Journal of Chemical Health Risks

www.jchr.org

JCHR (2026) 16(2), 2646-2651 | ISSN:2251-6727

Effectiveness of a COPD Action Plan in Reducing Exacerbations and Improving Lung Function: A Prospective Study

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(Received: 28 January 2026 Revised: 16 March 2026 Accepted: 09 April 2026)

KEYWORDS

Reducing Exacerbations

ABSTRACT:

Chronic Obstructive Pulmonary Disease (COPD) continues to be one of the major causes of morbidity and mortality in the world. The Global Initiative on Chronic Obstructive Lung Disease (GOLD) 2024 update defines COPD as the third cause of death in the world [1]. Asthma attacks often mark the clinical course, increasing the rate of lung depletion and raising healthcare expenses [1].

Introduction:

Chronic Obstructive Pulmonary Disease (COPD) continues to be one of the major causes of morbidity and mortality in the world. The Global Initiative on Chronic Obstructive Lung Disease (GOLD) 2024 update defines COPD as the third cause of death in the world [1]. Asthma attacks often mark the clinical course, increasing the rate of lung depletion and raising healthcare expenses [1].

The treatment of COPD has been redirected to self-treatment. A COPD Action Plan (CAP) is a personalized, written document that gives the instructions on the recognition of increasing symptoms and treatment [2]. CAPs are advised on a global basis, but their uptake is low with just one out of three providers actively providing them on routine basis [2]. There is evidence that the action plans designed on an individual basis decrease the length of exacerbation and the risk of hospitalization especially in patients with multi-comorbidity [3].

In developing countries, biomass smoke exposure, and other unique risk factors, play a significant role in determining the prevalence and severity of the disease and may have a different clinical phenotype than tobacco-induced COPD [4]. Moreover, the nutritional status is a decisive outcome predictor; patients with low Body Mass Index (BMI) an inherent trait in most clinical groups have more exacerbations and mortality [5].

This prospective study assesses the efficacy of a CAP in a population with a high biomass exposure and a high number of patients with underweight. We will measure the effect of a systematic plan of action on FEV1 and patient-reported outcomes in 12 months by following-up symptom days (Green, Yellow, and Red).

Methodology:

This was a prospective longitudinal study that was undertaken over a 1 year period to determine the effectiveness of a structured COPD Action Plan (CAP) in 145 patients in a tertiary care teaching hospital in chennai. Patients were recruited after receiving informed consent and ethical approval following a confirmed diagnosis of COPD by spirometry, as a continuum of disease severity between GOLD Stage I and IV. At baseline, the complete demographic and clinical information was recorded, including age, gender, Body Mass Index (BMI), smoking status, and environmental exposures, i.e., biomass, chemicals, and dust. The severity of the disease was determined based on the GOLD airflow limitation stages and the refined ABE assessment tool. The modified Medical Research Council (mMRC) dyspnea scale and COPD Assessment Test (CAT) were used to measure symptom burden and quality of life.

The intervention entailed the introduction of a personalized CAP, which informed patients about the need to identify and respond to the change in their health condition with the help of a color-coded system of a traffic light: "Green" (stable/baseline), "Yellow" (worsening symptoms that need more bronchodilator intake or antibiotics/ corticosteroids), and "Red" (emergency symptoms that need immediate medical care The patients were trained to note the rate of these days in a daily journal. At the baseline and at the 12 months

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JCHR (2026) 16(2), 2646-2651 | ISSN:2251-6727

follow-up, clinical outcomes, namely, in terms of FEV1 (L) and CAT scores were evaluated.

Statistical analysis:

Statistical work was conducted in comparison of pre and post intervention data, where paired t-tests were used to compare continuous variables of FEV1 and symptom scores, a p-value of less than 0.05 was taken to be statistically significant. All data were processed with standard statistical software to determine the effect of the plan on the reduction in the frequency of exacerbation and the objective lung function.

Results:

Table 1: Baseline Demographic and Clinical Characteristics of Study Population

Characteristic	**Category**	**No of Patients (n = 145)**
Age group	40–49 years	4 (2.8)
	50–59 years	37 (25.5)
	60–69 years	60 (41.4)
	≥70 years	44 (30.3)
Gender	Male	99 (68.0)
	Female	46 (32.0)
BMI category	Underweight	74 (51.0)
	Normal	42 (29.0)
	Overweight	22 (15.0)
	Obese	7 (5.0)

In this study population of 145 patients, the majority were aged 60–69 years (60, 41.4%) and ≥70 years (44, 30.3%), while smaller proportions were 50–59 years (37, 25.5%) and 40–49 years (4, 2.8%). Males predominated (99, 68.0%) compared to females (46, 32.0%). Regarding BMI, over half were underweight (74, 51.0%), followed by normal weight (42, 29.0%), overweight (22, 15.0%), and obese (7, 5.0%).

Table 2: Baseline Risk Factor and Clinical Profile

Parameter	**Category**	**No of Patients (n = 145)**
Smoking status	Current smoker	72 (49.7)
	Former smoker	18 (12.4)
Environmental exposure	Biomass exposure	34 (23.4)
	Chemical exposure	8 (5.5)
	Dust exposure	6 (4.1)
mMRC dyspnea grade	Grade 0–1	48 (33.1)

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JCHR (2026) 16(2), 2646-2651 | ISSN:2251-6727

	Grade 2–3	89 (61.4)
	Grade 4	8 (5.5)
CAT score	<10	39 (26.9)
	≥10	106 (73.1)
Comorbidities	Diabetes mellitus	42 (29.0)
	Systemic hypertension	38 (26.2)
	No comorbidity	58 (40.0)

Among 145 patients, nearly half were current smokers (72, 49.7%) and 18 (12.4%) were former smokers. Environmental exposures included biomass (34, 23.4%), chemical (8, 5.5%), and dust (6, 4.1%). Most patients had moderate-to-severe dyspnea with mMRC grade 2–3 (89, 61.4%), while 48 (33.1%) had grade 0–1 and 8 (5.5%) had grade 4. CAT scores were ≥10 in the majority (106, 73.1%), with only 39 (26.9%) scoring

Table 3: Baseline Disease Severity Classification

Classification	Category	n (%)
GOLD stage (FEV_1)	Mild	22 (15.2)
	Moderate	78 (53.8)
	Severe	38 (26.2)
	Very severe	7 (4.8)
ABE group	Group A	34 (23.4)
	Group B	82 (56.6)
	Group E	29 (20.0)

Among 145 patients, disease severity was predominantly moderate by GOLD stage (78, 53.8%), with smaller proportions classified as severe (38, 26.2%), mild (22, 15.2%), and very severe (7, 4.8%). Based on ABE grouping, most patients fell into Group B (82, 56.6%), followed by Group A (34, 23.4%) and Group E (29, 20.0%).

Table 4: Changes in Exacerbation Frequency (Green/Yellow/Red Days) Before and After COPD Action Plan

Group	**Period**	**Green Days (Mean ± SD)**	**Yellow Days (Mean ± SD)**	**Red Days (Mean ± SD)**
Group A **(n = 34)**	Baseline	100 ± 8	15 ± 6	5 ± 3
	12 months	115 ± 5	5 ± 3	0.1 ± 0.4
Group B **(n = 82)**	Baseline	72 ± 15	30 ± 10	18 ± 8
	12 months	102 ± 12	14 ± 7	4 ± 3

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Group E **(n = 29)**	Baseline	48 ± 18	32 ± 12	40 ± 15
	12 months	82 ± 14	24 ± 9	14 ± 8

After implementation of the COPD Action Plan, all groups showed improvement in exacerbation frequency. In Group A (n=34), mean green days increased from 100 ± 8 to 115 ± 5, while yellow days decreased from 15 ± 6 to 5 ± 3 and red days from 5 ± 3 to 0.1 ± 0.4. Group B (n=82) improved from 72 ± 15 to 102 ± 12 green days, with yellow days reduced from 30 ± 10 to 14 ± 7 and red days from 18 ± 8 to 4 ± 3. Group E (n=29) showed the most marked change, with green days rising from 48 ± 18 to 82 ± 14, yellow days decreasing from 32 ± 12 to 24 ± 9, and red days dropping substantially from 40 ± 15 to 14 ± 8.

Table 5: Clinical Outcomes Before and After COPD Action Plan

Outcome	Before CAP	After CAP	p-value
Mean FEV_1 (L)	2.10	2.52	***<0.001****
Mean CAT score	18.5	12.2	***<0.001****

Clinical outcomes improved significantly after the COPD Action Plan: mean FEV_1 rose from 2.10 L to 2.52 L ($p < 0.001$), while mean CAT score decreased from 18.5 to 12.2 ($p < 0.001$), indicating better lung function and reduced symptom burden.

Discussion:

This prospective study shows that a structured COPD Action Plan (CAP) implementation led to a significant reduction in the frequency of exacerbation and improvement in lung function and symptom burden in 12 months. The population of the study was mostly old, male and underweight, smoking was prevalent and moderate to severe disease was common. Such baseline features are in line with the epidemiological profile of chronic obstructive lung disease that has been reported all over the world especially in low and middle income nations whereby biomass exposure and undernourishment are also significant causal factors in addition to tobacco use [6,7].

An important observation in this research is that the percentage of underweight people is high (51%), and this finding has significant clinical implications. Low BMI in COPD is linked to low respiratory muscle strength, higher risk of exacerbation, and higher mortality [8]. Meanwhile, the presence of a high-risk population (high symptom burden, 73.1% with CAT ≥10; moderate-severe dyspnea, 66.9% with mMRC ≥2) also suggests that the study cohort is significantly representative of a high-risk population, as does the inclusion of the presence of the high-risk population in the reports of the Global Initiative

After the introduction of CAP, exacerbation patterns across all ABE groups have significantly improved due to a higher number of green days and significant decreases in yellow and red days. The greatest improvement was found in the patients in Group E which had the highest exacerbation burden at the start. These results are consistent with earlier randomized and observational studies showing that personalized action plans, especially those that include early symptom detection and timely medical intervention can greatly decrease the frequency of exacerbations and medical care use [10,11].

The reported decrease in exacerbations can be explained by the fact that the self-management behaviors, such as medication adherence, early access to rescue therapy, and timely access to healthcare, improved. CAPs have been reported to empower patients by educating them and utilizing programmed channels of decision making, thus minimizing delays to intervention in case of exacerbation. Bourbeau et al. also found that action plans were effective in self-management interventions to reduce hospitalizations and enhance health-related quality of life among COPD patients [10]. Equally, Fan et al. showed that the exacerbation rates

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JCHR (2026) 16(2), 2646-2651 | ISSN:2251-6727

were lower, but the results might differ with the choice of patients and the intensity of the program [11].

Besides exacerbation control, statistically significant lung function improvement (mean FEV 1 2.10 L to 2.52 L) was observed in this study ($p < 0.001$). Although COPD is conventionally defined on the basis of the irreversible airflow limitation, with an optimized treatment, increased adherence and decreased decline associated with exacerbation, small increases in FEV 1 can be obtained [12]. The observed improvement in this study could be a result of increased stability of the disease and less inflammatory burden owing to the reduction of exacerbations.

There was also a significant improvement in symptom burden in CAT score (18.5 to 12.2, $p < 0.001$) and quality of life was improved. This is in line with other previous research which indicates that structured self-management programs and action plans result in significant improvement of patient-reported outcomes [13]. Notably, the extent of reduction in CAT scores in this study is more than the minimal clinically important difference (MCID) of 2 points, indicating that the observed difference is not only statistically significant but also clinically important [14].

The study results support the necessity to include non-pharmacological interventions like patient education and self-management in the routine COPD treatment. Self-management interventions, such as written action plans, are highly recommended as part of overall COPD management by the Global Initiative on Chronic Obstructive Lung Disease [9]. Such interventions are more useful in a resource-limited environment as a cost-effective intervention to decrease disease burden and healthcare use.

Nonetheless, patient literacy, access to healthcare, and frequent follow-up may determine the effectiveness of CAPs. The positive results experienced in this study imply positive patient interaction and compliance which are paramount success determinants. Future research can consider the incorporation with digital health applications or telemonitoring to further increase compliance and the early intervention of exacerbations [15,16].

In general, the results of the present research are aligned with the literature and add further data on the significance of COPD action plans in enhancing clinical outcomes, especially in high-risk groups with a high symptom burden and risk of exacerbations.

Limitations:

The research has limitations due to its single center design, lack of a control group, a relatively short follow-up and the possibility of patient adherence and recall bias affecting self-reported outcomes.

Conclusion:

The prospective study demonstrates the presence of significant improvements in clinical outcomes and exacerbation burdens in all categories of GOLD ABE with a structured COPD Action Plan (CAP). The self-management framework of the CAP is clear and color-coded, allowing to recognize the symptoms earlier, which reduces the number of more frequent Group E patients with high-risk factors and increases the number of more frequent Group E patients with low-risk factors. The intervention also results in the best lung performance, as the mean FEV1 has increased to 2.52 L and the symptom burden as shown by the decrease in CAT scores. Since the study population is highly exposed to biomass and has significant numbers of underweight subjects, who are susceptible to adverse effects, the study results highlight the importance of CAP as a powerful and low-cost intervention that empowers patients. The authors suggest the incorporation of standardized action plans into practice to improve COPD management, reduce hospitalization, and improve the quality of life of patients.

Funding: Nil

Conflict of interest: Nil

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JCHR (2026) 16(2), 2646-2651 | ISSN:2251-6727

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