge mortality rate within one year (OR — 1.12) were also observed. Increased mortality was primarily found in patients with respiratory failure and multiple comorbidities; however, the distance to the hospital and treatment with oral corticosteroids — as in the case of the study by Groenwegen et al. — were also of relevance there. Bed occupancy also contributed to the adverse outcome of treatment. It was found that the decrease in the number of hospitals and beds resulted in the centralisation of hospitalisations for more severe cases of the disease. In the authors' opinion, this organisational change improved the prehospital care of patients with COPD.

The decrease in hospitalisations by 14% was also noted after a smoking ban had been introduced in Spain [12].

In 2014, a total of 46,000 hospitalisations for asthma were reported in Poland, including

29,000 of hospitalised adults and 17,600 of hospitalised children. Hospital morbidity rates constituted 92 per 100,000 inhabitants in adults and 253 per 100,000 inhabitants in children. In adults, the majority of the hospitalisations (18,000) were in lung disease and tuberculosis wards, followed by internal medicine wards (7,500) and allergy wards (3,500). The median lengths of stay varied by province and ranged from 3 to 6 days. Five percent of adult patients with asthma were hospitalised for more than 14 days. Acute severe asthma (status asthmaticus) (J46) was reported in the patients with asthma and ranged from 1% in the Kuyavian-Pomeranian Voivodeship to 13% in the Łódź Voivodeship.

This analysis merely shows the burden of asthma on the Polish healthcare system, which has been revealed by reporting activities, and may contain some errors due to incorrect diagnosis and incorrect reporting of an obstructive respiratory disease (asthma, COPD or coexistence of both). It is also important to differentiate between a hospitalisation for diagnostic evaluation of a disease and an acute exacerbation requiring hospitalisation. The unavailability of specialist outpatient care in the patients' local health centres often leads to unnecessary hospitalisations.

It should be noted that the number of patients registered in the NFZ databases has been relatively constant since 2009, with a predominance of women (115%) [13]. Approximately 55–57% of the registered patients live in urban areas, and 43–45% live in rural areas.

The GINA (Global Initiative for Asthma) document provides extensive information that suggests the possibility of controlling the disease outside the hospital setting (GINA) [5]. It is believed that the number of hospitalisations for asthma is proportionate to decreased disease control [14]. A considerable number of factors affects asthma control, including as follows: the lack of a correct diagnosis, undertreatment, patients' non-compliance, the lack of or non-adherence to a treatment plan.

In Australia, for instance, a 10% reduction in the number of hospitalisations was observed in 2015 when compared to 2010. In 2015, hospital morbidity averaged 1.85 per 1,000 inhabitants (1.93 per 1,000 inhabitants in urban areas and 1.64 per 1,000 inhabitants in rural areas). The authors point out to the fact that in epidemiological studies, optimisation of asthma treatment requires taking age, sex and place of residence under consideration. They stress the role of

primary care regarding the coordinated care of patients with asthma.

In Portugal, hospitalisations for asthma accounted for 2.5 per 1,000 hospitalisations, 28.1 per 100,000 inhabitants (66.6 per 100,000 individuals aged below 19 years) [16]. In-hospital deaths were estimated at 8 per 1,000 hospitalisations, corresponding to 2.4 per 1,000,000 inhabitants. Mortality statistics remain unchanged.

Hospitalisations of children with asthma merit a separate discussion. The diagnosis of asthma is more difficult to make in a child than in an adult for various reasons, which include the multiplicity of non-specific symptoms in the former. Many asthma phenotypes, including the wheezing phenotype, are particularly difficult to differentiate from asthma in this group of patients. Wheezing is a common symptom (especially in younger children) of many respiratory diseases, which causes that it is particularly difficult to differentiate it from asthma. It is often the case that children are hospitalised for bronchitis or bronchiolitis (the so-called wheezing babies), which is subsequently coded as asthma.

To sum up, the problem of hospitalisation for asthma in Poland includes:

- Conditions of the healthcare system;
- No asthma control, resulting from the lack of insufficient diagnosis and undertreatment of the disease;
- Differences in the diagnosis and treatment of asthma in children;
- Incorrect diagnosis (the lack of differentiation of asthma from COPD);
- A high proportion of smokers;
- Disease coding and reporting to the NFZ;
- Differences in coverage of medicines intended for the treatment of obstructive pulmonary diseases.

It is also important to consider statistical differences depending on the country in which the analysis is conducted: in Norway, the number of hospitalisations of children decreased by 51%, while it remained unchanged in Sweden [17].

According to the “European Lung White Book,” the prevalence of asthma is estimated at 1.6–20% in Europe, whereas 60% of patients with allergies are mainly allergic to animal hair, dust and mould, including 10–20% of them have the wheezing phenotype that is difficult to differentiate [1].

Due to the complex clinical presentation of CF and multidirectional treatment, the quality of care provided to CF patients, as measured by lifespan, is considered one of the best indicators

of healthcare quality in developed countries [18–20].

The most recent US studies have revealed that life expectancy of people born in 2010 is 40 years for females and 37 years for males [18].

In Poland, average lifespan of CF patients is shorter than that in Western Europe and the United States. Cystic fibrosis, a disease once considered a childhood one, currently affects adults as well (who only account for approx. 1/3 of all CF patients). Patients with CF account for 1% of hospitalisations of adults (with the mean age of 25 years) and 8% of hospitalisations of children (with the mean age of 8 years).

It is thus justified to follow the example of the rest of Europe by making attempts to establish CF treatment centres and to provide CF patients with comprehensive and multidisciplinary care.

Hospitalisations for CF occur at any age and the main reason is deterioration of lung function [20]. The most common management strategy involves intravenous antibiotic therapy, cleansing of the respiratory tract through appropriate inhalation and drainage therapy combined with an appropriate diet. Pulmonary rehabilitation is the key to the beneficial outcome of hospitalisation.

The registry of CF patients in the United States included 21,488 patients in 2003 and 28,134 in 2013, as well as collected data on hospitalisations [18]. The number of hospitalisations per 1,000 CF patients increased from 994 to 1,072 in 2013. During hospitalisation, 1.5% of the patients aged 27 years on average died (MLOS — 7 days). Between 2003 and 2013, mortality decreased from 1.9% to 1.2%. The risk factors included: chronic liver disease, acute kidney disease, and previous lung transplantation (6.5% of the hospitalisations). Keeping registries of CF patients contributes to improved patient care and to the pursuit of novel — often individualised — treatments.

## Conclusions

This publication serves as evidence that hospitalisations for asthma and COPD, especially those complicated by respiratory failure, constitute a serious burden on the Polish healthcare system. In accordance with the project assumptions, organisational and implementation-related actions have to be taken to reduce this burden.

## Conflict of interest

None declared.

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