Original Article

Chest Specialists versus Non-Specialists following International COPD Recommendations in Real-World Clinical Practice

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Abstract

Introduction: Real-world clinical practice for management of chronic obstructive pulmonary disease (COPD) differs from international recommendations by the Global Initiative for Chronic Obstructive Lung Disease and this affects clinical outcomes.

Objectives: To determine rates of following the recommendations and the impact on the clinical outcomes in COPD patients.

Methods: A prospective study was conducted in 2 outpatient clinics at a University Hospital in Thailand. Demographics and clinical data were collected. Chest specialist (CS) and non-CS groups clinical data was compared.

Results: One hundred forty-five patients (87.6% male) were included. Of these, 81 (55.9%) were followed up at a CS outpatient department. The overall prevalence of COPD management following recommendations was 29.0% (27.2% in the CS group and 31.3% in the non-CS group, P = 0.590). Compared to the non-CS group, the CS group had higher proportions of chronic kidney disease (21.0% vs 7.8%, P = 0.028), coronary heart disease (35.8% vs 15.6%, P = 0.007), and modified Medical Research Council scores (1.9 ± 1.1 vs 1.5 ± 1.2, P = 0.038). The CS group also had higher rates of vaccinations and pulse oximetry measurement than the non-CS group. There were no differences in pulmonary functions or exacerbation and hospitalization rates between the two groups.

Conclusions: One-third of patients were managed following the COPD recommendations in real-world practice. The rates of following the recommendations did not significantly differ between the CS and the non-CS groups. This finding may explain the similar clinical outcomes. Nevertheless, a larger prospective study is required to compare clinical outcomes between the two groups.

Keywords: Adherence, Clinical characteristics, COPD, GOLD recommendation, Outcomes

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Introduction

Chronic obstructive pulmonary disease (COPD) is a common, preventable, and treatable disease which is characterized by persistent respiratory symptoms and airflow limitation.[1] It is a leading cause of the global mortality. In 2010, there was approximately 384 million people with COPD, with a global prevalence of 11.7%[1]; the prevalence of COPD in Thailand was 3.7 to 7.1%.[2, 3]

Because of COPD's severity, the Global Initiative for Chronic Obstructive Lung Disease (GOLD)[1] establishes international recommendations for COPD management to guide physicians. Diagnosing disease and grading severity of COPD has to be done carefully and appropriately to properly manage patients with COPD. Diagnosing COPD is supported by spirometry using post-bronchodilator forced expiratory volume in one second (FEV_1) to forced vital capacity (FVC) ratio less than 0.7. Moreover, spirometry is also used for classifying the degree of airway obstruction into GOLD grade 1 to 4.[1] COPD patients can be categorized into 4 groups (ABCD) depending on clinical symptoms and risk of exacerbation.[1] Nonetheless, in real-world clinical practice, the recommendations are not followed as strictly as they should be, leading to misclassification of the disease's severity and ineffective therapy, both pharmacological and non-pharmacological e.g. inhaled medication, vaccinations, pulmonary rehabilitation, which affects the clinical outcomes of COPD patients, including quality of life, acute exacerbation and hospitalization.[4-9]

Some COPD patients, such as those with severe disease, uncertain diagnosis or presence of several comorbidities, need to be properly managed by pulmonologists. Adherence to the guidelines for COPD management varies among different physicians and healthcare clinics, which might affect COPD clinical outcomes, in addition to disease severity and comorbidities. This study aimed to determine the relationship of following international COPD recommendations and the rate of COPD exacerbation, and to compare chest-specialist (CS) and non-chest-specialist (non-CS) departments.

Methods

Study design and participants

A prospective study was conducted at 2 medical outpatient departments, with 10 chest physicians and 120 non-chest physicians, at Thammasat University Hospital, Thailand between July 2020 and January 2022. Patients aged 40 years or older with 10-pack-year smoking history, and diagnosis of COPD confirmed by a physician were included. Exclusion criteria were inability to complete the questionnaires and asthma.

Ethics approval was obtained from the Human Research Ethics Committee of Thammasat University No.1 (Faculty of Medicine), Thailand (IRB No. MTU-EC-IM-0-128/63, COA No. 212/2020), in compliance with Declaration of Helsinki, The Belmont Report, CIOMS Guidelines and The International Practice (ICH-GCP). All methods were performed in accordance with these guidelines and regulations. All participants provided written informed consent.

Data collection

Patient data was collected from electronic medical records and clinical COPD questionnaires including modified Medical Research Council (mMRC), COPD Assessment Test (CAT), and the exacerbation history for 1 year. Patients' demographic data, clinical characteristics, pulmonary functions by spirometry with bronchodilator test, disease classification, and clinical outcomes (exacerbation and hospitalization due to COPD) were also recorded. Bronchodilator response is improvement in FEV_1 and/or FVC of ≥12% and ≥200 mL from baseline according to the American Thoracic Society and European Respiratory Society 2005 criteria[10]. An exacerbation in this study was defined as an acute worsening of respiratory symptoms that requires additional therapy; oral antibiotics and/or oral corticosteroids, or treatment in the emergency department or a hospitalization.

Definition of terms

For the purpose of this study, 'adherence to the COPD recommendations' was defined as compliance with both of the following criteria, which are recommended by GOLD 2019.[1]

1. Based on pulmonary function data, participants had respiratory symptoms and persistent airflow limitation (post-bronchodilator FEV_1/FVC ratio < 0.7) consistent with COPD.

2. COPD severity was classified (grade 1 to 4 and/or ABCD groups) and symptoms were assessed using CAT or mMRC.

Study outcomes

The primary outcome was proportions of physicians following the GOLD recommendations and relationships between following the recommendations and clinical outcomes (exacerbation and hospitalization) of COPD patients. The secondary outcome was comparisons of clinical outcomes and following the GOLD recommendations between the CS and the non-CS groups.

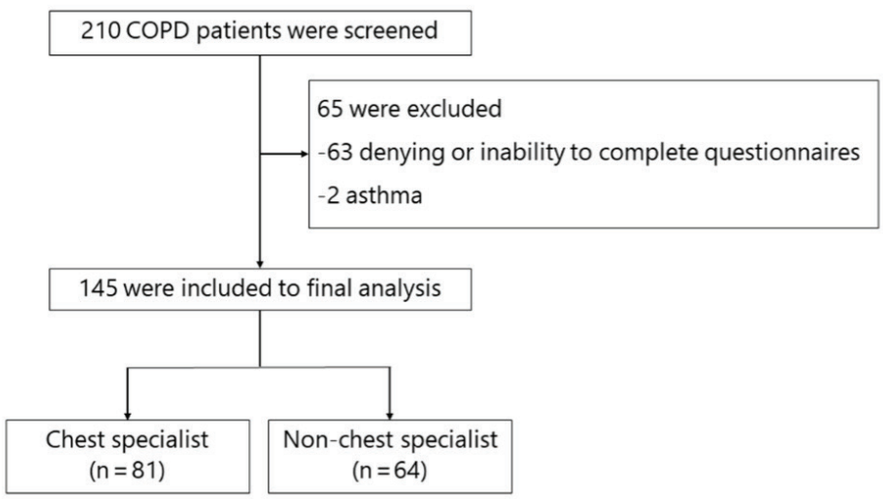
Statistical analysis

Based on a previous study[11], the prevalence of inappropriate treatment of COPD patients was 38.4%. The sample size was calculated using 80% power, 5% type I error, and 8% precision margin. Thus, the sample size would be 142.

Data is presented as number (%) and mean ± standard deviation. Chi-squared test was used to compare categorical variables between the CS and the non-CS groups. Student's t-test was used to compare continuous variables between two groups. A two-sided *p-value* < 0.05 was considered statistically significant. Statistical analyses were performed using SPSS version 26.0 software (IBM Corp., Armonk, NY, USA).

Results

A total of 210 COPD patients were screened. Of these, 145 patients (87.6% male) were eligible for inclusion and 65 patients were excluded (Fig 1). No patient with asthma-COPD overlap was screened. Mean age was 75.03 ± 9.03 years. Post-bronchodilator FEV_1 was 66.22 ± 24.10% predicted. Most patients were in spirometry grade 2 (47.4%) and were in GOLD group D (37.9%). 55.9% of patients were managed at the CS outpatient department. Common comorbidities included hypertension (69.7%), dyslipidemia (54.5%), coronary heart disease (26.9%), and diabetes (24.8%) (Table 1). Common COPD medications included short-acting beta2 agonist plus short-acting muscarinic antagonist (84.8%), inhaled corticosteroid (ICS) plus long-acting beta2 agonist (LABA) (60.0%), long-acting muscarinic antagonist (LAMA) (55.9%), LAMA plus LABA (18.6%) and oral xanthine (44.8%). Rates of influenza and pneumococcal vaccinations were 81.4% and 47.6%, respectively (Table 1).



COPD = chronic obstructive pulmonary disease

Figure 1 Flowchart of COPD patient recruitment to the study.

Table 1 Demographics and baseline characteristics of COPD patients

Characteristics	All patients (n = 145)	Chest specialist (n = 81)	Non-chest specialist (n = 64)	P-value
Age, years	75.0 ± 9.0	75.3 ± 9.6	74.6 ± 8.2	0.569
Male	127 (87.6)	72 (88.9)	55 (85.9)	0.594
Body mass index, kg/m^2	22.6 ± 4.4	22.3 ± 4.2	22.9 ± 4.6	0.226
Smoking, pack-years	30.0 ± 19.9	29.9 ± 20.9	30.2 ± 18.9	0.825
Active smoker	19 (13.1)	11 (57.9)	8 (42.1)	0.848
CAT, points	8.5 ± 6.1	8.8 ± 5.5	8.0 ± 6.7	0.267
mMRC, points	1.7 ± 1.1	1.9 ± 1.1	1.5 ± 1.2	0.038
Spirometry data				
Post-BD FEV_1/FVC, %	57.6 ± 12.9	56.5 ± 12.4	59.0 ± 13.5	0.271
Post-BD FEV_1, %predicted	66.2 ± 24.1	64.5 ± 25.3	68.5 ± 22.3	0.355
BD response	21 (15.9)	10 (12.8)	11(20.4)	0.244
Spirometry grading				0.700
1	35 (26.3)	21 (26.9)	14 (25.5)	
2	63 (47.4)	34 (43.6)	29 (52.7)	
3	25 (18.8)	16 (20.5)	9 (16.4)	
4	10 (7.5)	7 (9.0)	3 (5.5)	
GOLD classification				0.205
A	38 (26.2)	18 (22.2)	20 (31.3)	
B	41 (28.3)	27 (33.3)	14 (21.9)	
C	11 (7.6)	4 (4.9)	7 (10.9)	
D	55 (37.9)	32 (39.5)	23 (35.9)	
Comorbidity				
Hypertension	101 (69.7)	56 (69.1)	45 (70.3)	0.878
Dyslipidemia	79 (54.5)	41 (50.6)	38 (59.4)	0.292
Coronary heart disease	39 (26.9)	29 (35.8)	10 (15.6)	0.007
Diabetes	36 (24.8)	21 (25.9)	15 (23.4)	0.730
Chronic kidney disease	22 (15.2)	17 (21.0)	5 (7.8)	0.028
Cerebrovascular disease	8 (5.5)	5 (6.2)	3 (4.7)	0.697

Table 1 Demographics and baseline characteristics of COPD patients (Cont.)

Characteristics	All patients (n = 145)	Chest specialist (n = 81)	Non-chest specialist (n = 64)	P-value
Medication				
SABA plus SAMA	123 (84.8)	68 (84.0)	55 (85.9)	0.741
ICS plus LABA	87 (60.0)	38 (46.9)	49 (76.6)	<0.001
LAMA	81 (55.9)	44 (54.3)	37 (57.8)	0.674
LAMA plus LABA	27 (18.6)	24 (29.6)	3 (4.7)	<0.001
LABA	3 (2.1)	2 (2.5)	1 (1.6)	0.588
ICS	3 (2.1)	3 (3.7)	0 (0)	0.171
Xanthine	65 (44.8)	38 (46.9)	27 (42.2)	0.570
Procaterol	18 (12.4)	15 (18.5)	3 (4.7)	0.012
Leukotriene receptor antagonist	16 (11.0)	12 (14.8)	4 (6.3)	0.102
Phosphodiesterase-4 inhibitor	9 (6.2)	9 (11.1)	0 (0)	0.004
Macrolide	9 (6.2)	8 (9.9)	1 (1.6)	0.038
Vaccination				
Influenza vaccine within 1 year	118 (81.4)	76 (93.8)	42 (65.6)	<0.001
Pneumococcal vaccine	69 (47.6)	58 (71.6)	11 (17.2)	<0.001

Data presented as n (%) or mean ± SD

BD = bronchodilator, CAT = COPD Assessment Test, COPD = chronic obstructive pulmonary disease, FEV_1 = forced expiratory volume in 1 second, FVC = forced vital capacity, GOLD = Global Initiative for Chronic Obstructive Lung Disease, ICS = inhaled corticosteroid, LABA = long-acting beta2 agonist, LAMA = long-acting muscarinic antagonist, mMRC = modified Medical Research Council, SABA = short-acting beta2 agonist, SAMA = short-acting muscarinic antagonist

When compared to the non-CS group, the CS group had significantly higher proportion of coronary heart disease, chronic kidney disease, and severe symptoms assessed by mMRC (Table 1). Moreover, the CS group had higher prescription rates of LAMA plus LABA, procaterol, phosphodiesterase-4 inhibitor, macrolide, and influenza and pneumococcal vaccinations, but lower prescription rates of ICS plus LABA than the non-CS group (Table 1). In addition, the CS group had significantly higher rates of pulse oximetry measurement than the non-CS group (Table 2).

The overall prevalence of physicians following recommendations was 29.0%. There was no statistically significant difference in these rates between the CS (27.2%) and the non-CS (31.3%) groups (Table 2). Furthermore, clinical outcomes did not differ significantly between the CS and the non-CS groups (Table 2). Also, there were no statistically significant differences in acute exacerbation of COPD between those following and those not following recommendations in both the CS and the non-CS groups (Table 3). The dataset of study participants is shown in S1 File.

Table 2 Comparison in managements and clinical outcomes of COPD patients between the chest-specialist and the non-chest-specialist groups

Variables	Chest specialist (n = 81)	Non-chest specialist (n = 64)	P-value
Disease classification	38 (46.9)	38 (59.4)	0.136
CBC within 1 year	63 (77.8)	55 (85.9)	0.210
CXR within 1 year	78 (96.3)	61 (95.3)	0.768
SpO_2 measurement	77 (95.1)	43 (67.2)	<0.001
Treatment			
COPD education	70 (86.4)	56 (87.5)	0.848
Following recommendations	22 (27.2)	20 (31.3)	0.590
Clinical outcome			
AECOPD with ED visit	28 (34.6)	18 (28.1)	0.408
AECOPD with hospitalization	23 (28.4)	14 (21.9)	0.307

Data presented as n (%)
AECOPD = acute exacerbation of COPD, CBC = complete blood count, COPD = chronic obstructive pulmonary disease, CXR = chest x-ray, ED = emergency department, SpO_2 = oxygen saturation by pulse oximetry

Table 3 Comparison in acute exacerbation of COPD between following and non-following recommendations among the chest-specialist and non-chest-specialist groups

Variables	AECOPD	Following recommendations			P-value
		Yes	No	Total	
Chest specialist	Yes	20 (33.9)	8 (36.4)	28 (34.6)	0.836
	No	39 (66.1)	14 (63.6)	53 (65.4)	
Non-chest specialist	Yes	13 (29.5)	5 (25.0)	18 (28.1)	0.708
	No	31 (70.5)	15 (75.0)	46 (71.9)	

Data presented as n (%)
AECOPD = acute exacerbation of chronic obstructive pulmonary disease

Discussion

This is a study comparing rates of following the international COPD recommendations and clinical outcomes between CS and non-CS in real-world clinical practice. The prevalence was found to be 27.2% in the CS group and 31.3% in the non-CS group (overall rate of 29.0%). These rates were lower than the rates in previous studies of following the GOLD recommendations in real-life clinical practice (misclassifications in 32.8%[4] and inappropriate treatment in 62.1%[12]).

The international COPD recommendations by GOLD[1] suggest that COPD patients should be classified into ABCD groups based on clinical symptoms and risk of exacerbation. Moreover, the recommendations recommend that various treatments depend on disease conditions. However, our results indicated no correlation between clinical outcomes and adherence to the recommendations, and no difference between the CS group and the non-CS group. Nevertheless, rates of vaccinations were significantly higher in the CS group compared to the non-CS group (93.8% vs 65.6% for influenza vaccination and 71.6% vs 17.2% for pneumococcal vaccination). These immunization rates in the CS group were higher than the overall rates in an observational COPD study in Thailand by Saiphoklang N, et al. (71.4% for influenza vaccination and 50.6%for pneumococcal vaccination).[13]

A study of stable COPD in France by Jebrak G, et al.[5] showed that there are discrepancies between COPD recommendations by GOLD and routine treatments. Some treatments such as ICS were overused in mild stages of disease, whereas there was undertreatment by influenza vaccination and pulmonary rehabilitation. An observational study of adherence to COPD recommendations in Turkey by Turan O, et al.[11] demonstrated that 38.4 to 51.8% of COPD patients received unsuitable therapy and 98% of the unsuitable treatment was overtreatment. A study of primary care physicians for COPD management in Greece by Trakada G, et al.[14] showed that 66% of physicians treated patients according to the recommendations and 12.6% prescribed influenza vaccines.

A study on adherence to COPD GOLD recommendations by GPs in a rural area of Italy by Maniscalco M, et al.[15] showed that GPs often diagnosed and empirically treated COPD without confirmative spirometry. Patients in groups A and B were over-treated and 19% of those in group D were under-treated according to GOLD ABCD categorization[15].

A study by Cazzola M, et al.[6] comparing care of COPD patients in Italy to international COPD recommendations found that GPs usually prescribed treatment without the use of spirometry, and/or without assessment of the severity of airway obstruction. Only 31.9% of the patients had had a spirometry test and only 29.9% had visited a specialist. Similarly, a study of spirometry use for COPD management in Hong Kong by Yu WC, et al.[16] showed that only 18.3% of the patients had spirometry done at a diagnostic workup, and only 53.3% had ever had spirometry done. A study in the United States by Salinas GD, et al.[17] demonstrated that GPs' use of spirometry depended on agreement with the recommendations, self-efficacy, perceived outcome expectancy if recommendations were adhered to, and resource availability.[17] Furthermore, adherence to guideline recommendations of long-acting bronchodilator use was predicted by agreement with the recommendations and self-efficacy.[17]

A study on interpretation of pulmonary function tests in asthma and COPD by Raghunath AS et al.[18] showed that agreement in interpretation of the spirometry data between GPs and chest specialists was only 20.4% indicating that interpretation was difficult.

Moreover, a study comparing treatment efficacy between GPs following and not following the COPD recommendations in Italy by Tinelli C, et al.[7] showed that GPs following the recommendations had more outpatient appointments, specialist consultations and higher proportion of classification as severe COPD. However, quality of life and other clinical outcomes including decreased exacerbations, hospitalizations, and medication use were not affected by application of the recommendations[7].

A study of real-life GOLD 2011 implementation among CS in Czech Republic by Koblizek V, et al.[4] found discrepancy between subjective and objective COPD classifications in 32.8% of patients. The most common reason for incorrect classification was incorrect assessment of symptoms. Errors resulted in underestimation in 23.9% and overestimation in 8.9% of patients. The specialists examining 120 patients per month or more were most likely to misclassify their disease (36.7% of all patients). 19.5% of patients received ICS not recommended by the recommendations, and 12.2% of patients were not prescribed ICS which were recommended[4]. Similarly, an observational study of COPD treatment in Italy by Corrado A, et al.[12] showed poor correlation between GOLD international recommendations and real-life clinical practice, resulting in inappropriate treatment in 62.1% of cases. The inappropriateness was due to under-prescription in 7.2% and to over-prescription in 54.9%. COPD exacerbations might have played a role in over-prescription in stages I and II of diseases.[12] A study conducted at a university hospital in northern Thailand by Pothirat C, et al.[19] found that pulmonologists followed national COPD guidelines more closely than internists. The rates and frequencies of severe AECOPD were significantly lower in patients managed by pulmonologists, and the length of hospital stay and cost were significantly lower among the patients with severe AECOPD who required mechanical ventilation. These findings contrast with our study, which might be due to differences in medical policies at each hospital leading to different management and outcomes. Our results found that 36.4% of patients in the CS group, who did not follow the recommendations, had AECOPD, while 25% of patients in the non-CS group had AECOPD. Our results found that 36.4% of patients in the CS group, who did not follow the recommendations, had AECOPD, while 25%

of patients in the non-CS group had AECOPD. Our results found that 36.4% of patients in the CS group, who did not follow the recommendations, had AECOPD, while 25% of patients in the non-CS group had AECOPD. These findings might be attributed to the greater severity of COPD in our patients, as indicated by spirometry grade 3-4 and GOLD class D, in the CS group compared to the non-CS group (9-21% vs. 5-16% and 39% vs. 36%, respectively). Moreover, our study found that physicians in the CS group prescribed more LABA/LAMA, LABA, and PDE4 inhibitors than those in the non-CS group, while physicians in the non-CS group prescribed more ICS/LABA than those in the CS group. These findings might be attributed to the prescribing privileges of physicians in the CS group for LABA/LAMA, LABA, and PDE4 inhibitors, as well as limitations on medical prescriptions among physicians in the non-CS group."

Actually, there are various guideline recom mendations for COPD management other than GOLD such as the European Respiratory Society (ERS) and the British Thoracic Society (BTS). The BTS established the criteria for specialist referral, admission, discharge and follow-up for adults with COPD using appropriate steps tailored to the patient's history and evolving investigations.[20] A large comparative study of real-life COPD medication use in 7 European countries by Rudolf M [21] demonstrated that COPD was both under- and misdiagnosed, there were large differences between different European approaches to drug therapy, and COPD recommendations by the ERS and the BTS were often not followed.[21]

Our study and other studies suggest that there are gaps in COPD management between the CS and non-CS groups especially regarding vaccinations. Therefore, we emphasize the importance of COPD management to improve clinical outcomes.

There are a few limitations of this study. Firstly, this was a prospective cross-sectional study. We collected data on clinical outcomes by reviewing from electronic medical records and asking patients. Therefore, these parameters might lead to misinterpretation of the results. Secondly, this study was conducted in a single research center in Thailand, so the results might not be representative of the whole country. Thirdly, this study was conducted in times of coronavirus 2019 disease (COVID-19) pandemic, which may have influenced the exacerbation rate in COPD patients. Lastly, a small sample size of the population was used in this study. Thus, study outcomes might not be representative of the whole population and some results might not have reached statistically significant differences between groups. A large prospective longitudinal study is required to investigate the correlation between adherence and non-adherence to COPD recommendations in CS and non-CS groups.

Conclusions

One-third of patients were managed following the COPD recommendations in real-world practice. The rates of following the recommendations did not significantly differ between the CS and non-CS groups, nor did the clinical outcomes. Nevertheless, a large prospective study should be conducted to compare clinical outcomes, especially mortality rate, between the two groups.

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Compliance with Ethics Requirements

Ethic approval was obtained from the Human Research Ethics Committee of Thammasat University No.1 (Faculty of Medicine), Thailand (IRB No. MTU-EC-IM-0-128/63, COA No. 212/2020). All participants provided written informed consent.

Conflicts of Interest

The authors declare no conflicts of interest.

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Author Contributions

All authors participated in the design of this analysis, data collection and analysis, paper writing, and revision.

References

1. Global Initiative for Chronic Obstructive Lung

Disease. Global strategy for prevention, diagnosis, and management of chronic obstructive pulmonary disease 2019 report 2019. Available from: http://goldcopd.org/gold-reports/.
2. Maranetra KN, Chuaychoo B, Dejsomritrutai W, et al. The prevalence and incidence of COPD among urban older persons of Bangkok Metropolis. *J Med Assoc Thai.* 2002;85:1147-1155.
3. Pothirat C, Chaiwong W, Phetsuk N, Pisalthanapuna S, Chetsadaphan N, Inchai J. A comparative study of COPD burden between urban vs rural communities in northern Thailand. *Int J Chron Obstruct Pulmon Dis.* 2015;10:1035-1042.
4. Koblizek V, Pecen L, Zatloukal J, et al. Real-life GOLD 2011 implementation: the management of COPD lacks correct classification and adequate treatment. *PLoS One.* 2014;9:e111078.
5. Jebrak G, Initiatives B. COPD routine management in France: are guidelines used in clinical practice?. *Rev Mal Respir.* 2010;27:11-18.
6. Cazzola M, Bettoncelli G, Sessa E, Cricelli C. Primary care of the patient with chronic obstructive pulmonary disease in Italy. *Respir Med.* 2009;103:582-588.
7. Tinelli C, Rezzani C, Biino G, et al. Evaluation of the efficacy of the Italian guidelines on COPD: a cluster randomized trial. *Monaldi Arch Chest Dis.* 2003;59:199-206.
8. Hernandez P, Balter MS, Bourbeau J, Chan CK, Marciniuk DD, Walker SL. Canadian practice assessment in chronic obstructive pulmonary disease: respiratory specialist physician perception versus patient reality. *Can Respir J.* 2013;20:97-105.
9. Dong YH, Hsu CL, Li YY, Chang CH, Lai MS. Bronchodilators use in patients with COPD. *Int J Chron Obstruct Pulmon Dis.* 2015;10:1769-1779.
10. Pellegrino R, Viegi G, Brusasco V, et al. Interpretative strategies for lung function tests. *Eur Respir J.* 2005;26:948-968.
11. Turan O, Emre JC, Deniz S, Baysak A, Turan PA, Mirici A. Adherence to current COPD guidelines in Turkey. *Expert Opin Pharmacother.* 2016;17:153-158.
12. Corrado A, Rossi A. How far is real life from COPD therapy guidelines? An Italian observational study. *Respir Med.* 2012;106:989-997.
13. Saiphoklang N, Chomchoey C. Eosinophilia and parasitic infestations in patients with chronic obstructive pulmonary disease. *Sci Rep.* 2020;10:12490.
14. Trakada G, Spiropoulos K. Chronic obstructive pulmonary disease management among primary healthcare physicians. *Monaldi Arch Chest Dis.* 2000;55:201-204.
15. Maniscalco M, Martucci M, Fuschillo S, de Felice A, D'Anna SE, Cazzola M. A case scenario study on adherence to COPD GOLD recommendations by general practitioners in a rural area of southern Italy: The "progetto PADRE". *Respir Med.* 2020;170:105985.
16. Yu WC, Fu SN, Tai EL, et al. Spirometry is underused in the diagnosis and monitoring of patients with chronic obstructive pulmonary disease (COPD). *Int J Chron Obstruct Pulmon Dis.* 2013;8:389-395.
17. Salinas GD, Williamson JC, Kalhan R, et al. Barriers to adherence to chronic obstructive pulmonary disease guidelines by primary care physicians. *Int J Chron Obstruct Pulmon Dis.* 2011;6:171-179.
18. Raghunath AS, Innes A, Norfolk L, et al. Difficulties in the interpretation of lung function tests in the diagnosis of asthma and chronic obstructive pulmonary disease. *J Asthma.* 2006;43:657-660.
19. Pothirat C, Liwsrisakun C, Bumroongkit C, Deesomchok A, Theerakittikul T, Limsukon A. Comparative study on health care utilization and hospital outcomes of severe acute exacerbation of chronic obstructive pulmonary disease managed by pulmonologists vs internists. *Int J Chron Obstruct Pulmon Dis.* 2015;10:759-766.
20. British Thoracic Society Standards of Care C. BTS statement on criteria for specialist referral, admission, discharge and follow-up for adults with respiratory disease. *Thorax.* 2008;63 Suppl 1:i1-i16.
21. Rudolf M. The reality of drug use in COPD: the European perspective. *Chest.* 2000;117:29S-32S.