

Optimizing Treatment for Hospitalized Patients with COPD: A Study on the Impact of a LINE App-Based Multidisciplinary Team Approach Targeting Pharmacological Treatment, Lifestyle Changes, and Smoking Cessation

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Background: Chronic obstructive pulmonary disease (COPD) is a progressive respiratory condition that significantly impacts patients' health status. Effective management requires a multidisciplinary team (MDT) to address pharmacological and non-pharmacological treatments. The integration of mobile apps and devices improves COPD management by reducing symptoms and exacerbations. LINE, a commonly used communication app, enhanced team coordination and real-time decision-making. This study explored the effectiveness of LINE-based MDT interventions in hospitalized patients with COPD.

Methods: This retrospective analysis included patients with COPD admitted for exacerbations and compared their outcomes before and after the implementation of LINE-based MDT care. The MDT consisted of pulmonologists, care managers, nurses, dietitians, social workers, pharmacists, respiratory therapists, and long-term care teams. A LINE group coordinated care in real-time, enabling the team to promptly review the patients' conditions, adjust treatment plans, and provide tailored interventions.

Results: The LINE-based MDT group demonstrated significantly higher intervention rates, including systemic steroids, inhaled corticosteroids, long-acting beta-agonists, long-acting muscarinic antagonists, and pulmonary rehabilitation ($p < 0.05$). BSRs improvement was greater in the MDT group than the non-MDT group (40.9% vs 29.7%, $p = 0.016$). However, there were no significant differences between the groups' readmission rates, emergency room visits, or one year survival ($p > 0.05$).

Conclusion: Implementing LINE-based MDT care significantly improved the delivery of pharmacological and non-pharmacological interventions, enhanced coordination, and facilitated comprehensive management, leading to better quality of life outcomes, as

evidenced by improvements in BSRS scores. This highlights the value of leveraging real-time communication tools like LINE app to optimize COPD care.

Keywords: chronic obstructive pulmonary disease, multidisciplinary team, health-related quality of life, LINE-based

Introduction

Chronic obstructive pulmonary disease (COPD) is a respiratory disease influenced by several risk factors, including smoking, air pollution, occupational exposure, genetic predisposition, and infections during childhood or adulthood.¹ According to the World Health Organization (WHO), 3 million deaths are attributed to this disease each year. WHO also predicts that COPD will become the third leading cause of death by 2030.² COPD poses a significant public health challenge in Taiwan.³ An epidemiological survey revealed a prevalence rate of 6.1% in this population, with many affected individuals experiencing multiple comorbidities.³

COPD is a significant public health issue. It is a progressive condition that worsens over time, leading to health decline, reduced health-related quality of life (HRQL), and diminished endurance in daily activities.⁴ The symptoms and complications of COPD can severely limit the patient's ability to perform everyday tasks, greatly affecting their overall well-being. Frequent acute exacerbations and hospitalizations are common in COPD, often resulting in a further decline in HRQL and overall health status.⁴ Moreover, patients with COPD who experience frequent hospitalization are at a significantly higher risk of mortality.⁴ As such, effective management of hospitalized COPD patients is crucial.

The management of COPD requires collaborative efforts by multiple healthcare professionals to deliver both pharmacological and non-pharmacological interventions for optimal outcomes.⁵ There is a growing trend toward an interdisciplinary approach to COPD management.⁵ A multidisciplinary team (MDT) plays a crucial role in the comprehensive care of COPD, which often involves respiratory complications and comorbid conditions such as cardiovascular disease and malnutrition.^{6,7} Pulmonologists focus on medical treatment and respiratory care; physiotherapists assist with pulmonary rehabilitation (PR); dietitians offer nutritional support; and psychologists provide mental health care, addressing all aspects of the patient's treatment.⁶ MDT also strongly emphasizes patient education and self-management, empowering individuals to manage their symptoms and adhere to treatment plans.⁷ This collaborative approach has become essential in COPD care, enabling personalized strategies that effectively address both pulmonary and non-pulmonary challenges. However, the effectiveness of these programs remains unclear.^{5,7}

Many studies have highlighted the potential of electronic tools, including electronic monitoring devices, smartphone apps, and web-based platforms, in the management of patients with COPD.^{8,9} One systematic review suggested that the use of electronic health tools can improve adherence to inhalation therapy.⁸ myCOPD is a digital application (app) designed by experts to assist healthcare providers and patients in managing COPD.⁹ It offers education, self-management features, symptom tracking, and PR support. It has been reported to be non-inferior to face-to-face PR in terms of COPD assessment test (CAT) score, walking test performance, anxiety levels, and HRQL.⁹ The integration of electronic tools in COPD management is growing.^{8,9} In Taiwan, the use of the LINE app has become widespread, offering a convenient platform to assist with treatment support.

Given the complexity of COPD and its associated comorbidities, hospitalized patients with COPD often present with a poor condition and require more comprehensive treatment.¹⁰ This makes the MDT approach an ideal strategy for their care.¹⁰ To enhance MDT care, our study integrated LINE, a widely used communication app in Taiwan, to improve coordination and real-time communication among team members. Through the LINE-based system, the respiratory care manager promptly notified MDT members upon a patient's admission, enabling rapid evaluation and collaborative decision-making. This communication platform allowed for seamless updates on patient progress and facilitated the timely delivery of individualized care. By leveraging this tool, MDT care can be delivered more efficiently and effectively, addressing the complexities of hospitalized COPD management. The primary outcomes of this study included hospitalization days, 14-day re-admission rates, emergency room visits within 30 days of discharge, and one-year survival rate. Secondary outcomes included HRQL, adherence to treatment plans, and smoking cessation rates. By analyzing these outcomes, we aimed to assess the value of LINE-based MDT interventions in optimizing treatment and improving outcomes in hospitalized patients with COPD.

Materials and Methods

Patient Recruitment

The study included patients admitted to the Chest Ward for COPD exacerbation between January 1, 2018, and September 20, 2024. We retrospectively analyzed real-world data on COPD diagnoses confirmed by spirometry. The MDT was established on January 1, 2019. Therefore, the period from January 1, 2018, to December 31, 2018, represented care without MDT involvement, whereas the period after January 1, 2019, reflected care under the MDT approach. In this study, we compared patient outcomes before and after the implementation of MDT care. The Ethics Committee of the Taipei Tzu Chi Hospital approved the study protocol and the approval number is 14-IRB-208. We performed this study in accordance with the Declaration of Helsinki. Informed consent was obtained from all participants in the study.

Patient Care

Before MDT Care

The patients received usual care, with the chest physician prescribing medications based on their clinical expertise. The chest physician initiated PR interventions. Ward nurses provided routine care and education. Dietitian intervention was initiated when the patient's body mass index (BMI) was $< 18.5 \text{ kg/m}^2$. The nurse notified the smoking cessation manager to intervene if the patient was a current smoker. The Brief Symptom Rating Scale (BSRS-5) scores were routinely assessed at admission and discharge. During hospitalization, patient management was typically handled by physicians and nurses based on their individual experiences, without team oversight.

Applying MDT Care

The multidisciplinary team (MDT) consisted of chest physicians, ward nurses, respiratory care managers, smoking cessation managers, respiratory therapists, dietitians, long-term care case managers, social workers, technicians, and other specialists. The entire team communicated through a LINE group, whereupon patient admission for COPD exacerbation, the case manager promptly notified all team members. The respiratory care manager evaluated within one working day, and the team reviewed the patient's condition and treatment plan collaboratively via LINE. Other team members followed up with assessments and interventions within three working days. The respiratory therapist provided education on breathing exercises and diaphragmatic breathing, and recommended respiratory care. Dietitian intervention was triggered when the patient's BMI fell below 21 kg/m^2 , and the smoking cessation manager was informed to intervene with the smokers. BSRS assessments were performed at admission and discharge. Each MDT member delivered individualized care, performed comprehensive assessments, developed tailored treatment plans, provided educational interventions, and offered counseling through LINE. The LINE group facilitated real-time collaboration, allowing team members to promptly adjust treatment plans based on ongoing evaluations and ensuring a coordinated and responsive approach to patient care.

Pulmonary Function Test

Pulmonary function tests were performed by a technician following the established guidelines of the American Thoracic Society, employing a spirometer device produced by Medical Graphics Corporation, St. Paul, Minnesota, USA.¹¹ The measurements of forced vital capacity (FVC) and forced expiratory volume in the first second (FEV1) were included. The degree of airflow obstruction was assessed by evaluating the FEV1 percentage.⁶

Psychological Distress and Health-Related Quality of Life

Psychological distress was assessed using the BSRS-5, which includes items measuring anxiety, depression, hostility, inferiority, and insomnia.¹² Additionally, the final item screened for suicidal ideation. Patients rated each symptom on a 5-point scale ranging from 0 (not at all) to 4 (extremely), and the total score was calculated.¹² If depression was suspected based on BSRS-5 results, patients were referred to psychologists or social workers for further evaluation and management. BSRS-5 scores were assessed at admission and discharge.

Pharmacological Treatment by Chest Physician

The three main medications most commonly used for COPD exacerbation are bronchodilators, corticosteroids, and antibiotics (if an infection is present).¹⁰

Medications were prescribed by chest physicians and evaluated using the MDT within one working day following the Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines.⁶ For acute exacerbations, inhalation was the preferred route of administration, with nebulized Atrovent and Bricanyl being commonly used. Systemic corticosteroids such as hydrocortisone or methylprednisolone were administered as needed. Long-acting beta-agonists (LABA), long-acting muscarinic antagonists (LAMA), and inhaled corticosteroids (ICS) were prescribed before discharge. Patients were educated on proper inhaler techniques to ensure effective medication use.⁶

Education Provided by Ward Nurse

The ward nurses offered education centered on patient care during hospitalization, emphasizing the importance of understanding patients' conditions and treatment plans.¹³ The patients were taught about their medications, including dosages and potential side effects, and the significance of maintaining a healthy lifestyle, including nutrition. The nurses also provided information on recognizing early signs of complications and the importance of promptly communicating concerns.¹³

Education Provided by Respiratory Case Manager

The respiratory case manager provided education focused on managing respiratory conditions, emphasizing the importance of medication adherence, proper inhaler techniques, and self-treatment knowledge.¹⁴ Patients were taught to recognize and respond to the symptoms of exacerbations and the significance of regular follow-up appointments. In addition, the case manager offered resources and support for smoking cessation and exercise training.¹⁴

Breathing Exercise

The protocol for breathing exercises, such as pursed-lip and diaphragmatic breathing, was taught to the patients.¹⁵ Pursed-lip breathing involves slow inhalation through the nose and gentle exhalation through the pursed lips. This technique helps slow the breathing rate, increases oxygenation, and prevents airway collapse by maintaining a positive airway pressure during exhalation. Diaphragmatic breathing encourages deep breathing through engagement with the diaphragm. Patients were instructed to place one hand on their abdomen and the other on their chest, focusing on expanding their abdomen during inhalation.¹⁵

Airway Clearance Techniques

Airway clearance techniques, including huffing and oscillating positive expiratory pressure (OPEP) devices, were used in patients with sputum.¹⁶ Huffing involves taking a deep breath, followed by a forceful exhalation with an open mouth to help move mucus from the smaller to the larger airways for easier clearance. The patients were also provided with Aerobika, an OPEP device. Respiratory therapists instructed patients on properly performing huffing and used the Aerobika device for optimal airway clearance.¹⁶

Nutritional Strategies

Patients with a BMI < 21 kg/m² were referred to a dietician for nutritional counseling. They were advised to limit the intake of simple carbohydrates, including table sugar, candy, cake, and regular soft drinks.¹⁷ They should consume 20 to 30 grams of fiber daily, primarily through fruits, vegetables, and whole grains. Basic nutraceutical components such as vitamins and fibers were to be obtained from natural food sources. Additionally, a diet higher in healthy fats (excluding trans and saturated fats), increased protein intake, and reduced carbohydrate intake were suggested.¹⁷

Smoking Cessation

The ward nurse evaluated all admitted patients, identified current smokers, and advised them to quit.¹⁸ These patients were referred to a smoking cessation case manager. Clear guidance on smoking cessation was provided, highlighting its

significant health benefits, particularly for lung function and overall respiratory health. Patients were encouraged to seek assistance from smoking cessation specialists through counseling, nicotine replacement therapy, or medication, as needed, to aid the cessation process.¹⁸

Outcomes and Measurements

The primary outcome measures included clinical indicators such as hospitalization days, the occurrence of 14-day re-admission, emergency room visits within 30 days of discharge, and one-year survival.¹⁹ Secondary outcome measures included HRQL, adherence to treatment plans, and smoking cessation success rates.²⁰ All outcome measures were compared between patients treated with and without the MDT to evaluate the impact of the MDT approach on patient care.

Statistical Analysis

Patients were divided into two groups: those without and those with MDT support. Continuous variables with a normal distribution are presented as means \pm SD, while continuous variables with a skewed distribution are presented as medians (interquartile range, IQR). Categorical variables are presented as counts (percentages). An independent samples *t*-test was used to compare continuous variables between the two groups, whereas Pearson's chi-square and Fisher's exact test were used for categorical variables. The propensity score matching (PSM) was performed with age, body height, smoking, FEV1/FVC, and FEV1 as the matching variables using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA). The matching process followed a one-to-many approach. The method prioritizes "best" matches first and then proceeds with "next-best" matches until no more can be made. Statistical analyses except for PSM were conducted using SPSS (version 24.0; SPSS Inc., Chicago, IL, USA).

Results

Demographic and Clinical Differences Between Patients without and with MDT Before Matching

Table 1 presents the demographic and clinical characteristics of all patients before matching. The non-MDT and MDT groups included 83 and 406 patients, respectively. MDT patients were younger on average (75.8 vs 78.9 years, $p = 0.015$) but had a lower median FEV1/FVC ratio (49.0% vs 56.0%, $p = 0.026$) and FEV1% (50.0% vs 55.0%, $p = 0.036$). The non-MDT group had a higher proportion of nonsmokers than the MDT group (50.6% vs 25.9%, $p < 0.001$). BMI, body weight, COPD stage, FVC, and FVC% were not significantly different between the groups (all $p > 0.05$).

Demographic and Clinical Differences Between Patients without and with MDT After Matching

Table 2 shows that after propensity matching, there were no significant differences between the MDT and non-MDT groups. Age, height, BMI, body weight, FVC, FEV1, COPD stage, and smoking status were comparable, with similar distributions across all variables (all $p > 0.05$).

Comparison of Treatment and Intervention Usage Between Patients Treated without and with MDT After Matching

Table 3 compares treatment and intervention usage between the MDT and non-MDT groups. A higher proportion of patients in the MDT group received inhaled steroids (80.0% vs 59.0%, $p = 0.001$), overall steroids (96.8% vs 87.2%, $p = 0.005$), LABA (94.9% vs 71.8%, $p < 0.001$), LAMA (85.3% vs 61.5%, $p < 0.001$), and PR (80.8% vs 50.0%, $p < 0.001$) compared to the non-MDT group. No significant differences were observed between the groups regarding SABA, SAMA, smoking cessation interventions, successful smoking cessation, or influenza vaccination (all $p > 0.05$). Nutritional intervention usage varied, with a higher percentage of MDT patients with a BMI < 21 kg/m² receiving nutritional intervention than those without (22.2% vs 9.0%, $p < 0.001$).

Table 1 Demographic and Clinical Differences Between Patients Without and With Multidisciplinary Team

	All patients (n = 489)	Non-MDT (n = 83)	MDT (n = 406)	p-value
Age (years)	76.3 ± 10.6	78.9 ± 10.3	75.8 ± 10.6	0.015
Gender				
Female (n, %)	44 (9.0)	4 (4.8)	40 (9.9)	0.144
Male (n, %)	445 (91.0)	79 (95.2)	366 (90.1)	0.144
BH (cm)	162.0 (157.0–167.0)	165.0 (160.5–168.0)	162.0 (157.0–166.0)	0.002
BMI (kg/m²)	23.6 ± 4.3	23.4 ± 4.1	23.7 ± 4.3	0.533
BW (kg)	62.0 (53.2–70.1)	61.0 (53.3–69.8)	62.0 (53.1–70.4)	0.825
COPD stage (n, %)				0.397
I	57 (11.7)	11 (13.3)	46 (11.3)	
II	205 (41.9)	40 (48.2)	165 (40.6)	
III	165 (33.7)	25 (30.1)	140 (34.5)	
IV	62 (12.7)	7 (8.4)	55 (13.5)	
Smoking (n, %)				< 0.001
Non, smoking	147 (30.1)	42 (50.6)	105 (25.9)	
Current smoking	111 (22.7)	18 (21.7)	93 (22.9)	
Ex, smoking	231 (47.2)	23 (27.7)	208 (51.2)	
FEV1/FVC (%)	50.0 (42.0–62.0)	56.0 (45.0–64.0)	49.0 (42.0–61.0)	0.026
FVC (L)	2.2 ± 0.7	2.3 ± 0.7	2.2 ± 0.7	0.316
FVC (%)	79.5 ± 25.1	82.7 ± 24.6	78.8 ± 25.2	0.194
FEV1 (L)	1.1 (0.8–1.4)	1.1 (0.9–1.4)	1.1 (0.8–1.4)	0.105
FEV1 (%)	51.0 (38.0–64.0)	55.0 (42.0–71.0)	50.0 (36.0–63.0)	0.036

Notes: Continuous variables with normal distribution are presented as mean ± SD, data without normal distribution are presented as median (IQR); categorical variables are presented as counts (percentage). P-values < 0.05 are shown in bold. **Abbreviations:** BH, body height; BMI, body mass index; BW, body weight; COPD, chronic obstructive pulmonary disease; FEV1, forced expiratory volume in 1 s; FVC, forced vital capacity; FEV1/FVC, ratio of forced expiratory volume in 1 s to forced vital capacity.

Table 2 Demographic and Clinical Differences Between Patients Without and With Multidisciplinary Team (MDT) After Matching

	All patients (n = 234)	Non-MDT (n = 78)	MDT (n = 156)	p-value
Age (years)	77.4 ± 11.0	78.2 ± 9.9	77.0 ± 11.6	0.447
Gender				
Female (n, %)	12 (5.1)	4 (5.1)	8 (5.1)	1.000
Male (n, %)	222 (94.9)	74 (94.9)	148 (94.9)	1.000
BH (cm)	164.0 (160.0–168.0)	165.0 (160.0–167.0)	164.0 (160.0–168.0)	0.736
BMI (kg/m²)	23.8 ± 4.3	23.5 ± 4.2	24.0 ± 4.4	0.407
BW (kg)	63.1 (54.7–71.1)	61.0 (53.3–68.9)	64.4 (56.0–71.9)	0.163
COPD stage (n, %)				0.837
I	30 (12.8)	10 (12.8)	20 (12.8)	
II	107 (45.7)	36 (46.2)	71 (45.5)	
III	70 (29.9)	25 (32.1)	45 (28.8)	
IV	27 (11.5)	7 (9.0)	20 (12.8)	
Smoking (n, %)				0.941
Non-smoking	108 (46.2)	37 (47.4)	71 (45.5)	
Current-smoking	57 (24.4)	18 (23.1)	39 (25.0)	
Ex-smoking	69 (29.5)	23 (29.5)	46 (29.5)	

(Continued)

Table 2 (Continued).

	All patients (n = 234)	Non-MDT (n = 78)	MDT (n = 156)	p-value
FEV1/FVC (%)	53.5 (45.0–63.0)	53.5 (45.0–62.0)	53.5 (45.0–63.0)	0.979
FVC (L)	2.3 ± 0.7	2.2 ± 0.7	2.3 ± 0.7	0.847
FVC (%)	80.6 ± 25.1	83.0 ± 24.9	79.3 ± 25.2	0.289
FEV1 (L)	1.1 (0.9–1.5)	1.1 (0.9–1.4)	1.1 (0.9–1.5)	0.710
FEV1 (%)	55.0 (40.0–69.0)	55.0 (42.0–71.0)	55.0 (39.0–69.0)	0.709

Notes: Continuous variables with normal distribution are presented as mean ± SD, data without normal distribution are presented as median (IQR); categorical variables are presented as counts (percentage).

Abbreviations: BH, body height; BMI, body mass index; BW, body weight; COPD, chronic obstructive pulmonary disease; FEV1, forced expiratory volume in 1 s; FVC, forced vital capacity; FEV1/FVC, ratio of forced expiratory volume in 1 s to forced vital capacity.

Table 3 Comparison of Treatment and Intervention Usage Between Patients Treated Without and With a Multidisciplinary Team After Matching

	All patients (n = 234)	Non-MDT (n = 78)	MDT (n = 156)	p-value
Systemic steroid (n, %)	196 (83.8)	63 (80.8)	133 (85.3)	0.380
Inhaled steroid (n, %)	170 (73.0)	46 (59.0)	124 (80.0)	0.001
Overall steroid (n, %)	219 (93.6)	68 (87.2)	151 (96.8)	0.005
SABA (n, %)	218 (93.2)	71 (91.0)	147 (94.2)	0.360
SAMA (n, %)	213 (91.0)	70 (89.7)	143 (91.7)	0.628
LABA (n, %)	204 (87.2)	56 (71.8)	148 (94.9)	< 0.001
LAMA (n, %)	181 (77.4)	48 (61.5)	133 (85.3)	< 0.001
Pulmonary rehabilitation (n, %)	165 (70.5)	39 (50.0)	126 (80.8)	< 0.001
Smoking ceasing intervention (n, %) ^a	53/57 (93.0)	17/18 (94.4)	36/39 (92.3)	1.000
Quit Smoking (n, %) ^b	17/53 (32.1)	4/17 (23.5)	13/36 (36.1)	0.360
Influenza Vaccination (n, %)	107 (45.7)	33 (42.3)	74 (47.4)	0.458
BMI <21 kg/m ² (n, %)	65 (27.8)	26 (33.3)	39 (25.0)	0.180
Nutritional intervention (n, %)				< 0.001
No intervention ^c	27 (11.7)	20 (25.6)	7 (4.6)	
Intervention ^d	41 (17.7)	7 (9.0)	34 (22.2)	
Not need intervention ^e	163 (70.6)	51 (65.4)	112 (73.2)	
Missing	3	0	3	

Notes: Continuous variables with normal distribution are presented as mean ± SD, data without normal distribution are presented as median (IQR); categorical variables are presented as counts (percentage). P-values < 0.05 are shown in bold.

^a Included patients who were current smokers (n = 57). ^b Included current smokers who received smoking ceasing intervention. ^c Patients with a BMI < 21 kg/m² without nutritional intervention. ^d Patients with a BMI < 21 kg/m² with nutritional intervention. ^e Patients with a BMI > 21 kg/m² who did not require nutritional intervention.

Abbreviations: SABA, short-acting beta agonist; SAMA, short-acting muscarinic antagonist; LABA, long-acting beta agonist; LAMA, long-acting muscarinic antagonist; BMI, body mass index.

Comparison of Clinical Outcomes Between Patients Treated without and with MDT After Matching

Table 4 presents the clinical outcomes of the patients managed with and without MDT. The proportion of BSRS improvement was higher in patients in the MDT group compared to the non-MDT group (40.9% vs 29.7%, p = 0.016). No significant differences were observed in the length of stay, 14-day readmission rates, 30-day emergency visits, or one year survival rates between the two groups (all p > 0.05).

Table 4 Comparison of Clinical Outcomes Between Patients Treated Without and With a Multidisciplinary Team After Matching

	All patients (n = 234)	Non-MDT (n = 78)	MDT (n = 156)	p-value
BSRS at admission	1.0 (0.0–3.0)	1.0 (0.0–2.0)	1.0 (0.0–3.0)	0.064
BSRS at discharge	1.0 (0.0–2.0)	0.0 (0.0–1.0)	1.0 (0.0–2.0)	0.044
BSRS change ^a				0.016
Decreased	75 (37.3)	19 (29.7)	56 (40.9)	
Remained	112 (55.7)	36 (56.3)	76 (55.5)	
Increased	14 (7.0)	9 (14.1)	5 (3.6)	
LOS (days)	8.0 (6.0–11.0)	7.0 (5.0–11.0)	8.0 (7.0–11.0)	0.098
14 days re-admission (n, %)	13 (5.6)	4 (5.1)	9 (5.8)	1.000
30 days ER (n, %)	23 (9.8)	6 (7.7)	17 (10.9)	0.438
Survival (n, %)	223 (95.3)	74 (94.9)	149 (95.5)	1.000

Notes: Continuous variables are presented as median (IQR); categorical variables are presented as counts (percentage). P-values < 0.05 are shown in bold. ^a Decreased (improved): BSRS at discharge – BSRS at admission < 0; Remained: BSRS at discharge – BSRS at admission = 0; Increased (worsened): BSRS at discharge – BSRS at admission > 0.

Abbreviations: BSRS, brief symptom rating scale; LOS, length of stay; ER, emergency room.

Discussion

This study yielded several important and novel findings. The MDT group, supported by a LINE-based communication platform, demonstrated significantly higher rates of standard pharmacological and non-pharmacological treatments, including systemic steroids, ICS, LABA, LAMA, and PR. Furthermore, the MDT group exhibited greater improvement in the BSRS than the non-MDT group. However, no significant differences between the groups were observed in the readmission rates, emergency room visits, or one year survival. These findings emphasize the effectiveness and novelty of the LINE-based MDT model, which represents a significant advancement in optimizing COPD management through enhanced communication and collaboration. The integration of LINE enabled real-time coordination among team members, ensuring timely, tailored interventions that directly addressed each patient's needs. To our knowledge, this is the first study to show a LINE-based communication platform for COPD management within a MDT setting, marking an important step forward in the use of digital tools.

There have been previous studies on MDT care for patients with stable COPD. A recent Cochrane review of MDT programs for COPD suggested improvements in disease-specific QoL, exercise capacity, hospital admissions, and hospital stay.⁷ Statistically significant improvements were observed in the MRC Dyspnea Scale at short- and medium-term follow-ups but not at long-term follow-ups.⁷ No differences were observed in terms of mortality.⁷ MDT management programs have positively affected PR attendance, self-reported daily activities, and disease knowledge.²¹ However, there were no significant differences between groups in HRQL, exacerbation rates, or length of hospital stay.²¹ A study on MDT in primary care led by general practitioners for COPD found no statistically significant differences in the St. George's Respiratory Questionnaire (SGRQ) and CAT score changes between the MDT and non-MDT groups. The proportion of participants showing improvements in hospital anxiety and depression scale (HADS) scores and modified Medical Research Council (mMRC) grades was also not significantly different between the groups, and the smoking cessation success rates were similar.⁵ Previous studies on MDT care have shown improvements in disease-specific quality of life, exercise capacity, and hospital admissions; however, findings regarding long-term outcomes, HRQL, exacerbation rates, and hospitalized acute exacerbations remain inconclusive. Although some studies have explored MDT care in patients with stable COPD, research focusing specifically on hospitalized patients with acute exacerbations remains limited.

Only a few review articles have suggested implementing MDT care for hospitalized patients with COPD.^{10,22} One study showed that daily MDT meetings significantly reduced the hospital stay duration for COPD patients from 5.6 to 3.4 days.²² However, this study excluded patients with known or suspected heart failure and those with a febrile temperature (> 38°C), despite secondary infections being a common cause of COPD exacerbations. Furthermore, the study reported only the length of hospital stay and did not assess any other outcomes.²² Therefore, these results only apply to patients with COPD without heart failure or

infection.²² One study showed that patients' 30-day all-cause readmission rate dropped from 22.7% without bundled care to 14.7% with bundled care.²³ In a previous study, we implemented a COPD care bundle for hospitalized patients with reduced readmission rates.²⁴ The 30-day rate dropped from 38.3% to 22.4% post-intervention, with similar reductions at 60 days (40.3% to 13.7%) and 90 days (32.2% to 10.1%).²⁴ Studies suggest that MDT and COPD care bundles significantly reduce hospital stay duration and readmission rates.

This study is the first to explore the use of LINE-based MDT in treating patients with COPD. The COPD Foundation highlighted the importance of digital adaptation in improving usability and enabling healthcare providers to access critical COPD management resources more efficiently.²⁵ Another prior study also revealed the effectiveness of smart-phone applications in enhancing COPD management, improving the quality of life, and increasing patients' knowledge about the disease and its nonpharmacological management.²⁶ A recent review emphasized that integrating simple, scalable, affordable, and future-proof digital solutions into healthcare systems could transform global chronic disease management and optimize patient care and healthcare resources.²⁷ Our study contributes to the growing body of evidence by providing comprehensive insights into the application of LINE-based MDT for COPD care.

Management of COPD is complex and requires both pharmacological and non-pharmacological treatments for comprehensive care.⁶ The GOLD guidelines recommend long-acting bronchodilators (LABA or LAMA) as first-line therapy, with short-acting bronchodilators (SABA or SAMA) used for immediate relief. ICS was administered to patients with frequent exacerbations or higher eosinophil counts. Triple therapy (LAMA, LABA, and ICS) is recommended for patients with persistent symptoms or frequent exacerbations.⁶ However, before the introduction of MDT care, we observed low utilization of LABA, LAMA, and ICS. The application of LINE-based MDT significantly improved the use of standard pharmacological treatments. Relying solely on pharmacological agents is insufficient for treating patients with COPD, necessitating several non-pharmacological interventions to enhance treatment options, such as PR.²⁸ One meta-analysis revealed that inpatient PR improved the 6-minute walk distance, quality of life, and lower limb muscle strength, although it did not affect the length of hospital stay.²⁹ Another meta-analysis showed early PR in patients hospitalized for acute exacerbations of COPD. Early PR significantly improved readmission rates, 6-minute walk distance, SGRQ scores, and mMRC dyspnea scale results.³⁰ However, a low participation rate in PR has been observed in patients with acute exacerbations of COPD.³¹ In the current study, the application of Line-based MDT significantly increased the rates of bronchodilator and steroid use during COPD exacerbation, which are often necessary in these situations. Additionally, there has been an increase in the use of non-pharmacological treatments such as PR.

The integration of mobile apps or devices in chronic lung disease management is expanding.^{32–36} A randomized trial (RCT) using myCOPD app in patients with COPD showed improvements in CAT scores and inhaler technique, along with trends toward fewer exacerbations and lower readmission risk.³² Another RCT in Germany and Switzerland found that app users with higher adherence had greater exercise capacity gains.³³ Additionally, a study using the MyTatva app's algorithm demonstrated significant improvements in FEV1, body weight, and six-minute walk test performance.³⁴ A real-world study showed that physical activity, tracked via a wearable device, was inversely associated with CAT scores and acute exacerbations.³⁵ A systematic review suggests that wearable interventions significantly improve daily step count and exercise capacity, with the greatest benefits from multi-component interventions combining wearable technology with health coaching or pulmonary rehabilitation.³⁶ Furthermore, previous studies suggested mobile apps beneficial for asthma management³⁷ in both patients and healthcare professionals.³⁷ These studies underscore the growing potential of mobile apps in improving the management of chronic respiratory diseases. In the context of communication tools, the integration of the LINE app within a MDT for COPD management holds significant potential, as demonstrated by our current study. The use of LINE in this study facilitated real-time communication and coordination among healthcare professionals, leading to higher intervention rates, optimized pharmacological treatment, and enhanced non-pharmacological care.

Limitations of This Study

This study had several limitations. This study was conducted at a single center, which may limit the generalizability of the results to broader clinical settings and diverse patient populations. Moreover, the potential impact of the COVID-19 pandemic on the before-and-after results was not fully accounted in this study. The pandemic significantly disrupted healthcare delivery, leading to changes in patient care practices, treatment protocols, and follow-up schedules, which could have influenced both the management and outcomes of COPD patients.³⁸ The additional strain on healthcare

systems, reduced patient access to rehabilitation programs, and delays in elective procedures may have affected the clinical results.³⁸ Furthermore, there was a relatively large number of patients who received the intervention compared to those who did not, which may have introduced selection bias. These factors could have influenced the outcomes and may not have been fully controlled for by the statistics. Despite these limitations, this real-world analysis provides valuable insights into the clinical benefits of a LINE-based MDT approach for managing COPD.

Conclusions

The management of COPD is complex and necessitates a comprehensive approach that integrates both pharmacological and non-pharmacological interventions. The LINE-based MDT, comprising physicians, nurse practitioners, nurses, respiratory therapists, social workers, dietitians, physiotherapists, disease managers, and smoking cessation managers, facilitates a holistic care plan. This study demonstrates that the LINE-based MDT significantly improved adherence to standard pharmacological treatments, including steroids, LABA, LAMA, and PR. Furthermore, the MDT group exhibited notable improvements in BSRS scores. The use of the LINE app also contributed to improved discharge processes and more effective medication management, highlighting its potential in enhancing clinical outcomes. These findings suggest that the LINE-based MDT model has potential to optimize COPD management by improving coordination, communication, and patient care, ultimately fostering better clinical outcomes.

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Disclosure

The authors declare no conflicts of interest in this work.

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