

# Current status and trends of pulmonary rehabilitation in South Korea

## National level data analysis using Health Insurance Review and Assessment Service (HIRA) database from 2016 to 2018

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### Abstract

In South Korea, there are few studies to understand the current status of pulmonary rehabilitation in clinical practice and develop it. This study aimed to assess the current status and annual changes in the number and pattern of prescriptions for pulmonary rehabilitation before and after its insurance coverage.

The trends of pulmonary rehabilitation before and after its insurance coverage commencement were evaluated using the data of 24,380 patients during the 3-year period from 2016 to 2018 that were archived by the National Health Information Database of the Health Insurance Review and Assessment Service in South Korea. The annual total number of patients who received pulmonary rehabilitation was stratified by the type of prescription, sex, age, type of insurance, medical institution, and region. In addition, the frequencies of pulmonary rehabilitation for various diagnoses were investigated using the major codes of the Korean Standard Classification of Disease.

The patients who received pulmonary rehabilitation increased by approximately 2 times from 5936 in 2016 (before insurance coverage) to 10,474 in 2019. Before 2017, most patients underwent simple pulmonary rehabilitation coded as MM290. However, since the insurance coverage of rehabilitation exercise for pulmonary disease (MM440), the proportions of patients receiving them increased. Men underwent pulmonary rehabilitation more often than women, and >70% of the patients were aged >60 years. Most patients received pulmonary rehabilitation at tertiary hospitals in Seoul. In 2016, pulmonary rehabilitation was prescribed more frequently for cerebral infarction; after 2017, it was prescribed more frequently for lung cancer.

This study summarized the current status and trends of pulmonary rehabilitation in South Korea before and after National Health Insurance Service coverage, which commenced on January 1, 2017. A significant increase in the number of pulmonary rehabilitations was confirmed after the insurance coverage.

**Abbreviations:** COPD = chronic obstructive pulmonary disease, HIRA = Health Insurance Review and Assessment Service, NHIS = National Health Insurance Service.

**Keywords:** big data, health service, pulmonary rehabilitation

### 1. Introduction

Pulmonary rehabilitation is a core component of treatment for patients with chronic lung disease, and it is considered a highly effective therapy for improving exercise intolerance, health-related quality of life (HRQoL), and dyspnea.<sup>[1]</sup> Although it has been steadily reported that pulmonary rehabilitation is effective against all forms of respiratory diseases and chronic obstructive pulmonary disease (COPD), it is not performed well in actual clinical practice.<sup>[2–4]</sup>

In Canada, the United Kingdom, Australia, and the United States, several studies have been conducted to understand the current status of pulmonary rehabilitation in clinical practice and develop it.<sup>[5–9]</sup> However, there are few studies on this issue in South Korea.<sup>[10]</sup> According to a study conducted in South Korea in 2011, only 20.9% of institutions performed pulmonary rehabilitation.<sup>[10]</sup> The reasons for such a low rate include the lack of awareness of the program, which was not reimbursed, and its practical limitations.

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*All data generated or analyzed during this study are included in this published article.*

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However, since January 2017, pulmonary rehabilitation has been covered by the National Health Insurance Service (NHIS). This study aimed to evaluate the national trends of pulmonary rehabilitation and the annual changes in the number and patterns of prescriptions of pulmonary rehabilitation before and after the insurance coverage.

## 2. Methods

### 2.1. Data sources

The database used in this study was provided by the Health Insurance Review and Assessment Service (HIRA) in South Korea. Using the HIRA service, we conducted a survey of 87,740 cases collected over 3 years from 2016 to 2018. The HIRA database, also called the National Health Insurance data, is a repository of claims data collected during the process of reimbursing healthcare providers. It contains healthcare information of almost the entire Korean population, including general information, healthcare services, diagnosis, outpatient prescription, drug master, and provider information. The NHIS covers >97% of the Korean population (approximately 51 million people).<sup>[11]</sup> As the HIRA also reviews the claims data for the remaining 3%, who are covered by the National Medical Aid program, the database includes almost all inpatient and outpatient data from hospitals and community clinics in South Korea, respectively, making a nationwide population study feasible. Access to HIRA data is regulated by HIRA's rules for data exploration and use, and data are used with the approval of the HIRA data access committee.

In South Korea, physicians run private clinics and serve as primary care providers. Secondary hospitals are regional hospitals and highly differentiated with specialties and bed sizes ranging between 30 to 100. General hospitals have more than nine specialties and >100 beds with specialized technical facilities.<sup>[12]</sup> Tertiary hospitals are designated by the Minister of Health and Welfare every 3 years. Forty-three hospitals were designated as tertiary hospitals in Korea between 2015 and 2017, and 42 hospitals were designated between 2018 and 2020.

### 2.2. Patient selection and primary and secondary outcome variables

We conducted a big data analysis among patients with respiratory diseases using a nationwide cohort based on the HIRA from 2016 to 2018. Patients who received pulmonary rehabilitation were tracked using the MM290 (rehabilitative breathing therapy) or MM440 (rehabilitation exercise for pulmonary disease) codes.

MM290 can be claimed when pulmonary rehabilitation therapy, including exercise using an instrument, such as incentive spirometry and postural drainage, is performed for >30 minute. MM440 has been covered by insurance since January 1, 2017; it involves approximately 60 minute of personalized exercise programs, including aerobic and muscle strength training in patients with chronic respiratory diseases, such as COPD, asthma, bronchiectasis, interstitial lung disease, and lung cancer.

The data were analyzed. The annual total number of patients who received pulmonary rehabilitation according to the type of prescription, sex, age, type of insurance, medical institution, the region where treatment was performed, and the frequency of the disease, which is the primary indication for performing pulmonary rehabilitation, was determined using the major codes of the Korean Standard Classification of Disease.

The primary outcome was the number of patients who received pulmonary rehabilitation and their baseline characteristics. The secondary outcomes included annual changes in the trends of number and patterns of pulmonary rehabilitation prescriptions before and after the insurance coverage, types of

institutions/distributions where pulmonary rehabilitation was performed, and the top 10 causes of primary diagnosis that led to pulmonary rehabilitation.

### 2.3. Statistical analysis

Baseline characteristics were summarized using descriptive statistics and presented as frequencies and percentages of patients or means with standard deviation (SD). Data analysis was conducted using Microsoft Excel (Microsoft Corp., Redmond, WA, USA).

### 2.4. Ethics statement

Before the data provision, the HIRA removed confidential and identifying information of all the patients to protect their privacy. Thus, this study was exempt from acquiring patient informed consent due to the de-identification of all personal information. The study protocol was approved by the Institutional Review Board of the Inje University Haeundae Paik Hospital (IRB No. HPIRB 2019-07-039-002), and official approval was obtained from the HIRA Research Inquiry Commission (No. M20190711848).

## 3. Results

### 3.1. Baseline characteristics of patients receiving pulmonary rehabilitation

The total number of patients who received pulmonary rehabilitation increased approximately 2-fold from 5936 in 2016 (before insurance coverage) to 10,474 in 2018. Of the patients receiving pulmonary rehabilitation during the 3-year study period, 64 to 66% were male and the average age was 65 to 67 years. It was confirmed that >70% of the patients were older than 60 years, and most were covered by national health insurance; approximately 10% received medical aid (Table 1).

### 3.2. Annual trends of pulmonary rehabilitation cases prescribed by physicians

In 2016, before pulmonary rehabilitation was covered, most patients were only treated according to MM290, which is a shorter program. The more intensive MM440 was rarely

**Table 1**  
Baseline characteristics of evaluated patients.

Baseline characteristics	Yr, no. (%)			
	2016	2017	2018	
Total patients (n)	5936	7970	10,474	
Male (%)	3783 (64)	5272 (66.1)	6825 (65.2)	
Age (yrs)	Mean ± SD	65.90 ± 14.75	66.70 ± 14.08	67.03 ± 13.48
Age group (yrs)	<30	182 (3.1)	207 (2.6)	231 (2.2)
	30–39	180 (3.0)	232 (2.9)	208 (1.9)
	40–49	381 (6.4)	431 (5.4)	602 (5.7)
	50–59	949 (16.0)	1155 (14.5)	1528 (14.6)
	60–69	1430 (24.1)	2023 (25.4)	2774 (26.5)
	70–79	1836 (30.9)	2594 (32.5)	3360 (32.1)
	≥80	978 (16.5)	1328 (16.7)	1771 (16.9)
Insurance type	National Health Insurance	5335 (89.9)	7165 (89.9)	9465 (90.4)
	Medical aid	622 (10.5)	835 (10.5)	1033 (9.9)
	Veterans' insurance	21 (0.4)	22 (0.3)	23 (0.2)

SD = standard deviation.

**Table 2**  
**Annual number of pulmonary rehabilitation.**

Prescription name (KCD code)	Number of times		
	2016	2017	2018
Rehabilitative breathing therapy (MM290)	16,253	14,363	15,198
Rehabilitation exercise for pulmonary disease (MM440)	293	10,283	16,757
Rehabilitative breathing therapy + rehabilitation exercise for pulmonary disease (MM290 + MM440)	52	514	688
<b>Total</b>	<b>16546</b>	<b>24646</b>	<b>31955</b>

KCD = Korean Standard Classification of Disease.

performed owing to its high cost, as it was not covered by insurance. Since the time rehabilitation exercise for pulmonary disease (MM440) received coverage, the proportion of patients undergoing MM440 has increased, while the proportion of patients undergoing MM290 has been roughly maintained. Some patients, which comprised <10%, were prescribed both MM290 and MM440 simultaneously (Table 2; Fig. 1).

**3.3. Pattern of prescriptions of pulmonary rehabilitation**

**1.3.3. Types of institutions that performed pulmonary rehabilitation** Approximately 70% of the patients were treated at tertiary hospitals, and the remaining 30% were treated in secondary and general hospitals (Table 3).

**2.3.3. Distribution of areas performing pulmonary rehabilitation** In 2016, most patients receiving pulmonary rehabilitation were in Seoul, followed by Gyeonggi, Busan, and Jeonbuk. After 2017, pulmonary rehabilitation was covered by national insurance, and most patients receiving it were from Seoul, followed by Busan, Gyeonggi, and Jeonbuk. Areas with <10 patients receiving pulmonary rehabilitation per year were also identified (Table 4).

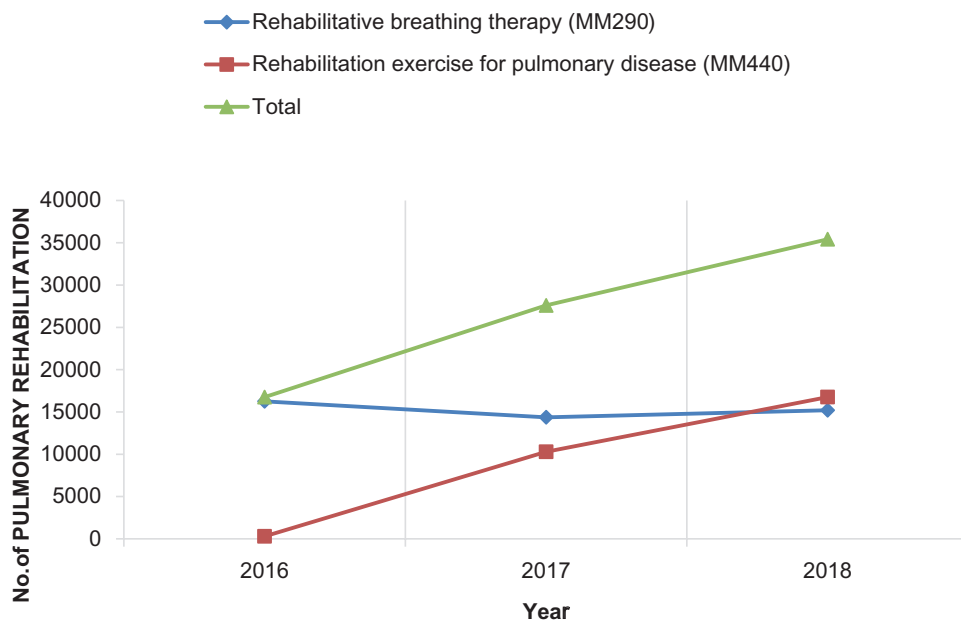
**3.3.3. Top 10 primary diagnoses that led to pulmonary rehabilitation** In 2016, before pulmonary rehabilitation was

covered by insurance, approximately 4% of patients were treated with this specialized pulmonary rehabilitation, and the rest received simple rehabilitative breathing therapy. On analyzing the primary diagnoses of patients who underwent pulmonary rehabilitation, cerebral infarction was the most frequent disease, followed by pneumonia and lung cancer. In 2017, when insurance reimbursement was applied, lung cancer accounted for most cases of pulmonary rehabilitation, followed by COPD, pneumonia, and interstitial lung disease; all these respiratory diseases were associated with high frequencies of pulmonary rehabilitation. In 2018, the number of patients who received pulmonary rehabilitation increased approximately 2-fold from 2016, and the number of patients who received specialized pulmonary rehabilitation increased >27 times (5970 patients in 2018 compared to 217 patients in 2016). The order of frequency of the primary diagnoses of patients who underwent pulmonary rehabilitation in 2018 was the same as that in 2017. The number of patients who underwent pulmonary rehabilitation for lung cancer increased nearly 3-fold from 356 in 2016 to 965 in 2017 and 5-fold to 1677 in 2018. The number of patients who received pulmonary rehabilitation for COPD, a common airway disease, also increased more than 3-fold, from 203 in 2016 to 685 in 2017, and 5-fold to 1025 patients in 2018 (Table 5).

**4. Discussion**

Pulmonary rehabilitation is a comprehensive intervention based on a thorough patient assessment followed by patient-tailored treatments that include exercise training, behavioral changes, and education to improve the physical and psychological conditions of patients with chronic respiratory disease. Pulmonary rehabilitation is a core component of treatment for patients with chronic lung disease with high efficacy and an established therapy to improve symptoms, quality of life, pulmonary function, and health care utilization.<sup>[1]</sup> Although it has been reported that pulmonary rehabilitation is effective for all forms of respiratory diseases, including COPD, it is not well performed in clinical practice.<sup>[2-4,13-15]</sup>

According to a survey conducted in Canada in 2005, >40% of institutions were performing pulmonary rehabilitation (60/149 facilities), and most of the programs were in the outpatient



**Figure 1.** Annual changes in pulmonary rehabilitation in Korea.

**Table 3**  
Type of institutions that performed pulmonary rehabilitation.

Medical institutions	Yr, no. (%)		
	2016	2017	2018
Total patients (n)	5936	7970	10,474
Private clinics	3 (0.1)	1 (0.0)	–
Secondary and general hospitals	1884 (31.7)	2061 (25.9)	3325 (31.7)
Tertiary hospitals	4122 (69.4)	6017 (75.5)	7256 (69.3)

**Table 4**  
Distribution of areas performing pulmonary rehabilitation.

Distribution	Yr, no. (%)		
	2016	2017	2018
Seoul	2230 (37.6)	3730 (46.8)	4797 (45.8)
Busan	813 (13.7)	1013 (12.7)	1372 (13.1)
Incheon	40 (0.7)	96 (1.2)	194 (1.9)
Daegu	397 (6.7)	377 (4.7)	360 (3.4)
Gwangju	150 (2.5)	134 (1.7)	132 (1.3)
Daejeon	283 (4.8)	382 (4.8)	482 (4.6)
Ulsan	48 (0.8)	202 (2.5)	384 (3.7)
Gyeonggi	852 (14.4)	896 (11.2)	1042 (9.9)
Gangwon	41 (0.7)	81 (1.0)	442 (4.2)
Chungbuk	83 (1.4)	51 (0.6)	160 (1.5)
Chungnam	45 (0.8)	7 (0.1)	2 (0.0)
Jeonbuk	644 (10.8)	627 (7.9)	728 (7.0)
Jeonnam	17 (0.3)	17 (0.2)	29 (0.3)
Gyeongbuk	117 (2.0)	104 (1.3)	109 (1.0)
Gyeongnam	221 (3.7)	277 (3.5)	310 (3.0)
Jeju	15 (0.3)	40 (0.5)	19 (0.2)
Total (n)	5936	7970	10,474

setting.<sup>[15]</sup> A survey conducted in the UK in 2001 also found that pulmonary rehabilitation was performed in 40% of institutions (68/171), with most in the outpatient setting.<sup>[6]</sup> According to a study conducted in Korea in 2011, only 20.9% of 43 tertiary and general hospitals performed pulmonary rehabilitation.<sup>[10]</sup> When performed, most of them were focused on respiratory education, and it was very rare for them to implement high-intensity pulmonary rehabilitation programs recommended by the guidelines. The reasons for such a low implementation rate included the lack of awareness of the program and the practical problem of patients not being reimbursed for the costs owing to non-coverage by national insurance.

In Korea, the only code covered by insurance was MM290 (rehabilitative breathing therapy) until 2017, but it did not include supervised exercise, the core component of pulmonary

rehabilitation. The cost is <6000 KRW (5.0 USD), and it is not realistic to implement it in real-world practice.

In this study, the number of patients who received rehabilitative therapy coded as MM290, which had always been covered, did not change significantly (approximately 5000 patients per year). However, the number of patients who received the newly covered pulmonary rehabilitation therapy coded as MM440 increased 15 times, from 269 before the reimbursement change to 4117 patients in 2017, and more than 24 times, to 6658 patients, in 2018.

Approximately 70% of the patients were treated at tertiary hospitals, and the remaining 30% were treated in secondary and general hospitals. Pulmonary rehabilitation requires various medical staff, such as physical therapists, respiratory internal medicine, and rehabilitation medicine doctors; therefore, it can only be implemented in a few hospitals, which are likely to be tertiary hospitals. The study confirmed that >70% of cases of pulmonary rehabilitation are conducted in Seoul, Gyeonggi, Busan, and Jeonbuk, which are the most populous areas. This suggests that several patients have limited access to pulmonary rehabilitation owing to distance, and there are still difficulties in performing pulmonary rehabilitation for outpatients. Before it was reimbursed, pulmonary rehabilitation was performed for neurological disorders, such as cerebral infarction, paraplegia, and intracerebral hemorrhage; however, patients with lung cancer accounted for the largest proportion of patients who have received pulmonary rehabilitation since 2017. Most studies on pulmonary rehabilitation have involved patients with COPD.<sup>[16,17]</sup> Recent studies involving patients with lung cancer have also been conducted, and they have demonstrated that pulmonary rehabilitation is effective.<sup>[15,18,19]</sup> As aforementioned, there have been several studies on the effectiveness of pulmonary rehabilitation for patients with COPD,<sup>[16,17]</sup> and the 2021 Global Initiative for Chronic Obstructive Lung Disease reports have recommended pulmonary rehabilitation based on evidence grade A.<sup>[20]</sup> In Korea, patients with COPD account for the second-largest proportion of those receiving pulmonary rehabilitation after insurance coverage. Moreover, it has been confirmed that the number of patients with COPD receiving pulmonary rehabilitation increased 5-fold in 2018. However, considering that the prevalence of COPD in Korea was >3 million in 2015,<sup>[21]</sup> it was confirmed that approximately 0.03% of patients with COPD participated in pulmonary rehabilitation.

The strength of this study is that it is the first nationwide population-based study involving >51 million individuals. However, it also has limitations. First, the primary diagnostic codes provided by the physician may not have been completely accurate, and the analysis was based on the primary diagnostic codes provided at the time of pulmonary rehabilitation, while there may have been 2 or more primary diagnoses that necessitated pulmonary rehabilitation for the same patient.

**Table 5**  
Top ten cause of primary diagnosis undergoing pulmonary rehabilitation.

	2016, no.		2017, no.		2018, no.	
1	Cerebral infarction	466	Lung cancer	965	Lung cancer	1677
2	Pneumonia	444	COPD	689	COPD	1025
3	Lung cancer	356	Pneumonia	599	Pneumonia	626
4	Paraplegia	354	Other interstitial pulmonary disease	571	Other interstitial pulmonary disease	610
5	ICH	325	Cerebral infarction	420	Cerebral infarction	443
6	COPD	203	Paraplegia	380	Paraplegia	351
7	Intracranial injury	187	Respiratory failure	277	Respiratory failure	269
8	Aspiration pneumonia	178	ICH	235	Bronchiectasis	261
9	Bronchiectasis	160	Bronchiectasis	190	ICH	248
10	Spinal muscular atrophy and related syndrome	159	Intracranial injury	182	Intracranial injury	194

COPD = chronic obstructive pulmonary disease, ICH = intracerebral hemorrhage.



In conclusion, 2-fold increase in the number of prescriptions of pulmonary rehabilitation was confirmed after NHIS coverage. Approximately 70% of patients who underwent pulmonary rehabilitation were treated at tertiary hospitals and were residents of major metropolitan cities. Given the differences in access to pulmonary rehabilitation by region, it is necessary to develop a pulmonary rehabilitation program suitable for the domestic medical environment so that more patients can receive pulmonary rehabilitation.

The authors have no conflicts of interest to disclose.

### Author contributions

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