

# Pharmacist-Driven Outcomes in Asthma and COPD: A Meta-Analysis of Clinical Outcomes and Medication Adherence

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**Purpose:** This meta-analysis aimed to evaluate the effectiveness of pharmaceutical care in managing asthma and chronic obstructive pulmonary disease (COPD), focusing on clinical outcomes, medication adherence, and quality of life.

**Patients and Methods:** Randomized controlled trials comparing asthma or COPD patients who received pharmaceutical care intervention on the basis of the original treatment and the control group who only received the original treatment were included. The main results include Asthma Control Test (ACT); COPD Assessment Test (CAT); modified Medical Research Council (mMRC) dyspnea scale. Secondary outcomes were medication adherence; correct rate of inhaler technique; emergency room visit; hospitalization; Asthma Quality of Life Questionnaire (AQLQ); Peak Expiratory Flow Rate (PEFR, L/min). All analyses used a random - effects model.

**Results:** A total of 18 randomized controlled trials involving 4173 patients were included. The results showed that in the pharmaceutical care group, the mean correct inhalation technique rate (OR = 6.53, 95% CI: [3.19, 13.37],  $P < 0.001$ ), medication adherence (OR = 1.45, 95% CI: [1.03, 2.03],  $P = 0.031$ ), and the number of patients with better asthma control as indicated by ACT results (OR = 2.51, 95% CI: [2.51, 4.35],  $P < 0.01$ ) were significantly better than those in the control group. The emergency room visit rate (OR = 0.44, 95% CI: [0.29, 0.67],  $P < 0.001$ ) and hospital admissions rate (OR = 0.27, 95% CI: [0.19, 0.39],  $P < 0.001$ ) were significantly lower. The PEFR of patients was better (SMD = 0.37, 95% CI: [0.09, 0.6],  $P < 0.01$ ). However, no significant changes were observed in CAT, AQLQ, or mMRC.

**Conclusion:** Pharmacists' interventions exert a positive effect on asthma and COPD management outcomes, though improved research design and quality are still needed.

**Keywords:** asthma, COPD, meta-analysis, pharmaceutical care

## Introduction

Asthma and chronic obstructive pulmonary disease (COPD) are major chronic respiratory diseases with substantial global burden. Asthma affects about 250 million globally, is common in children, and can persist into adulthood, and by 2050 the projected incidence is about 520 per 100,000 people.<sup>1-3</sup> Among the modifiable exposures linked to asthma development and poorer control, tobacco smoke and excess adiposity are consistently reported and are amenable to pharmacist delivered preventive and behavioral interventions.<sup>4</sup> COPD affects more than 400 million people, remains the third leading cause of death worldwide.<sup>5</sup> Its main pathogenic factors include smoking, household air pollution, occupational particulate matter, and secondhand smoke. The global burden attributable to these factors continues to rise and is expected to affect 600 million people globally by 2050.<sup>6</sup> Management is challenging because of heterogeneous phenotypes and variable treatment responses.<sup>7-9</sup> Contemporary work spans disease pathogenesis and prevention,

phenotype and precision approaches, nonpharmacological strategies such as pulmonary rehabilitation, and care models that include pharmacist led education, adherence support, and inhaler technique training.<sup>1,2,7</sup>

Pharmaceutical care has been shown to improve clinical outcomes in a variety of chronic diseases, such as diabetes, cardiovascular conditions, and respiratory diseases.<sup>10</sup> The provision of pharmaceutical care by pharmacists helps to improve patient treatment adherence, rational drug use, reduce adverse drug reactions, enhance quality of life, and decrease medical disputes.<sup>11–13</sup> In particular, pharmacists have demonstrated significant success in managing blood pressure, lipid profiles, and disease control in asthma and COPD.<sup>14</sup> This study aims to fill a gap in the literature by systematically collecting relevant studies on the role of pharmacists in the management of asthma and COPD. By synthesizing evidence across both conditions, this review is the first meta-analysis to combine asthma and COPD outcomes. It not only underscores the impact of pharmacist-driven care in improving outcomes but also provides a unique perspective on the cross-disease applications of these interventions. The objectives of this study are to evaluate the effectiveness of pharmacist-driven interventions on clinical outcomes, medication adherence, and quality of life in asthma and COPD management, with the aim of providing a reference for clinical pharmacists to enhance their participation in patient care and inform strategies for more extensive incorporation of pharmacists in clinical diagnosis and treatment protocols for both diseases.

## Methods

### Protocols and Registration

Drafted on the basis of a preset protocol registered with PROSPERO 2025 (CRD420250649500). This study is based on the Preferred Reporting Items for Systematic Reviews and Meta - Analyses (PRISMA) statement.<sup>15</sup>

### Study Selection

The methods of this meta-analysis are as follows: We included randomized controlled trials (RCTs) published internationally. The study subjects were patients clinically diagnosed with asthma or COPD. For intervention measures, the control group received routine treatment, while the intervention group received pharmaceutical care based on routine treatment, which included but was not limited to education on asthma and COPD knowledge, drug-related knowledge, the significance of compliance, oral instruction and demonstration of inhaler techniques, self-monitoring and assessment of diseases, and setting of disease control goals. The outcome indicators mainly covered medication adherence, correct rate of inhaler technique, emergency room visit rate, hospitalization rate, Asthma Control Test (ACT), Peak Expiratory Flow Rate (PEFR, L/min), COPD Assessment Test (CAT), modified Medical Research Council (mMRC) dyspnea scale, and Asthma Quality of Life Questionnaire (AQLQ), etc. (Table 1) The exclusion criteria were as follows: articles with duplicate reports, and articles whose original texts were neither in Chinese nor in English.

### Data Sources and Search Strategies

Computer-based searches were conducted in the following databases: PubMed, CENTRAL (the Cochrane Central Register of Controlled Trials), Web of Science, and Embase. English search terms: “asthma”, “Pharmaceutical Services”, “Pulmonary Disease, Chronic Obstructive”. Articles in languages other than English or Chinese were excluded from the review process. All titles and abstracts retrieved through electronic searches were downloaded into EndNote. After removing duplicates, researchers screened according to the inclusion and exclusion criteria to determine whether the literature should be included, and finally extracted valid data. The extracted information included basic literature information (such as publication time, authors, etc), basic characteristics of the study subjects (such as gender, age, disease status, etc), and outcome indicators (such as patients’ drug compliance, mMRC assessment, etc).

### Statistical Analysis and Quality Assessment

Meta - analysis was performed using Stata 15 software. For binary variable data, the odds ratio (OR) and 95% confidence interval (CI) were used as the effect size, and for continuous variable data, the standardized mean difference (SMD) and 95% CI were used as the effect size. All analyses used a random - effects model. The statistical heterogeneity among

**Table 1** The Outcome Changes of 18 Included Studies

| Authors                           | Years | Mean Correct Inhalation Technique | Medication Adherence | Emergency Room Visits | Hospital Admissions | ACT $\geq$ 20 | mMRC    | PEFR                                   | ACT                                | CAT                               | AQLQ                            |
|-----------------------------------|-------|-----------------------------------|----------------------|-----------------------|---------------------|---------------|---------|----------------------------------------|------------------------------------|-----------------------------------|---------------------------------|
| Almomani, B. A. <sup>16</sup>     | 2016  | NR                                | 35/27                | 21/38                 | 10/34               | 68/37         | NR      | NR                                     | NR                                 | NR                                | NR                              |
| Armour, C. <sup>17</sup>          | 2007  | NR                                | 74/82                | NR                    | NR                  | NR            | NR      | NR                                     | NR                                 | NR                                | NR                              |
| Cordina, M. <sup>18</sup>         | 2001  | NR                                | NR                   | NR                    | 0/8                 | NR            | NR      | NR                                     | NR                                 | NR                                | NR                              |
| Garcia-Cardenas, V. <sup>19</sup> | 2013  | 141/75                            | 113/80               | NR                    | NR                  | NR            | NR      | NR                                     | NR                                 | NR                                | NR                              |
| Jarab, A. S. <sup>20</sup>        | 2012  | NR                                | 45/33                | 10/11                 | 3/10                | NR            | NR      | NR                                     | NR                                 | NR                                | NR                              |
| Khdour, M. R. <sup>21</sup>       | 2019  | 80/29                             | 16/5                 | 29/58                 | 15/36               | 39/10         | NR      | NR                                     | NR                                 | NR                                | NR                              |
| Khdour, M. R. <sup>22</sup>       | 2009  | NR                                | 55/43                | 25/40                 | 18/32               | NR            | NR      | NR                                     | NR                                 | NR                                | NR                              |
| Manfrin, A. <sup>23</sup>         | 2017  | NR                                | NR                   | NR                    | NR                  | 195/163       | NR      | NR                                     | NR                                 | NR                                | NR                              |
| McLean, W. <sup>24</sup>          | 2003  | NR                                | NR                   | 5/22                  | 9/17                | NR            | NR      | NR                                     | NR                                 | NR                                | NR                              |
| Mehuys, E. <sup>25</sup>          | 2008  | NR                                | NR                   | 1/5                   | NR                  | 54/42         | NR      | NR                                     | 20.20 $\pm$ 3.50/19.70 $\pm$ 4.80  | NR                                | 6.00 $\pm$ 0.70/5.80 $\pm$ 0.90 |
| Nguyen, T. <sup>26</sup>          | 2024  | 90/77                             | NR                   | NR                    | NR                  | NR            | 46/65   | NR                                     | NR                                 | NR                                | NR                              |
| Petkova, V. B. <sup>27</sup>      | 2008  | NR                                | NR                   | NR                    | 4/22                | NR            | NR      | 338.64 $\pm$ 12.55/333.57 $\pm$ 14.00  | NR                                 | NR                                | NR                              |
| Rodrigues, A. T. <sup>28</sup>    | 2021  | 40/16                             | NR                   | 4/8                   | NR                  | NR            | 12/10   | NR                                     | 20.97 $\pm$ 3.75/20.07 $\pm$ 3.80  | 14.54 $\pm$ 9.34/17.03 $\pm$ 8.58 | NR                              |
| Shdaifat, M. B. M. <sup>29</sup>  | 2021  | NR                                | NR                   | 16/26                 | NR                  | 28/17         | NR      | NR                                     | 19.79 $\pm$ 1.704/18.86 $\pm$ 1.66 | NR                                | 4.45 $\pm$ 0.35/3.76 $\pm$ 0.62 |
| Smith, L. <sup>30</sup>           | 2007  | NR                                | NR                   | NR                    | NR                  | NR            | NR      | NR                                     | NR                                 | NR                                | 1.70 $\pm$ 0.55/1.90 $\pm$ 0.83 |
| Tommelein, E. <sup>31</sup>       | 2013  | NR                                | NR                   | 18/15                 | 9/35                | NR            | 130/124 | NR                                     | NR                                 | 15.90 $\pm$ 7.80/15.90 $\pm$ 7.70 | NR                              |
| Wong, L. Y. <sup>32</sup>         | 2017  | 69/20                             | NR                   | NR                    | NR                  | NR            | NR      | 305.00 $\pm$ 102.80/270.45 $\pm$ 86.30 | 22.05 $\pm$ 2.60/17.39 $\pm$ 3.50  | NR                                | NR                              |
| Yadav, A. <sup>33</sup>           | 2019  | NR                                | NR                   | NR                    | NR                  | NR            | NR      | NR                                     | NR                                 | NR                                | 5.64 $\pm$ 0.31/5.41 $\pm$ 0.40 |

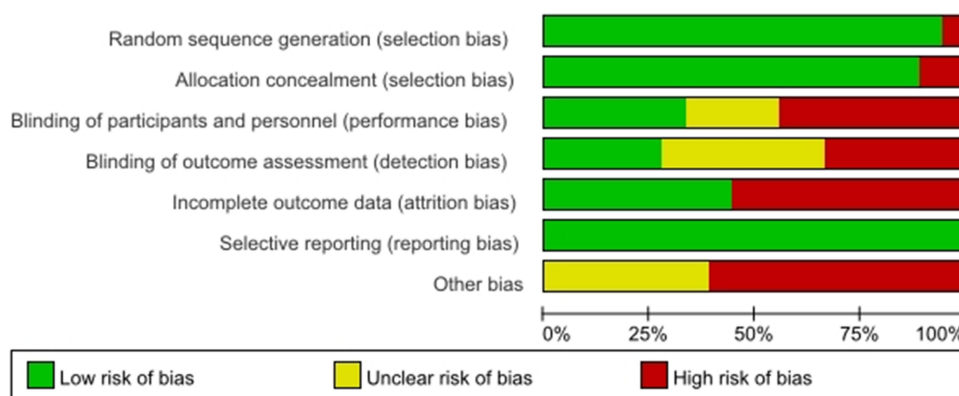
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**Table I** (Continued).

| Authors                           | Year | Country          | Sample size (IG/CG) | Mean Age (IG/CG)        | Disease | Time    | Intervention                                                                                                                                                                                                                                                     |
|-----------------------------------|------|------------------|---------------------|-------------------------|---------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Almomani, B. A. <sup>16</sup>     | 2016 | Jordan           | 101/105             | 9.00/10.00              | Asthma  | 6month  | Educate the patients and their parents about: 1. Asthma symptoms, drugs, and triggers 2. Asthma self-management. 3. The importance of adherence to asthma medication 4. Proper use of the inhalation devices                                                     |
| Armour, C. <sup>17</sup>          | 2007 | Australia        | 165/186             | 49.30/50.90             | Asthma  | 6month  | The PACP included targeted counselling and education on the condition, medication and lifestyle issues; review of inhaler technique; adherence assessment; detection of drug-related problems; goal setting and review, etc.                                     |
| Cordina, M. <sup>18</sup>         | 2001 | Malta            | 64/55               | 41.30±18.35/45.88±18.11 | Asthma  | 12month | The pharmaceutical care interventions implemented by intervention pharmacies focused on two issues: patient education and patient monitoring.                                                                                                                    |
| Garcia-Cardenas, V. <sup>19</sup> | 2013 | Spain            | 186/150             | 54.30±19.10/57.80±19.00 | Asthma  | 6month  | Patients were educated using verbal instructions, physical demonstration and written information about turbuhaler use.                                                                                                                                           |
| Jarab, A. S. <sup>20</sup>        | 2012 | Jordan           | 63/64               | 61.00±14.00/64.00±15.00 | COPD    | 6month  | Clinical pharmacists provided structured education on COPD and symptom management to intervention patients in outpatient clinic consultation rooms.                                                                                                              |
| Khdour, M. R. <sup>21</sup>       | 2019 | Palestine        | 102/98              | >18.00                  | Asthma  | 12month | Asthma knowledge, control, adherence to treatment and inhalation techniques                                                                                                                                                                                      |
| Khdour, M. R. <sup>22</sup>       | 2009 | Northern Ireland | 71/72               | 65.63±10.10/67.30±9.20  | Asthma  | 12month | Education on disease state, medications and breathing techniques. Patients were given booklets and a customized action plan.                                                                                                                                     |
| Manfrin, A. <sup>23</sup>         | 2017 | Italy            | 400/416             | NR                      | Asthma  | 9month  | Consultation with a pharmacist, covering asthma symptoms, medicines used, attitude towards medicines and adherence                                                                                                                                               |
| McLean, W. <sup>24</sup>          | 2003 | British          | 119/105             | 48.00                   | Asthma  | 12month | UC involved an initial interview with the patient to complete a symptom, drug utilization and knowledge assessment. The patient was also taught proper inhaler technique, and the pharmacist answered any questions the patient had about asthma or the project. |

**Note:** The table shows the outcome changes of the 18 included studies.

**Abbreviations:** ACT, asthma control test; mMRC, modified Medical Research Council; PEF, Peak expiratory flow rate; CAT, COPD (Chronic obstructive pulmonary disease) assessment test; AQLQ, Asthma quality of life questionnaire; NR, No reference; IG, Interference group; CG, Control group; PACP, Pharmacy asthma care program; COPD, Chronic obstructive pulmonary disease; UC, Usual care.



**Figure 1** Quality assessment. The quality assessment of the included studies by the Cochrane Risk.

studies was judged by forest plots and the  $I^2$  statistic. Once statistical heterogeneity ( $I^2 \geq 50\%$ ) was detected, the potential sources of heterogeneity were analyzed by a one-by-one exclusion method for sensitivity analysis of the combined results. The funnel plot was used to evaluate the degree of publication bias.

The quality assessment was independently conducted by two authors using the Cochrane Risk-of-Bias tool for the following aspects: random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective outcome reporting, and “other biases”. Studies were classified as having a “low risk”, “high risk”, or “unclear risk” of bias (Figure 1).

## Results

### Literature Search Results

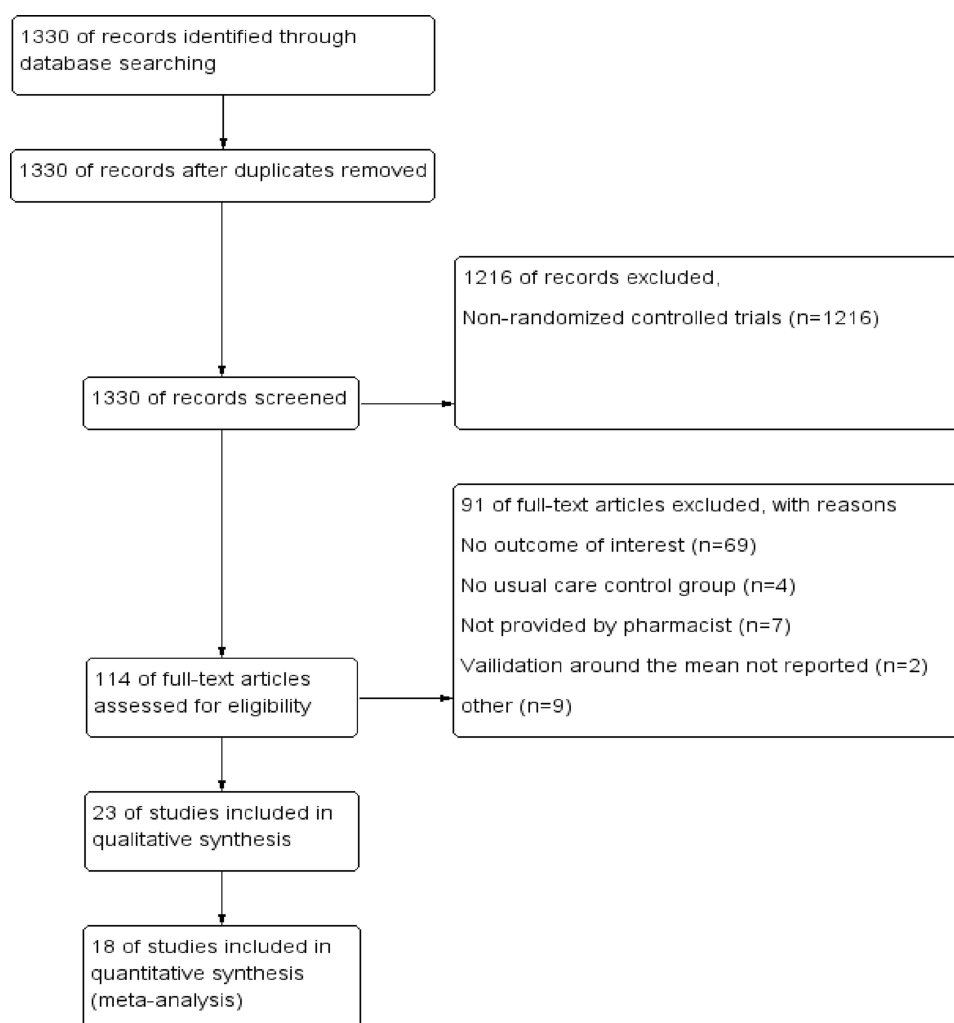
Published literature was searched in various databases. According to the inclusion and exclusion criteria, after removing duplicates and preliminary screening, 109 articles were re-screened based on the screened titles and abstracts, with non-English or non-Chinese articles excluded from the review process. After full-text review, a total of 91 articles were excluded, and 18 RCT studies met the inclusion criteria of this review.<sup>16–33</sup> The literature screening process is shown in the figure (Figure 2).

### Characteristics of the Included Studies

A total of 4173 patients were included, with an average age ranging from 7 to 69 years. The 18 included studies were all randomized controlled clinical trials.<sup>16–33</sup> Most of the studies were conducted in Western countries, and some also involved resource-scarce Asian countries, such as Jordan, Malaysia, and Nepal. Most of the places where pharmaceutical care was provided were community pharmacies and hospitals, and one study was a remote intervention.<sup>29</sup> The providers were all clinical pharmacists or pharmacists with professional training. Some studies' intervention measures also included distributing educational brochures and setting individualized intervention goals. Most of the intervention durations were 3 months, 6 months, or 12 months. In addition to ACT, CAT, medication adherence, hospitalization rate, etc, the outcome indicators of some studies also included FEV1, St. George's Respiratory Questionnaire (SGRQ), and inhaler technique step-by-step operations. The basic characteristics of the included studies are shown in the table (Table 2).

### Mean Correct Inhalation Technique

A total of 5 studies were included, and binary variables were used to describe whether the inhalation method of patients with asthma and COPD was correct.<sup>19,21,26,28,32</sup> There were 1074 patients in total, with 561 in the experimental group and 513 in the control group. The results showed that the experimental group was better than the control group in the correct use of inhalers, and the difference was statistically significant (OR = 6.53, 95% CI: [3.19, 13.37],  $P < 0.001$ ;  $I^2 =$



**Figure 2** The flow diagram of the study inclusion process.

78.3%,  $P = 0.001$ ), as shown in the figure Sensitivity analysis was performed on the studies with significant heterogeneity ( $I^2 = 78.3\%$ ), and the results showed that this study was not affected by any single study alone (Figure 3).

### Medication Adherence

A total of 7 studies were included, and binary variables were used to describe the medication adherence of patients with asthma and COPD.<sup>16,17,19–22</sup> There were 2179 patients in total, with 1088 in the experimental group and 1091 in the control group. The results showed that the experimental group was better than the control group in medication adherence, and the difference was statistically significant (OR = 1.45, 95% CI: [1.03, 2.03],  $P = 0.031$ ;  $I^2 = 64.2\%$ ,  $P = 0.01$ ), as shown in the figure After sensitivity analysis, by excluding each study one by one, it was found that after removing Manfrin,<sup>23</sup> the heterogeneity decreased ( $I^2 = 41.4\%$ ,  $P = 0.131$ ; OR = 1.61, 95% CI: [1.17, 2.22]) (Figure 3).

### Emergency Room Visits

A total of 9 studies were included, and binary variables were used to describe whether patients with asthma and COPD received emergency treatment.<sup>16,20–22,24,25,28,29,31</sup> There were 1981 patients in total, with 1003 in the experimental group and 978 in the control group. The results showed that the experimental group had fewer emergency room visits than the control group, and the difference was statistically significant (OR = 0.44, 95% CI: [0.29, 0.67],  $P < 0.001$ ;  $I^2 = 53.0\%$ ,  $P = 0.03$ ), as shown in the figure Sensitivity analysis was performed on the studies with significant heterogeneity ( $I^2 = 53.0\%$ ), and the results showed that this study was not affected by any single study alone (Figure 3).

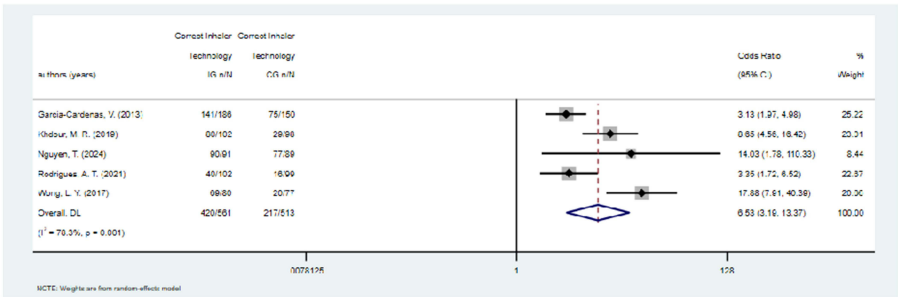
**Table 2** Characteristics of the 18 Included Studies

| Authors                          | Year | Country    | Sample Size (IG CG) | Mean Age (IG/CG)        | Disease | Time   | Intervention                                                                                                                                                                                                                                                                                                  |
|----------------------------------|------|------------|---------------------|-------------------------|---------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Mehuys, E. <sup>25</sup>         | 2008 | Belgium    | 80/70               | 35.20/36.30             | Asthma  | 6month | A training session about asthma (pathophysiology), its nonpharmacological and pharmacological treatment (GINA guidelines) and about the use of the study protocol.                                                                                                                                            |
| Nguyen, T. <sup>26</sup>         | 2024 | Viet Nam   | 91/89               | 65.20±9.50/66.6±7.00    | COPD    | 1month | In addition to usual care, the IG received clinical pharmacist-led interventions to provide oral and written information. Then, the IG distributed the information leaflet describing COPD symptoms, medication, and inhaler techniques to reinforce the knowledge at home.                                   |
| Petkova, V. B. <sup>27</sup>     | 2008 | Bulgaria   | 22/28               | 35.14±17.40/40.82±17.70 | Asthma  | 4month | The educational program included information about asthma, instruction on the appropriate use of medication, training in the inhaler technique, adverse drug reactions during treatment, recognition of early signs of exacerbation, information about the identification and control of asthma attacks, etc. |
| Rodrigues, A. T. <sup>28</sup>   | 2021 | Portugal   | 102/99              | 62.82±15.29/61.48±17.03 | COPD    | 6month | The intervention consisted of a structured, pharmacist-led educational program, providing oral and written information to asthma and COPD patients.                                                                                                                                                           |
| Shdaifat, M. B. M. <sup>29</sup> | 2021 | Jordan     | 42/42               | 7.18±1.78/7.82±2.21     | Asthma  | 12week | Participants in the intervention group were educated through synchronized video call sessions via smart devices with active Internet connections.                                                                                                                                                             |
| Smith, L. <sup>30</sup>          | 2007 | Australian | 35/56               | 51.42±18.38/54.40±20.13 | Asthma  | 9month | The Workbook also contained information regarding asthma physiology and treatment, symptom control and trigger avoidance, and was written in lay language.                                                                                                                                                    |
| Tommelein, E. <sup>31</sup>      | 2013 | England    | 346/346             | 68.40±9.70/68.90±9.60   | COPD    | 3month | To support interventions, pharmacists were provided with information leaflets on COPD, demonstration inhaler units and a list of practical solutions to specific nonadherent behaviour medication.                                                                                                            |
| Wong, L. Y. <sup>32</sup>        | 2017 | Malaysia   | 80/77               | 54.70±14.70/55.70±11.60 | Asthma  | 6month | Structured asthma education covering signs/symptoms; Counseling with hands-on demonstrations of correct inhaler technique; Medication counseling including administration methods, potential side effects, and precautions; etc.                                                                              |
| Yadav, A. <sup>33</sup>          | 2019 | Nepal      | 25/21               | NR                      | Asthma  | 1month | They were counselled by the pharmacist about the asthma management and proper use of inhalers.                                                                                                                                                                                                                |

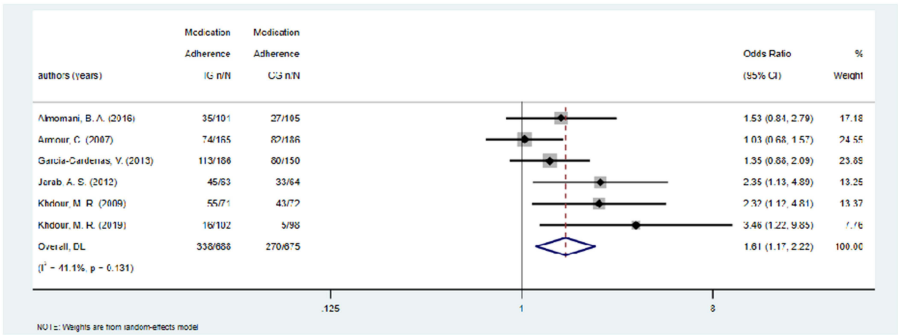
**Note:** The table shows the characteristics of the 18 included studies.

**Abbreviations:** IG, Interference group; CG, Control group; COPD, Chronic obstructive pulmonary disease; NR, No reference.

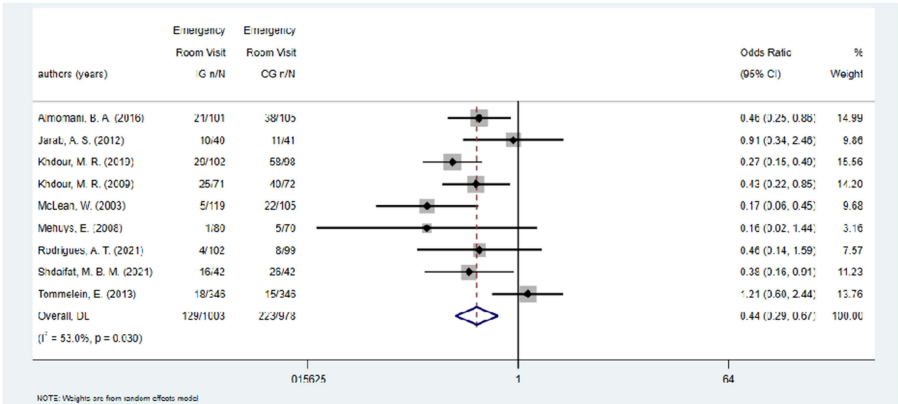
(A)Mean correct inhalation technique



(B)Medication adherence



(C)Emergency room visits



(D)Hospital admissions

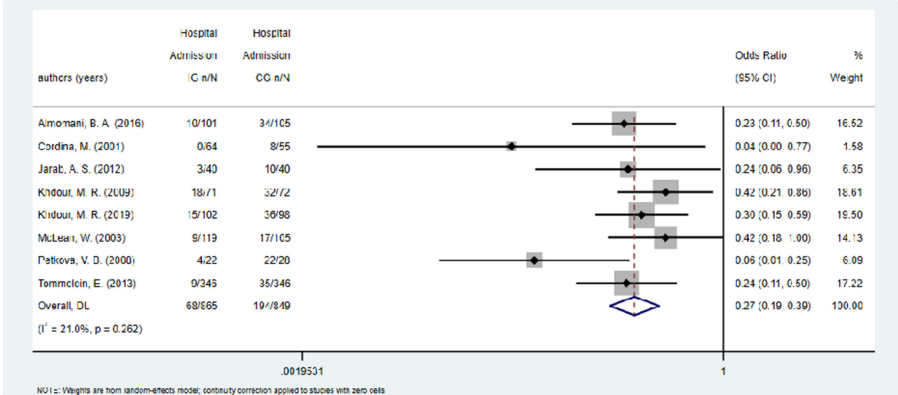


Figure 3 Forest plots of (A) Mean correct inhalation technique, (B) Medication adherence, (C) Emergency room visits, (D) Hospital admissions.

## Hospital Admissions

A total of 8 studies were included, and binary variables were used to describe whether patients with asthma and COPD received hospitalization.<sup>16,18,20–22,24,27,31</sup> There were 1714 patients in total, with 865 in the experimental group and 849 in the control group. The results showed that the experimental group had fewer hospital admissions than the control group, and the difference was statistically significant (OR = 0.27, 95% CI: [0.19, 0.39],  $P < 0.001$ ;  $I^2 = 21.0\%$ ,  $P = 0.262$ ), as shown in the figure (Figure 3).

## Peak Expiratory Flow Rate (PEFR, L/Min)

A total of 2 studies were included, and continuous variables were used to describe the peak expiratory flow rate of patients with asthma and COPD.<sup>27,32</sup> There were 207 data in total, with 102 in the experimental group and 105 in the control group. The results showed that the PEFR of patients with asthma and COPD in the pharmaceutical care group was better than that in the control group, and the difference was statistically significant (OR = 0.37, 95% CI: [0.09, 0.6],  $P < 0.01$ ;  $I^2 = 0.0\%$ ,  $P = 0.963$ ), as shown in the figure (Figure 4).

## Asthma Control Test (ACT)

Five studies used binary variables to describe the Asthma control test (ACT) scores of patients with asthma and COPD.<sup>16,21,23,25,29</sup> There were 1456 data in total, with 725 in the experimental group and 731 in the control group. The results showed that the number of patients with better asthma control as indicated by the ACT results in the pharmaceutical care group was greater than that in the control group, and the difference was statistically significant (OR = 2.51, 95% CI: [2.51, 4.35],  $P < 0.01$ ;  $I^2 = 77.3\%$ ,  $P = 0.001$ ), as shown in the figure (Figure 4).

Four studies used continuous variables to describe the Asthma control test (ACT) scores of patients with asthma and COPD.<sup>25,28,29,32</sup> There were 592 data in total. The results showed that the asthma control effect as indicated by the ACT results in the pharmaceutical care group was better than that in the control group, and the difference was statistically significant (OR = 0.60, 95% CI: [- 0.02, 1.22],  $P < 0.01$ ;  $I^2 = 92.5\%$ ,  $P < 0.01$ ), as shown in the figure. Sensitivity analysis was performed on the studies with significant heterogeneity ( $I^2 = 92.5\%$ ), and the results showed that this study was not affected by any single study alone (Figure 4).

## COPD Assessment Test (CAT)

A total of 2 studies were included, and continuous variables were used to describe the CAT scores of patients with asthma and COPD.<sup>28,31</sup> There were 893 data in total. The results showed that the condition of COPD patients as indicated by the CAT results in the pharmaceutical care group was better than that in the control group, but the difference was not statistically significant (OR = - 0.11, 95% CI: [- 0.38, 0.15],  $P = 0.407$ ;  $I^2 = 66.4\%$ ,  $P = 0.085$ ), as shown in the figure (Figure 5).

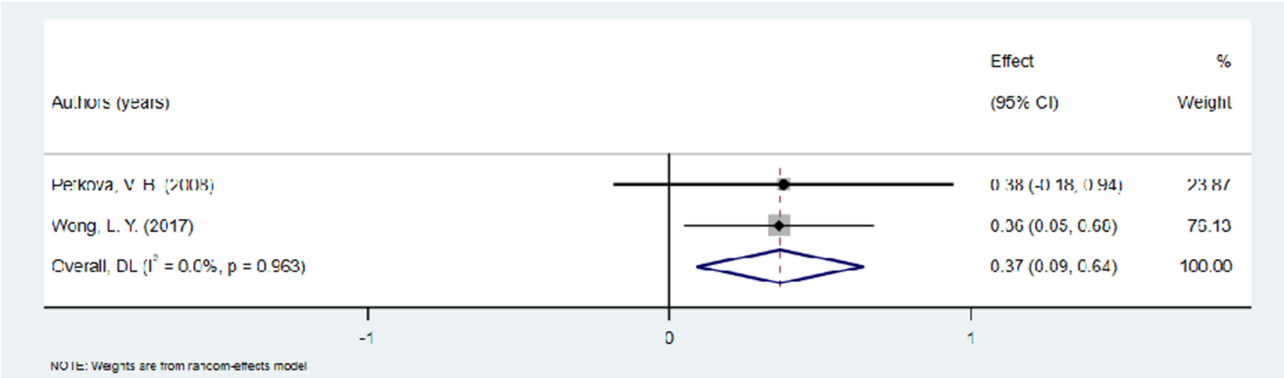
## Modified Medical Research Council (mMRC)

Three studies were included, and continuous variables were used to describe the mMRC scores of patients with asthma and COPD.<sup>26,28,31</sup> The results showed that the degree of dyspnea as indicated by the mMRC results in the pharmaceutical care group was better than that in the control group, but the difference was not statistically significant (OR = 0.78, 95% CI: [0.38, 1.60],  $P = 0.501$ ;  $I^2 = 78.1\%$ ,  $P = 0.010$ ), as shown in the figure. Sensitivity analysis was performed on the studies with significant heterogeneity ( $I^2 = 78.1\%$ ), and the results showed that this study was not affected by any single study alone (Figure 5).

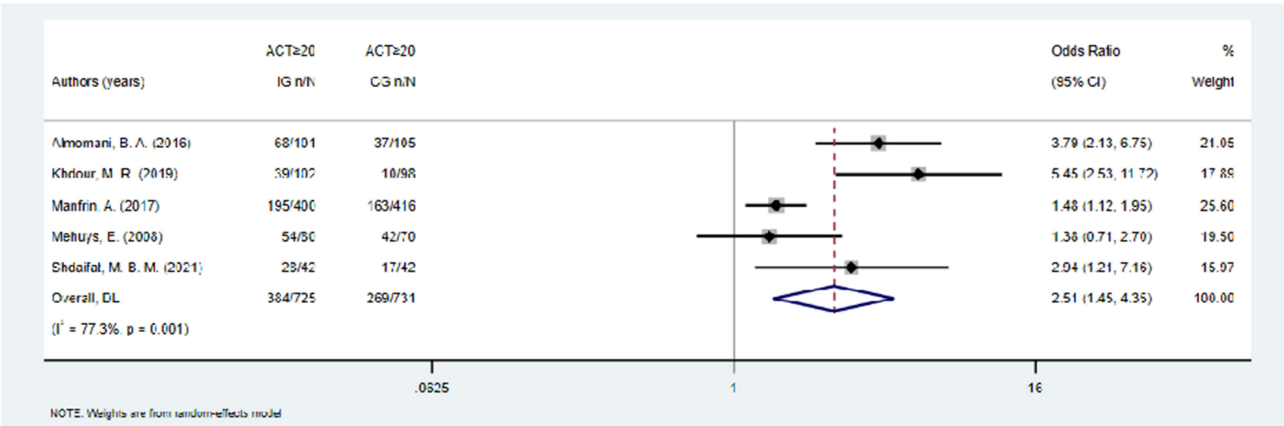
## Asthma Quality of Life Questionnaire (AQLQ)

A total of 4 studies were included, and continuous variables were used to describe the AQLQ scores of patients with asthma and COPD.<sup>25,29,30,33</sup> There were 371 data in total. The results showed that the impact of the disease on the quality of life of patients as indicated by the AQLQ results in the pharmaceutical care group was better than that in the control group, but the difference was not statistically significant (OR = 0.49, 95% CI: [- 0.17, 1.15],  $P = 0.148$ ;  $I^2 = 88.9\%$ ,  $P < 0.001$ ), as shown in the figure. Sensitivity analysis was performed on the studies with significant heterogeneity ( $I^2 = 88.9\%$ ), and the results showed that this study was not affected by any single study alone (Figure 5).

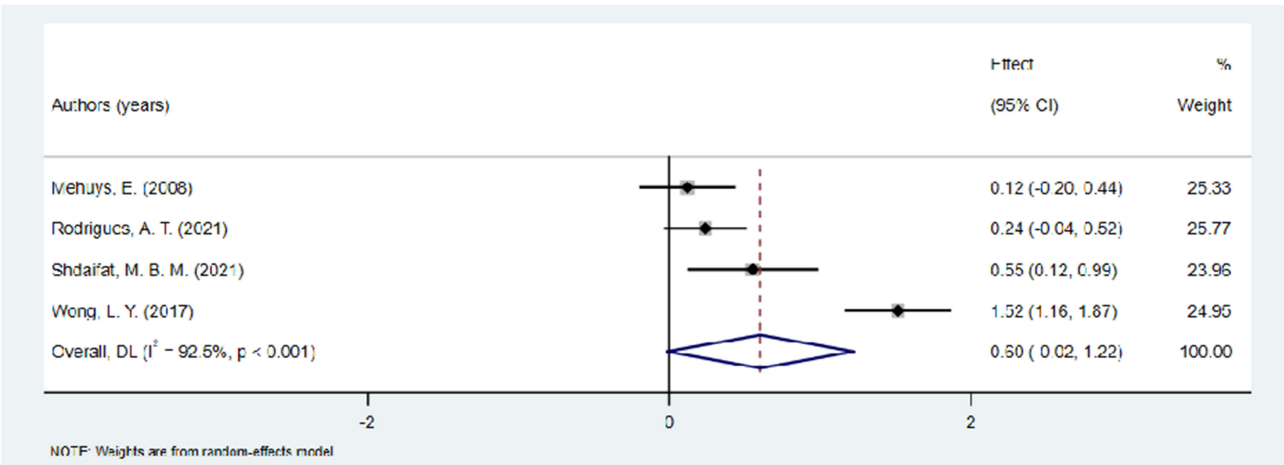
(A)PEFR



(B)i.Asthma control test(dichotomy)



(B)ii.Asthma control test(continuity)

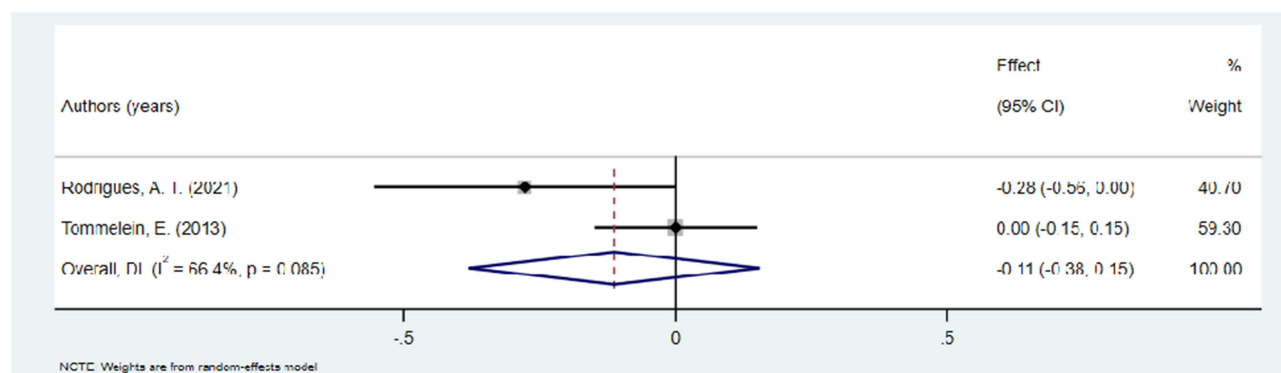


**Figure 4** Forest plots of (A) PEFR, (B)i. Asthma control test (dichotomy), (B)ii. Asthma control test (continuity).

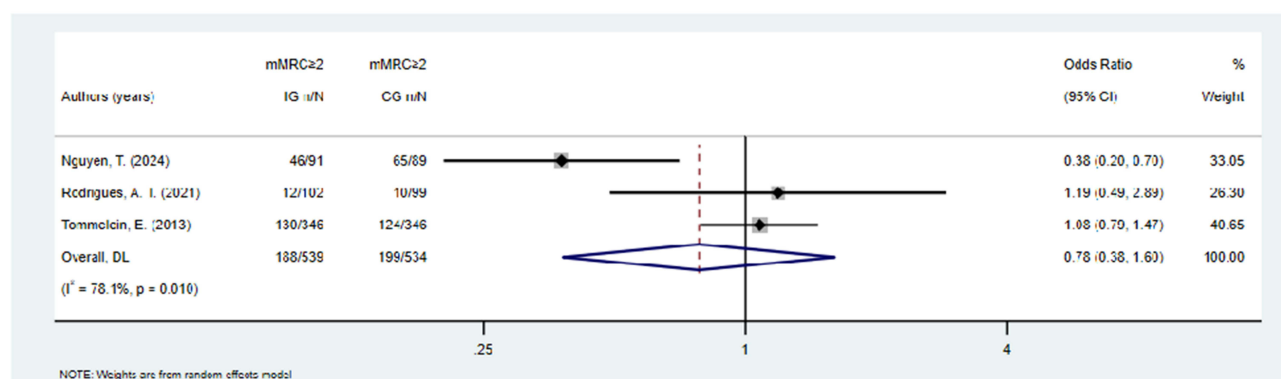
# Discussion

This study aimed to evaluate the effectiveness of pharmacist-led interventions in improving inhaler technique, medication adherence, disease control, and quality of life in asthma and COPD patients. The results demonstrate significant improvements in inhaler technique and medication adherence, as well as reductions in emergency room visits and hospitalizations. These findings highlight the positive impact of pharmacist-led care in improving key aspects of disease

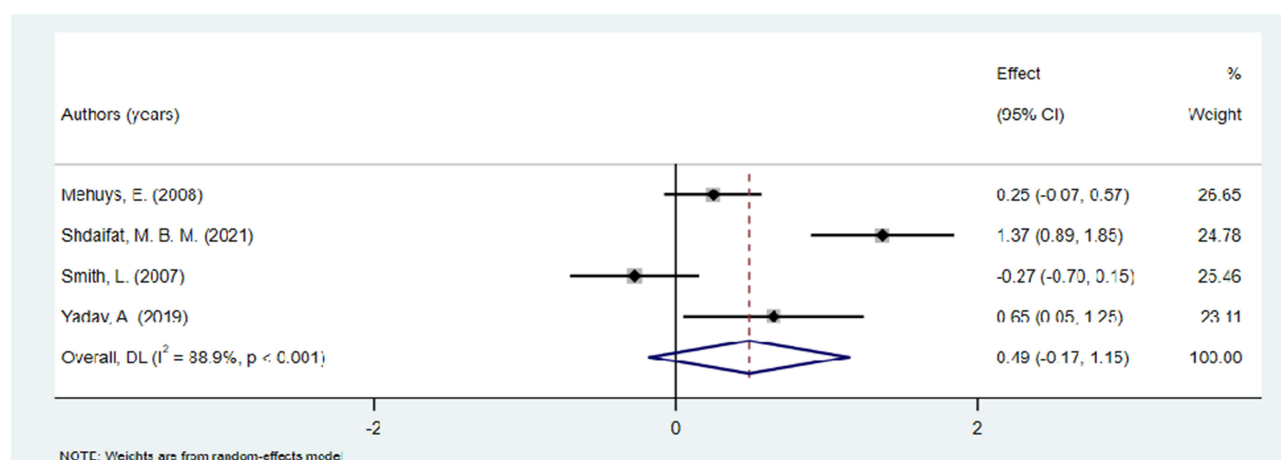
## (A) COPD assessment test



## (B) modified Medical Research Council



## (C) Asthma quality of life questionnaire



**Figure 5** Forest plots of (A) COPD Assessment test, (B) modified Medical Research Council, (C) Asthma quality of life questionnaire.

management. However, non-significant improvements in CAT, mMRC scale, and AQLQ suggest that further investigation is needed to fully understand the impact on quality of life and symptom control.

The results demonstrate that the pharmaceutical care group exhibited superior inhaler technique and medication adherence compared to the control group. This suggests that targeted education on inhaler use demonstration and foundational knowledge about anti-asthmatic medications significantly enhanced patients' ability to properly use inhalers and reinforced their understanding of correct medication administration, thereby improving disease control. These conclusions are consistent with the research results of Iman Hesso. et al,<sup>34</sup> that is, community pharmacists have a positive impact on inhaler techniques and medication adherence in patients with COPD. These findings align with

the systematic review by Xiaona Jia et al, which indicated that pharmacist-led interventions based on the Information-Motivation-Behavioral skills (IMB) model effectively improved medication adherence and inhaler techniques in asthma/COPD patients.<sup>35</sup> The high heterogeneity observed across studies may relate to variations in patient education levels, medication types, and inhaler devices. Cordina M et al identified that health education on inhaler use is of significant value, but as medication adherence data in the included studies were collected via patient self-reporting, this methodological feature may have led to no statistically significant difference in medication adherence between the intervention group and the control group.<sup>18</sup> Yadav A et al demonstrated that both dry powder inhaler and metered-dose inhaler techniques were significantly improved after the intervention, and analyzed that the possible reason why patients could not correctly complete the inhalation technique might be insufficient inhalation or exhalation before and after using the inhaler.<sup>33</sup> Notably, heterogeneity in medication adherence studies decreased after excluding Manfrin et al (2017), likely because this study used unvalidated two-item adherence assessments rather than standardized scales.<sup>23</sup> This highlights the need for unified measurement tools in future asthma/COPD adherence research.

The treatment goals of the Global Initiative for Chronic Obstructive Lung Disease (GOLD) Report not only include alleviating and reducing the impact of symptoms, but also lowering the risk of adverse health events that may affect patients in the future.<sup>8</sup> The pharmaceutical care group showed lower emergency visit and hospitalization rates than controls, indicating that effective pharmaceutical interventions significantly enhance symptom control and reduce acute exacerbations. Sensitivity analyses confirmed result stability, unaffected by individual studies. These findings partially align with Han Zhong et al, whose pharmacist interventions reduced hospitalization but not emergency visits in COPD patients, possibly due to heterogeneous intervention strategies and follow-up durations.<sup>12</sup>

For asthma patients, pharmaceutical care improved both PEFR and ACT scores, suggesting enhanced lung function and disease control. In COPD patients, improvements in CAT and mMRC scores indicated better disease management and reduced dyspnea. High heterogeneity may stem from subjective measurement scales or environmental influences. These outcomes corroborate Hossein Mahdavi et al's demonstration of community pharmacist interventions improving symptom control and overall health.<sup>13</sup> These conclusions are also consistent with the results of Guohua Lin et al's intervention for COPD patients in a hospital environment.<sup>36</sup> Under the guidance of the logical modeling framework, the role of hospital pharmacists in COPD management can be clearer. The substantial heterogeneity in ACT data may reflect variations in patient age, ACT versions used, and differences in asthma severity/duration across studies.

However, while the study highlights significant improvements in inhaler technique and medication adherence, we also observed non-significant improvements in CAT, mMRC scale, and AQLQ. These null results could be attributed to several factors. First, the CAT and mMRC scales may not fully capture the broader effects of pharmacist interventions on symptom control, particularly in patients with varying disease severities.<sup>37</sup> Additionally, AQLQ measures aspects of quality of life that might not be as responsive to short-term pharmaceutical interventions, especially when the intervention primarily focuses on improving adherence and inhaler technique.<sup>38,39</sup> Variations in study designs, patient populations, and follow-up durations may also contribute to inconsistent results.<sup>40,41</sup> Although the AQLQ results were not statistically significant, the intervention group demonstrated a trend toward improvement, consistent with Suthasinee Dokbua et al's findings that community pharmacist-led self-management support enhanced asthma control.<sup>11</sup> In the study by Bunchai Chongmelaxme et al, it was also indicated that telemedicine provided by medical personnel can control the condition of asthma patients and improve their quality of life, which offers some new intervention methods for pharmacists to provide pharmaceutical services.<sup>42</sup> The included studies employed six different measures to assess quality of life, with all self-management subgroups showing improvements. The high heterogeneity observed in these outcomes suggests that differences in intervention methods and patient characteristics could have influenced the findings, highlighting future studies will require more patient data and more rigorous, standardized measurement methods to evaluate and further support the findings.

This review is unique in its synthesis of outcomes across asthma and COPD populations, providing valuable insights into the role of pharmacists in managing both diseases. Despite the limited number of studies included, these findings contribute to the understanding of pharmacist-driven care, particularly in cross-disease interventions. The results highlight the potential for pharmacists to improve both medication adherence and disease management, but more research is needed to address heterogeneity and to clarify the overall impact of interventions on quality of life.

## Limitations

Several limitations should be acknowledged in this review. First, substantial heterogeneity across outcomes reflects variability in study designs, including differing inclusion/exclusion criteria, patient demographics, disease status, and prescribed treatments. Intervention strategies also varied significantly, with differences in treatment duration, inhaler types, and pharmacist training standards. Outcome measurements were inconsistent, with some studies using unsubstantiated tools for medication adherence assessments, which may have contributed to the observed heterogeneity. Additionally, smaller sample sizes in some studies may affect the reliability of the results. While random-effects models were used to account for heterogeneity, residual variability remains, and sensitivity analyses may not have fully identified all influencing factors. Furthermore, regional disparities in pharmaceutical care development, differences in how respiratory diseases are prioritized, and variations in pharmacists' expertise and service delivery across studies likely contributed to the heterogeneity of the findings. Future research should aim to standardize intervention approaches and incorporate diverse patient populations to improve the universality of the results.

## Conclusions

This study demonstrates that pharmacist-led interventions improve asthma and COPD management, particularly in medication adherence, inhaler technique, and quality of life. However, non-significant results in AQLQ, CAT, and mMRC suggest the need for further research. The high heterogeneity observed across studies, likely due to variations in study design and patient populations, highlights the importance of addressing these factors in future research. Future studies should focus on reducing heterogeneity, ensuring more robust study designs, and incorporating diverse populations to enhance the generalizability of findings. Overall, pharmacist-led interventions have significant potential to improve outcomes for asthma and COPD patients, providing a foundation for advancing pharmacist involvement in respiratory disease management.

## Data Sharing Statement

All relevant data are within the manuscripts.

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## Disclosure

The authors report no conflicts of interest in this work.

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