

Observational study on the prescription practices of family and pulmonary physicians for airway clearance devices in chronic obstructive pulmonary disease management

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Abstract

Background: Productive cough with sputum is a prominent sign generally associated with respiratory diseases, including chronic obstructive pulmonary disease (COPD). Airway clearance devices are an option for COPD management, but physicians' preferences for and clinical practice with them are not known.

Objective: This study aims to explore preferences for and clinical practice with airway clearance devices among physicians in Saudi Arabia.

Design: An observational, cross-sectional survey.

Methods: A self-administered questionnaire was conducted between October 2022 and September 2023, which included a review of respiratory medication prescriptions by physicians for patients with COPD. The analysis was performed using the Statistical Package for the Social Sciences.

Results: The participants were 445 physicians. The majority were female, accounting for 64.3% of the sample. Flutter and Acapella were the most commonly preferred airway clearance devices (45.8% and 20.7%, respectively). Among the participants, 12.6% reported unfamiliarity with any of the mentioned devices. Of the participants, 43.6% "usually" suggested the devices for patients with daily, difficult-to-clear, thick sputum, while 27% "sometimes" recommended them to COPD patients who had experienced four exacerbations or more. In routine clinical practice, physicians prescribe pharmacological therapies as the main treatment. The prescribing data showed that in the last year, there was no record of prescribed airway clearance devices for COPD by physicians.

Conclusion: Family and pulmonary physicians prefer Flutter and Acapella devices, but a significant number of physicians are unaware of such devices. Prescribing data showed no record of prescribed airway clearance devices for COPD management. Further initiatives are needed to increase awareness in clinical practice.

Keywords: airway clearance, COPD, cough, physician, respiratory care

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Background

Coughing is an important protective mechanism that helps to clear the airway and inhibit

pulmonary complications.^{1,2} Productive cough with sputum is a prominent sign generally associated with respiratory diseases, including chronic

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obstructive pulmonary disease (COPD).^{2,3} During a pathological state of the respiratory tract, tracheobronchial mucus formation exceeds its clearance due to the inhibition of mucociliary function.² This leads to the excessive accumulation of secretions in the airway, which promotes breathing difficulty and increases the risk of exacerbation in COPD patients.² Therefore, airway clearance therapy is one of the most crucial aspects of treatment for individuals with COPD.⁴

One important treatment shown to enhance airway clearance in COPD patients is the use of mucolytic agents.⁵ These agents help to decrease sputum viscosity and facilitate its removal during coughing. Moreover, it has been shown that treatment with mucolytic drugs is associated with a slight reduction in the probability of developing exacerbation in COPD and chronic bronchitis patients.⁵⁻⁷ Airway clearance techniques, particularly airway clearance devices, are non-pharmacological therapies that can be used with or without mucolytic medications to improve airway function and decrease the risk of respiratory exacerbation. Airway clearance devices work on the concept of applying high-frequency vibrations during exhalation, resulting in a reduction in secretion viscoelasticity and the augmentation of mucus mobility.⁸ Accordingly, this might prevent the risks associated with secretion accumulation, which positively impacts hospital admission rates and quality of life for COPD patients.^{9,10} Notably, several clinical studies have suggested that using Oscillatory Positive Expiratory Pressure (OPEP) devices with COPD patients enhances clinical outcomes and prevents subsequent severe diseases after discharge.¹¹⁻¹³ Thus, these findings offer some important insights regarding COPD management that healthcare providers should consider when promoting secretion removal.

The current COPD management guidelines in Saudi Arabia include non-pharmacological strategies alongside other treatment regimens.^{14,15} However, there are questions about the knowledge and attitudes of family and pulmonary physicians regarding adherence and the implementation of these guidelines.¹⁶ It has been suggested that there is a need for more awareness of international COPD guidelines,¹⁷ understanding disease epidemiology, or applying available beneficial treatments among family and pulmonary physicians in primary care settings.¹⁶ Despite the importance of airway clearance devices in

managing patients, data on the understanding of these devices in clinical practice are still limited. Hence, this study aims to explore preferences and the clinical practice of airway clearance devices among family and pulmonary physicians in Saudi Arabia.

Methods

Study design

This cross-sectional observational study was conducted between October 2022 and September 2023 using a self-administered questionnaire. The questionnaire was previously used in COPD clinical studies and was only available in English (Supplemental digital content 1).^{18,19} The questionnaire was employed to evaluate the preferences and clinical practices of airway clearance devices among family and pulmonary physicians in Saudi Arabia. The prescription data for respiratory medications with COPD from October 2022 to September 2023 was reviewed. This study adheres to the guidelines outlined in the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement.²⁰

Questionnaire

The questionnaire was initially designed and validated by a team of respiratory medicine experts who also assessed its face and content validity.¹⁹ It had been previously employed in clinical studies on COPD and was only available in English; demographics, preferences, and clinical practices of using airway clearance devices were the themes of this survey. The term *airway clearance device* refers to any physical device that helps clear mucus.^{18,21} COPD exacerbation was defined as any deterioration in the symptoms requiring medical assistance.^{17,22} A 5-point Likert scale (i.e., “always,” “usually,” “sometimes,” “rarely,” and “never”) was used to answer the multiple-choice questions. The purpose and summary of the study, as well as information about the principal investigator, were presented to the participants before they began filling out the questionnaire. While demographic information was collected, no personal identifiable information was gathered, and participation was voluntary. The following additional statement was included in the survey: ‘By responding “Yes” or “No” to the survey questions, you give your consent to your anonymous data being used for research purposes.’ When a participant answered

“Yes,” the survey page opened, and if they answered “No,” the survey closed.

Data collection and sampling strategy

Methods for convenience cross-sectional sampling were employed to recruit the study participants. The sample size determination was based on a report published by the General Authority of Statistics, which enumerated approximately 65,316 physicians in Saudi Arabia.²³ Employing a 95% confidence level, an anticipated response rate of 50%, and a 5% margin of error, the minimum sample size was calculated to be 382 physicians. The questionnaire was distributed online. Physicians, particularly family and pulmonary specialists, who were more inclined to perform standard assessments for COPD patients and monitor their health status, were included. These physicians must hold an active license, practice in Saudi Arabia, and agree to participate in the study. Two professional bodies managing respiratory diseases were invited to assist in data collection. These were the Saudi Society of Family and Community Medicine and the Saudi Thoracic Society. Prescriptions of medications by family and pulmonary physicians were collected retrospectively from Al-Noor Specialist Hospital and the Security Forces Hospital in Makkah using a standard spreadsheet.

Statistical analysis

The Statistical Package for the Social Sciences (SPSS, V.26, IBM Corporation, Armonk, NY, USA) was used for the analysis. Categorical variables were reported as percentages and frequencies. The statistical significance of the categorical variables was determined using a chi-square test. We used a 95% confidence interval to determine the ideal sample size. However, the significance level of $p < 0.01$ was used to determine the significance threshold.

Results

The study included 445 physicians. The majority of the participants were female, accounting for 64.3% of the sample, with most falling in the 20–30 age group (50.8%), followed by the 31–40 age range (31.5%). Most of the physicians who participated in the study were Saudi nationals (84.3%) and worked in specialist hospitals (44%). Geographically, the southern region (29.4%) and

the eastern region (24.3%) had the highest representation among the participants. The majority held a medical bachelor's degree (66.5%) and identified as family physicians (67.1%). The largest groups had 3–4 years (31.2%) of experience with COPD patients, followed by 5–6 years (28.1%) and 1–2 years (23.4%), as depicted in Table 1.

Physicians' preferences for prescribing airway clearance devices

The second theme in the survey focused on the physicians' preferences for prescribing airway clearance devices (the survey included pictures of the devices). Approximately two-thirds of the participants selected Flutter (45.8%) and Acapella (20.7%). Conversely, Aerosure (2.5%), Bubble PEP (4.7%), Aerobika (5.8%), and PEP masks (7.9%) were the least selected devices. Notably, 12.6% of respondents reported not being familiar with any of the airway clearance devices mentioned (Table 2).

Difference between physicians' preferences for prescribing airway clearance devices

Factors related to physicians' preferences for prescribing airway clearance devices were explored based on demographics. In general, the analysis revealed that age, place of work, region, and academic qualifications could be potential factors that influence the prescription of airway clearance devices among family and pulmonary physicians (Table 3). An additional analysis comparing family and pulmonary physicians who exclusively prescribed airway devices identified an additional influencing factor: nationality (Supplemental digital content 2).

Physicians' Recommendations for Airway Clearance Devices

When the physicians were asked about their recommendations for using airway clearance devices for different COPD severity categories, 43.6% of them “usually” suggested them for patients with daily, difficult-to-clear, thick sputum. Physicians also “sometimes” (40%) or “usually” (23%) recommended these devices to COPD patients who produced sputum throughout the day but could clear it. In addition, 34% of physicians “sometimes” recommended cough devices for patients with COPD who had morning sputum only.

Table 1. Characteristics of the survey participants ($n = 445$).

Characteristics	Frequency (n)	Percentage
Gender		
Male	159	35.7
Female	286	64.3
Age		
20–30	226	50.8
31–40	140	31.5
41–50	54	12.1
51–60	23	5.2
>60	2	0.4
Nationality		
Saudi	375	84.3
Non-Saudi	70	15.7
Medical centers		
Clusters	25	5.6
General practice	100	22.5
Specialized hospitals	196	44
Medical cities	67	15.1
Private hospitals	57	12.8
Geographical location		
Central region	83	18.7
Eastern region	108	24.3
Northern region	70	15.7
Southern region	131	29.4
Western region	53	11.9
Academic and clinical qualifications		
Medical bachelor's degree (MD)	296	66.5
MD and master's degree	68	15.3
MD and medical board residency/fellowship	54	12.1
MD and PhD degree	27	6.1

(Continued)

Table 1. (Continued)

Characteristics	Frequency (n)	Percentage
Profession		
Family physicians	299	67.1
Pulmonary physicians	146	33.0
Years of experience with COPD patients		
1–2 years	104	23.4
3–4 years	139	31.2%
5–6 years	125	28.1
7–8 years	36	8.1
>8 years	41	9.2
COPD, chronic obstructive pulmonary disease; MD, medical doctor.		

Regarding recommending airway clearance devices for COPD exacerbations, 37% of the physicians “sometimes” recommended airway clearance devices, with an increased percentage when exacerbations occurred four or more times a year (Figure 1).

Clinical practices of prescribing airway clearance devices

In clinical practice, physicians have reported the prescription of different airway clearance devices for patients with COPD. Questionnaire data indicated that 38% of physicians prescribed the Flutter device, 22% recommended the Acapella, 23% opted for the Aerobika, and 21% selected the PEP mask for one or two COPD patients (Figure 2). When assessing the real prescription data by family and pulmonary physicians, the retrospective data showed that there was no record of prescribed airway clearance devices over the reported year (the report covers the period from October 2022 to September 2023). On the other hand, drugs for obstructive airway diseases were prescribed to manage cough and sputum in COPD: 90.7% were prescribed short-acting beta-2 agonists (SABA), followed by long-acting muscarinic antagonists (LAMA) (80.3%), long-acting beta-2 agonists (LABA; 59.2%), and inhaled corticosteroids (55.2%) (Figure 3).

Table 2. Comparing physicians' preferences in prescribing airway clearance devices.

Airway clearance devices	Total	Family	Pulmonary	Chi-square (<i>p</i> value)
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	
Flutter (Allergan, Dublin, Ireland)	204 (45.8)	138 (46.5)	66 (44.6)	<0.001*
Acapella (Smiths-Medical, Dublin, OH, USA)	92 (20.7)	58 (19.5)	34 (23)	0.005*
PEP mask	35 (7.9)	25 (8.3)	12 (8.1)	<0.001*
Aerobika (Monaghan Medical, Plattsburgh, NY, USA)	26 (5.8)	9 (3)	17(11.5)	<0.001*
Bubble PEP	21 (4.7)	7 (2.4)	12 (8.1)	0.05
Aerosure (Actegy, Bracknell, UK)	11 (2.5)	7 (2.4)	4 (2.7)	0.05
<i>I don't know any of these devices</i>	56 (12.6)	55 (18.5)	1 (0.7)	<0.001*

Percentages compared with the chi-square test.
 *Denotes that the difference between groups was statistically significant.
 PEP, positive expiratory pressure.

Discussion

Generally, family and pulmonary physicians are aware of airway clearance devices, but preferences and reasons for prescribing them for individuals with COPD vary. The findings show a disparity between physicians' preferences and the prescribing data for airway clearance devices. There was no record of prescribed airway clearance devices for COPD in the reported year. This study makes an important contribution toward a better understanding of the current clinical practices related to airway clearance devices among family and pulmonary physicians in Saudi Arabia. It has been well documented that airway clearance devices can lead to a reduction in exacerbation frequency, improvements in sputum clearance, and a reduction in symptoms in individuals with COPD.^{13,18,24} Therefore, the current understanding and utilization of airway clearance devices among physicians must be updated continuously to facilitate the use of low-cost, high-value, non-pharmacological treatments in COPD care rather than respiratory medications. In parallel, clinical practice guidelines for COPD care in Saudi Arabia are still missing clinical data that present the benefits of using airway clearance devices.¹⁸

Our study revealed that, among the participants, Flutter and Acapella were the two most popular devices in clinical practice. However, there was a significant difference in preferences between family and pulmonary physicians. Family physicians

avored Flutter, PEP masks, and Aerobika devices the most. This observation may stem from familiarity with the devices depicted in the survey, which included images. Furthermore, the existing evidence substantiates the use of these devices in aiding sputum clearance for COPD patients. Another contributing factor could be that the majority of participants held a medical bachelor's degree and were relatively young, with fewer than 4 years of independent clinical practice, which may have influenced their familiarity with the devices. Additionally, the popularity of certain devices over others can be attributed to another study that found comparable performance characteristics between Acapella and Flutter. Notably, Acapella's performance is not gravity-dependent; this means it does not rely on the device's orientation. This feature might make it easier for some patients to use, particularly at a lower expiratory flow.²⁵

It is important to emphasize the need for future studies to explore the reasons behind the low preference for other devices, including Aerosure, Bubble PEP, Aerobika, and PEP masks. It is pivotal to determine whether the limited use of these devices stems from availability, clinical rationale, or simply a lack of awareness.

From this study, we can observe that a significant number of physicians recommend these devices for clearing thick mucus in the airways, mainly for

Table 3. Comparing demographic factors related to prescribing airway clearance devices.

Variables	Comparing factors related to airway clearance device prescription				p Value
	Family		Pulmonary		
	n	%	n	%	
Gender					
Female	112	37.5	47	32.2	0.071
Male	187	62.5	99	67.8	
Age					
20–30	158	52.8	68	46.6	0.008
31–40	95	31.8	45	30.8	
41–50	27	9.0	27	18.5	
51–60	19	6.4	4	2.7	
Nationality					
Saudi	259	86.6	116	79.5	0.680
Non-Saudi	40	13.4	30	20.5	
Medical center					
Clusters	19	6.4	6	4.1	0.004
General practice	88	29.4	12	8.2	
Specialized hospitals	130	43.5	66	45.2	
Medical cities	30	10.0	37	25.3	
Private hospitals	32	10.7	25	17.1	
Regions					
Central region	58	19.4	25	17.1	<0.001
Eastern region	80	26.8	28	19.2	
Northern region	50	16.7	20	13.7	
Southern region	80	26.8	51	34.9	
Western region	31	10.4	22	15.1	
Academic and clinical qualifications					
Medical bachelor's degree (MD)	149	49.8	92	63.0	<0.001
MD and master's degree	34	11.4	34	23.3	
MD and medical board residency/fellowship	52	17.4	2	1.4	
MD and PhD degree	23	7.7	4	2.7	

(Continued)

Table 3. (Continued)

Variables	Comparing factors related to airway clearance device prescription				p Value
	Family		Pulmonary		
	n	%	n	%	
Years of experience with COPD patients					
1–2 years	81	27.1	23	15.8	0.080
3–4 years	89	29.8	50	34.2	
5–6 years	69	23.1	56	38.4	
7–8 years	25	8.4	11	7.5	
>8 years	35	11.7	6	4.1	

MD, medical doctor; PhD, Doctor of Philosophy.

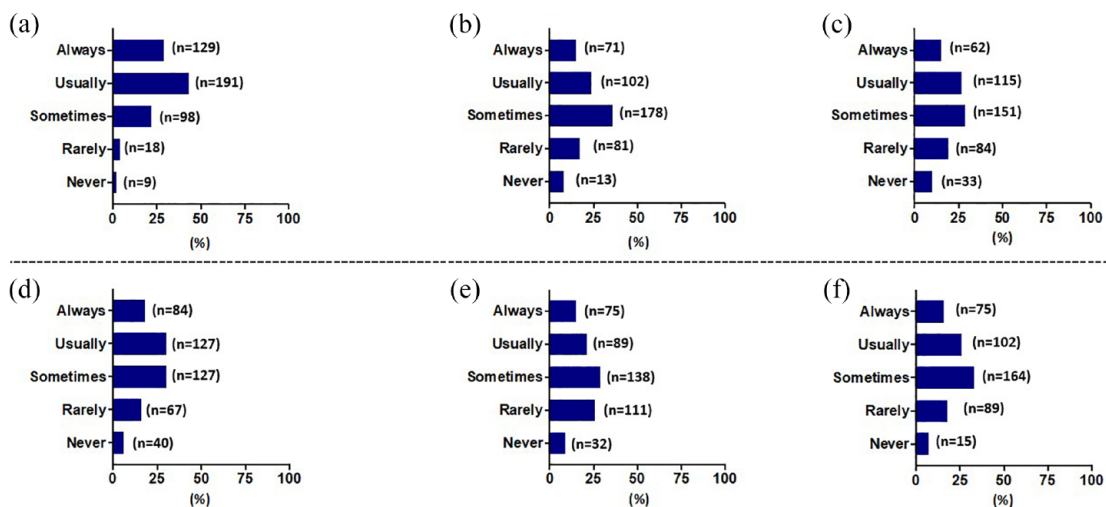


Figure 1. Physicians' recommendations for airway clearance devices based on severity categories: (a) A COPD patient with daily difficulties clearing thick sputum, (b) A COPD patient producing sputum throughout the day but able to clear it, (c) A COPD patient with morning sputum only, (d) A COPD patient who only has sputum with exacerbations or has 0-1 exacerbation/year, (e) A COPD patient who only has sputum with exacerbations and has 2-3 exacerbations /year and (f) A COPD Patient who only has sputum with exacerbations and has >4 exacerbations/year.

individuals with COPD, who have a large amount of secretions. They also stated that these devices are often recommended during COPD exacerbations. Furthermore, our findings corroborate other studies, providing collective evidence that airway clearance devices can improve sputum clearance and reduce exacerbation frequency and symptoms in stable COPD.^{26–28} These findings encourage future studies to investigate the

short- and long-term impacts of using these devices on individuals with COPD.

Our analysis of the clinical data revealed that the majority of individuals with COPD were prescribed SABA, LAMA, and LABA along with inhaled corticosteroids. In contrast, there were no records of airway clearance devices being prescribed. This suggests a disparity in the management of COPD

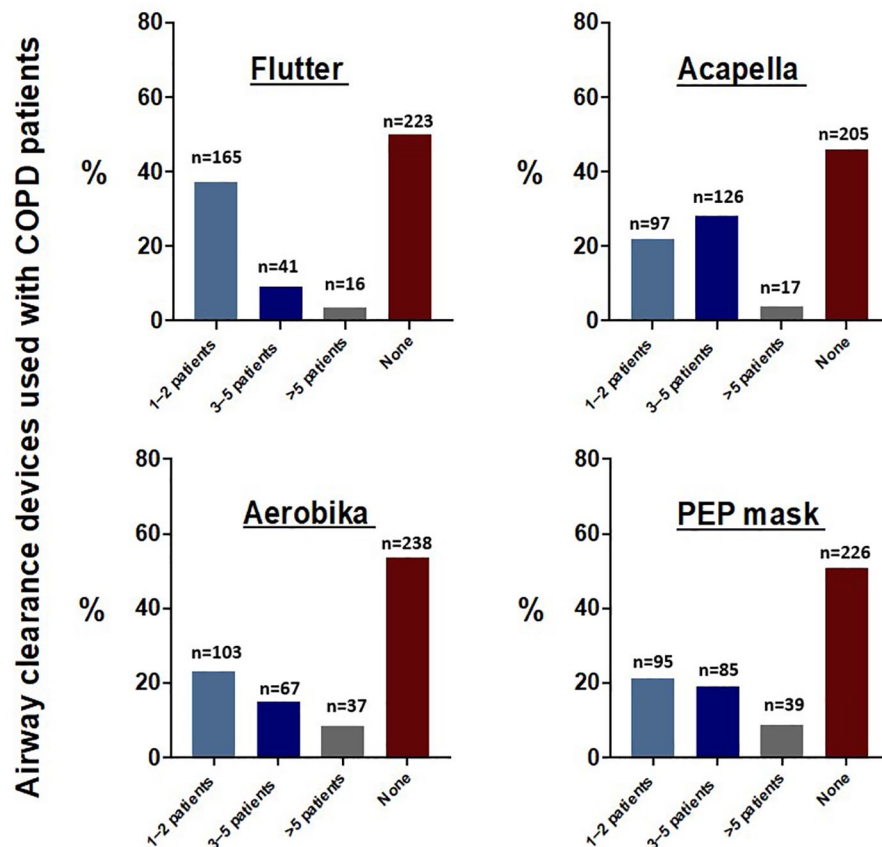


Figure 2. Clinical practices of prescribing airway clearance devices used with COPD patients. Family and pulmonary physicians’ survey. COPD, chronic obstructive pulmonary disease.

symptoms. This discrepancy can also be explained by the underutilization of airway clearance devices, as well as the lack of awareness of the existence of these devices. In addition, Saudi guidelines for the diagnosis and management of COPD did not refer to using airway clearance devices or chest physiotherapy when describing “non-pharmacological therapies” in COPD with sputum production.^{14,15} Thus, informing and reinforcing local guidelines with recent evidence about the benefits of non-pharmacological therapies must be established.^{5,13,16,18,24} However, our prescribing data do reveal a concern about the underutilization of airway clearance devices in treating COPD patients.

Clinical implementation

Based on the findings of our study, it is evident that there is a need for continuous medical education within the physician community. This requirement is especially pertinent among

younger healthcare professionals, as a substantial section of this demographic is unaware of the existence and efficacy of various airway clearance devices for COPD. To enhance the quality of care and streamline the prescription process, it is essential to establish precise guidelines for device utilization and documentation. This is particularly critical for patients dealing with persistent and challenging sputum. By aligning prescription practices with evidence-based guidelines and subjecting them to clinical reviews, we can enhance patient outcomes. Furthermore, there is an exigent need to intensify patient education efforts regarding the potential advantages of non-pharmacological devices. Such initiatives could potentially lead to an increased frequency of device prescriptions following the latest evidence-based recommendations. A strength of this study was its reporting of preferences for airway clearance devices, which are rarely documented in clinical practice. Additionally, it provides a comparison

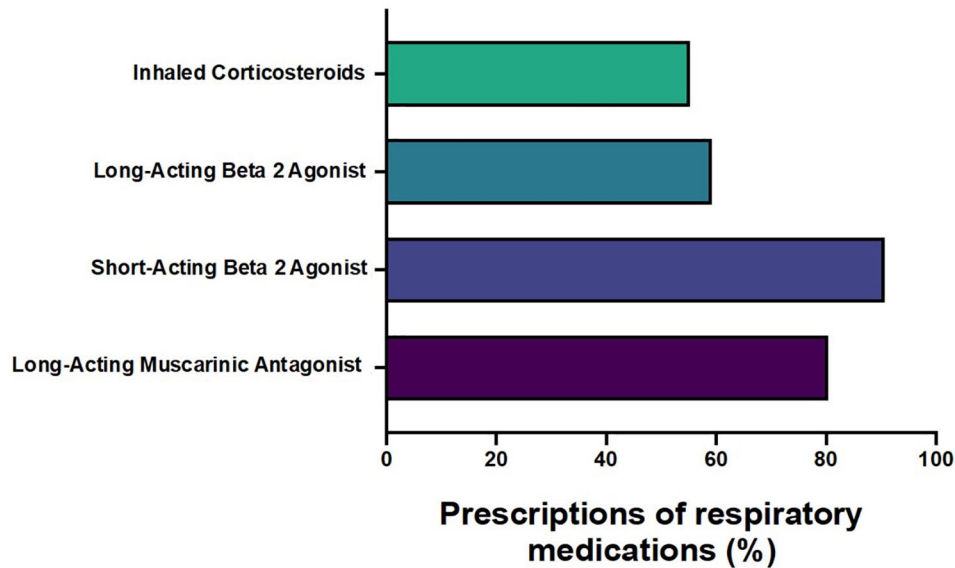


Figure 3. Prescribing data of respiratory medications by family and pulmonary physicians to manage cough and sputum per total number of patients. The data represent the prescriptions for 700 patients with a COPD diagnosis. The percentages in the figure represent the percentage of patients who received respiratory medications prescribed by family and pulmonary physicians. Prescribing data showed that there was no record of airway clearance devices being prescribed. COPD, chronic obstructive pulmonary disease.

between pharmacological treatments and airway clearance devices for COPD in routine care.

Limitations

However, this study is not free of certain limitations that should be taken into consideration. First, the findings may not be readily generalizable to other regions of Saudi Arabia, as the prescribing data collection process exclusively focused on hospitals within a specific geographical area; they did not include data from hospitals in all the regions of the country. Additionally, information from two facilities that provide airway clearance devices through medical prescriptions indicates that their situation may differ from other healthcare facilities. Consequently, these data should be interpreted carefully. Moreover, it is pivotal to note that this study relied on self-reported responses from physicians, thereby introducing the possibility of response bias, whereby they may not have provided completely accurate or unbiased information. Finally, as a cross-sectional study, our research design did not permit us to create the temporality between our variables of interest. Future studies with different designs are warranted to investigate causal relationships in greater depth.

Conclusion

Notwithstanding the wide range of airway clearance devices available for COPD patients, the Flutter and Acapella devices are preferred by physicians. Intriguingly, a significant number of physicians are unaware of any such devices. When prescribing airway clearance devices, the frequency of exacerbations and the patients' pattern of sputum production significantly impact the recommendations for them. Thus, pharmaceutical therapies are the main therapeutic strategy compared to non-pharmacological therapies in COPD patients with frequent sputum production. This suggests that, while physicians can identify the significance of airway clearance devices in treating COPD, their actual usage might not align with their current practice, thus highlighting the need for further initiatives to increase awareness about using airway clearance devices in clinical settings.

Declarations

Ethics approval and consent to participate

Ethical approval for the study was obtained from the Institutional Review Boards (IRB) at Al-Noor Specialist Hospital at Makkah, (IRB number:

H02K0760523951) and Security Force Hospital at Makkah (IRB number: 0560070223). Written consent was obtained prior to participation in the study.

Consent for publication

Not applicable.

Author contributions

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Competing interests

The authors declare that there is no conflict of interest.

Availability of data and materials

All pertinent data are contained within the paper.

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Supplemental material

Supplemental material for this article is available online.

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