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The Effect of Nurse-Led Educational Intervention on the Use of Inhalers in COPD Patients — Multisystem Review and Semi-quantitative Analysis

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Abstract: *Purpose*: The aim was to synthesize quantitative and qualitative research that identified the most effective educational strategies for nurse-led inhaler technique (IT) education in Chronic Obstructive Pulmonary Disease (COPD) patients, as perceived by patients, healthcare providers, and nurses. *Methods*: A systematic literature search in Embase, PubMed, Cochrane Library, Web of Science, and CINAHL from 2018 to 30 June 2024 was conducted. In total, 327 articles were identified. The results of 14 studies that met the inclusion criteria were synthesized. Data were analyzed with descriptive and semi-quantitative methods to yield summarizing findings on the effectiveness of different educational strategies. All investigations had assessed patient adherence to IT. *Results*: Data indicated that nurse-led IT teaching strategies are effective in promoting IT adherence and correctness in COPD patients utilizing the personalized Teach-Back method. However, studies in disease control and comparison of patient IT satisfaction and self-efficacy need further investigation. *Conclusion*: The results of this study may contribute to the understanding of the most effective educational strategies in nurse-led IT education for COPD patients. The synthesized findings can be used for the development of new educational interventions and assessment instruments for IT adherence.

Keywords: COPD; Inhaler use; Educational; Management; GOLD guidelines

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1. Introduction

COPD defined as a progressive chronic disease characterized by airway obstruction and difficulty breathing, ranking as the third leading cause of death worldwide [1]. With an expected 23% increase in prevalence by 2050, COPD poses a significant burden on healthcare systems and patients' quality of life [2]. Inhalation therapy is a crucial component of COPD management, yet patients often use inhalers incorrectly, and adherence is low despite device improvements. Previous studies have identified factors contributing to low adherence and incorrect inhaler use, including educational background, age, lack of effective training, comorbidities, and socioeconomic status [3–6]. Guidelines recommend ongoing assessment and intervention to ensure effective inhaler use, emphasizing the role of nurses in COPD patient self-management. Nurse-led interventions aim to improve adherence through personalized support, education, and follow-up, which have shown to enhance quality of life and reduce disease exacerbations [7]. However, the effectiveness of different educational methods and strategies for inhaler use in COPD patients remains insufficiently understood. A systematic review is necessary to identify the most effective educational strategies, providing nurses with the latest evidence-based practices to improve inhaler use and patient outcomes. Thus, this study aimed to critically evaluate and compare diverse educational methodologies and instructional strategies that have been employed to augment the efficacy of inhaler therapy among COPD patients. The insights gleaned from this comprehensive review are anticipated to hold significant clinical utility, informing and enhancing future nurse-led educational initiatives aimed at optimizing inhaler therapy outcomes in the near future.

2. Methods

2.1. Review of the literature

A search strategy was implemented using a PICO model (stands for Problem, Intervention, Comparator, Outcomes) (**Table 1**). The main aim of this investigative research is to address the pivotal question: "What constitutes the most efficacious nurse-led instructional strategies within the sphere of inhaler utilization for COPD patients based on the available evidence?"

Table 1. PICO framework

PICO strategy	Meaning
P (Population)	Patients with Chronic Obstructive Pulmonary Disease (COPD)
I (Intervention)	Nurse-led instructional strategies for inhaler use
C (Comparator)	Other types of inhaler use instructions or standard care without specific guidance
O (Outcomes)	Efficacy of inhaler use, including but not limited to, correct usage skills, patient satisfaction, symptom control, and quality of life

2.2. Criteria of study

2.2.1. Inclusion criteria

This review prioritizes the inclusion of RCTs to obtain high-quality evidence. However, preliminary searches revealed limited RCT data relevant to the research question. To address this evidence gap and cover a broader range of modern interventions, the inclusion criteria have been expanded to include various study designs, such as

non-randomized controlled trials, cohort studies, pre-post studies, quasi-experimental studies, and mixed methods studies, thereby enhancing the comprehensiveness of the review's evidence base.

2.2.2. Exclusion criteria

In alignment with the methodologies outlined in the Cochrane Handbook, this review will exclude further review articles, secondary reports, conference abstracts, case reports, and non-peer-reviewed studies from consideration. The rationale for this exclusion is that the methodological rigor and data presented in such literature are often insufficient to permit a thorough quality assessment and subsequent analysis [8].

2.3. Research methods for identification of studies

This review's search strategy encompasses the retrieval of published articles from a selection of esteemed databases, including Embase (2018-2024.6), PubMed (2018-2024.6), Cochrane Library (2019-2024.6), Web of Science (2018-2024.6), and CINAHL (2018-2024.6). In addition to these electronic searches, the authors diligently conducted a manual search of reference lists, a practice that is particularly effective in mitigating the risk of omission and enhancing the comprehensiveness and reliability of the study's evidence base. This dual approach ensured exhaustive coverage of available literature throughout the review process [9].

The search strategy was meticulously designed, leveraging truncation (*) and Boolean operators, which were crucial for broadening the search terms and refining the accuracy and sensitivity of the search The search formula was constructed as follows: ((“Pulmonary Disease, Chronic Obstructive” OR COAD OR “Chronic Obstructive Airway Disease” OR “Chronic Airflow Obstruction” OR “Chronic Obstructive Lung Disease” OR COPD OR “Chronic Obstructive Lung Disease*” OR “Chronic Bronchitis” OR “Chronic Obstructive Pulmonary Diseases”) AND (“Nebulizers and Vaporizers” OR “Inhaler therapy*” OR “Inhalation techniques” OR Atomizer OR “Inhalation Devices” OR Inhaler OR Inhalator OR Nebulizer OR Vaporizer) AND (nursing OR nurse OR care) AND (“Patient Compliance” OR “Medication Adherence” OR Adherence)). This systematic and comprehensive search strategy is instrumental in identifying the most relevant and high-quality studies, thereby providing a solid foundation for the review's findings and conclusions.

2.4. Extraction, management, and analysis of data

(1) Screening process: This review, conducted according to the PRISMA guidelines, involved a reviewer searching the database using predefined strategies. The search results were deduplicated using EndNote and then screened for irrelevant literature through title and abstracts. The remaining articles were thoroughly reviewed. The screening process strictly adhered to established standards, with the PRISMA intervention study flowchart and MOOSE observational study guidelines used to document the procedures, ensuring transparency and traceability.

(2) Quality assessment and risk of bias: For assessing the risk of bias in randomized controlled trials, the Risk of Bias 2 (RoB2) tool was employed [11]. The Methodological Index for Non-Randomized Studies (MINORS) was used for assessing observational studies and non-randomized controlled trials.

3. Results

3.1. Research characteristics

Fourteen studies were included in the review, published between 2018 and 2024, showcasing a diverse array of experimental designs as detailed in **Figure 1**. The cohort includes 6 randomized controlled trials, 3 non-randomized controlled trials, 2 prospective studies, and 3 single-group experimental studies. These studies span across various global regions, with representation from the Netherlands, the United States, Spain, Taiwan, South Korea, Australia, Turkey, Sweden, Jordan, and Germany. The sample sizes vary significantly, ranging from 29 to 726 participants, and the study durations span from 3 to 21 months, as detailed in **Table 2**.

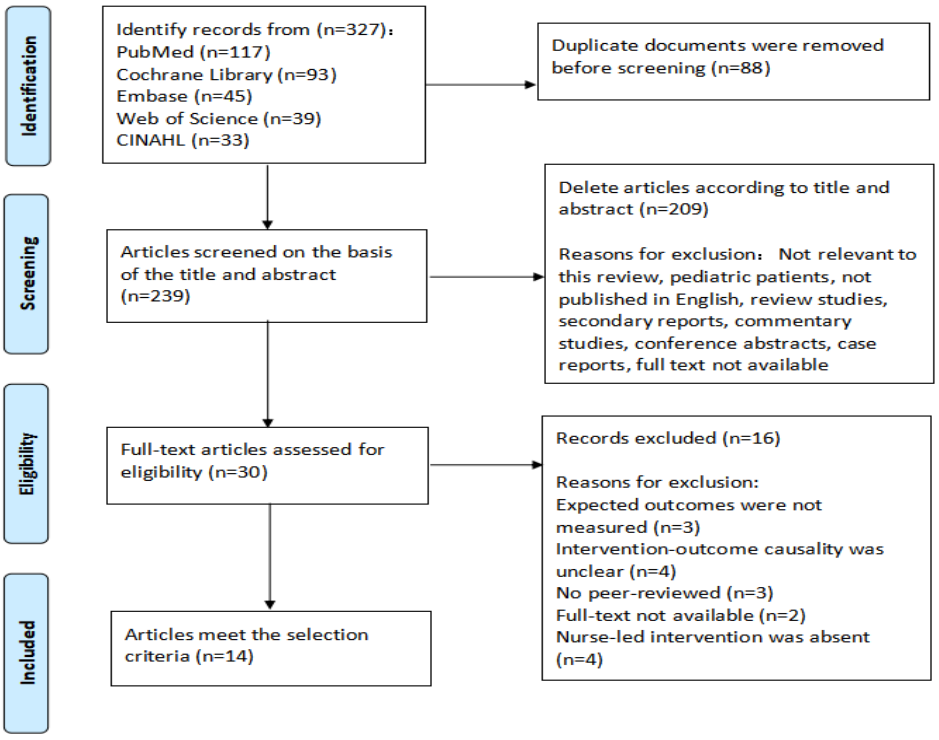

Figure 1. PRISMA Flowchart of study inclusion

Table 2. Study characteristics

Author/Year	Region	Design	Sample size	Duration
(Ahn *et al.*, 2020)	South Korea	Prospective cohort study	261	6 months
(Ansari *et al.*, 2020)	Australia	Single-group experimental study	50	6 months
(Kim *et al.*, 2020)	South Korea	Non-randomized controlled trial	59	Control group: 7 months, Experimental group: 3 months
(Efil *et al.*, 2020)	Turkey	Randomized controlled trial	29	12 months
(Press *et al.*, 2020)	United States	Randomized controlled trial	121	19 months
(Luley *et al.*, 2020)	Germany	Single-group experimental study	38	12 months
(Çigdem *et al.*,2022)	Turkey	Randomized controlled trial	67	4 months
(Hsiao *et al.*, 2022)	Taiwan	Prospective, observational study	109	8 months
(Lindh *et al.*, 2022)	Sweden	Non-randomized experimental study	79	6 months
(Barnestein *et al.*, 2023)	Spain	Randomized controlled trial	726	12 months
(Vázquez *et al.*, 2023)	Spain	Cluster randomized controlled trial	286	12 months

(Al-Kharouf *et al.*, 2023)	Jordan	Randomized controlled trial	103	3 months
(Achterbosch *et al.*, 2024)	Netherlands	Single-group experimental study	79	21 months
(Visser *et al.*, 2024)	Netherlands	Non-randomized controlled trial	81	4 months

Demographically, the studies present a spectrum of participant characteristics, with age, gender ratio, socio-economic status, and lifestyle information not uniformly measured across all research. Regarding COPD, the mean disease duration reported in six studies varies from 3.6 years to 29.5 years, and the severity of COPD is declared using the Global Initiative for Chronic Obstructive Lung Disease (GOLD) standards in six studies. Comorbidity numbers are reported in five studies, and baseline inhaler usage information, including types, numbers, duration of use, and inhalation therapy, is mentioned in nine studies. In terms of intervention descriptions, two studies compared the effectiveness of online video teaching and face-to-face teaching. Press *et al.* contrasted virtual target teaching with face-to-face target teaching in hospitalized patients, while Al-Kharouf *et al.* evaluated a video-based Teach-to-Goal intervention against conventional verbal education over a three-month period [12, 13].

Three additional studies combined face-to-face teaching with teach-back intervention and placebo demonstrations, with follow-up education every three months within a year [14–16]. These studies targeted medium to severe COPD patients to test the impact of inhaler training on treatment management, with an emphasis on proper inhalation technique and individual training by instructors. Four studies investigated the effects of repeated, additional, and intensive education on inhaler use, focusing on repeated education regarding inhaler technique, adherence, quality of life, and satisfaction. Ansari *et al.* aimed to improve patient activation and correct inhaler use in a single-group study, while Lindh *et al.* conducted an unrandomized trial on inhaler use errors, and Luley *et al.* provided an 8-day multimodal training program with daily counseling and video demonstration [17–19]. Five studies applied individual teaching methods to address and rectify the challenges faced by COPD patients during the use of inhalation devices [20–24]. Despite variations in educational interventions and outcomes, these studies consistently demonstrate the effectiveness of nurse-led inhaler education for COPD patients.

3.2. Risk assessment of bias and study quality

Figure 2 presents a comparison of the methodological rigor across studies utilizing the RoB2 tool. Among the six RCTs, five were identified as having a high risk of bias, while one carried a medium risk. A significant strength across these RCTs was the employment of random allocation methods, which is crucial for bolstering internal validity. However, the lack of detailed randomization processes in studies by Efil *et al.* and Vázquez *et al.* introduces potential biases [14, 16].

The majority of studies conformed to CONSORT guidelines, suggesting a low risk of selective reporting bias. Nevertheless, common limitations such as issues with blinding and incomplete outcome data were noted. Four studies exhibited a high risk of deviations from intended interventions, indicating variability in intervention delivery. However, the application of the intention-to-treat principle in studies by Barnestein *et al.* and Vázquez *et al.* ensured the inclusion of all participants, providing a comprehensive understanding of intervention effectiveness [15, 16]. Concerning outcome measures, inconsistencies in the application of inhaler technique checklists and scales, along with the variability in personnel involved, raise questions about the standardized assessment of inhaler proficiency. These methodological inconsistencies highlight the necessity for standardized protocols with validated checklists and uniformly trained evaluators to enhance data reliability and comparability. For the seven non-randomized studies assessed using the MINORS, only two studies demonstrated a low risk of bias. Other studies presented validity and reliability constraints, such as non-synchronization of

Figure 2. Risk of bias judgment using the Cochrane Risk of Bias 2 tool

Table 3. Risk of bias assessment using a modified MINORS checklist for non-randomized studies (Criteria 1–8).

Author	Title	(1) A clearly stated aim	(2) Inclusion of consecutive patients	(3) Prospective collection of data	(4) Endpoints appropriate to the aim of the study
Ahn JH, 2020	The effects of repeated inhaler device handling education in COPD patients: a prospective cohort study	Low RoB	Moderate RoB: Not explicitly mentioned	Low RoB	Low RoB
Ansari S, 2020	Activating primary care COPD patients with multi-morbidity through tailored self-management support	Low RoB	High RoB: Not mentioned	Low RoB	Low RoB: Patient activation, COPD knowledge, COPD-related quality of life, and inhaler device technique
Kim YM, 2020	Effects of a tailored inhaler use education program for chronic obstructive pulmonary disease patients.	Low RoB	Moderate RoB: From hospitalized patients in G University Hospital	Low RoB	Low RoB: Disease knowledge and correct inhaler use
Luley MC, 2020	Training improves the handling of inhaler devices and reduces the severity of symptoms in geriatric patients suffering from chronic obstructive pulmonary disease.	Low RoB	Moderate RoB: Not specify whether all eligible consecutive patients were included	Low RoB: Prospective intervention study	Low RoB: The frequency of mistakes during handling of inhaler devices, FEV1, FVC, CAT
Hsiao YH, 2022	Shared decision-making facilitates inhaler choice in patients with newly diagnosed chronic obstructive pulmonary disease: a multicenter prospective study.	Low RoB	High RoB: Not mentioned	Low RoB: multicenter, prospective, observational	Low RoB: The CAT score, mMRC dyspnea scale, adherence, satisfaction score, willingness to keep the initial inhaler
Lindh A, 2022	One additional educational session in inhaler use to patients with COPD in primary health care–a controlled clinical trial.	Low RoB	Moderate RoB: Not clearly stated	Low RoB	Low RoB: The differences in inhaler use and health status
Visser CD, 2024	Self-management support with the Respiratory Adherence Care Enhancer instrument in asthma and chronic obstructive pulmonary disease: An implementation trial	Low RoB	Low RoB: From 5 participating community pharmacies	Low RoB: Acceptability, practicality and the implementation process of the intervention	Low RoB: The RACE questionnaire, CRFs, an experience questionnaire and reported findings
Author	(5) Unbiased assessment of the study endpoint	(6) Follow- up period appropriate to the aim of the study	(7) Loss to follow-up less than 5%	(8) Prospective calculation of study size	
Ahn JH, 2020	Low RoB: Standardized checklist and questionnaires	Low RoB: Three visits within 6 months	High RoB: Forty patients were lost to follow-up	Low RoB	
Ansari S, 2020	Low RoB: Standardized and questionnaires	Low RoB: A 6-month follow-up period	High RoB:12%	High RoB: Not mentioned	
Kim YM, 2020	Low RoB: Non-parametric statistics	Low RoB: Admission and after discharge	Low RoB: only one patient was discharged early	Low RoB: G *Power software	
Luley MC, 2020	Low RoB: Video demonstration	Low RoB: Short-term intervention with 8 days	High RoB: Unidentified and insufficient information	High RoB: Not mentioned	
Hsiao YH, 2022	Low RoB	Low RoB	High RoB: 12% (96/109)	High RoB: Not mentioned	
Lindh A, 2022	Low RoB	Low RoB: A 6-month follow-up period	High RoB: 19%	High RoB: Not mentioned	
Visser CD, 2024	Low RoB: A 10-week follow-up period	High RoB: Insufficient information	High RoB: Not mentioned	Low RoB	

Abbreviation: FEV1, the forced expiratory volume in 1 s; FVC, the forced vital capacity; CAT, COPD Assessment Test; CRFs, consultation case report forms

Table 4. Additional criteria in the case of comparative study (Criteria 9–12)

Author	An adequate control group	Contemporary groups	Baseline equivalence of groups	Adequate statistical analyses	Overall risk of bias assessment and total score
Ahn JH, 2020	N/A	N/A	N/A	Moderate RoB: Student's t-test and Mann–Whitney U test	Moderate RoB (14)
Ansari S, 2020	N/A	N/A	N/A	Moderate RoB: McNemar's Test	High RoB (11)
Kim YM, 2020	Low RoB: regular education	Moderate RoB: non-synchronized	Low RoB: no significant differences at baseline	Low RoB: Chi-square tests, Shapiro-Wilk test, Mann–Whitney U test, Cronbach's α or KR-20	Low RoB (22)
Luley MC, 2020	N/A	N/A	N/A	Low RoB: non-parametric methods (two-tailed Wilcoxon signed rank test for pre/post intervention comparisons, MannWhitney U test and Kruskal-Wallis test for unpaired observations)	Moderate RoB (13)
Hsiao YH, 2022	N/A	N/A	Moderate RoB: well-established SDM process	Moderate RoB: Fisher's exact test, Kruskal–Wallis test, Logistic regression analyses	High RoB (12)
Lindh A, 2022	Moderate RoB	Low RoB	Low RoB: no significant differences between the intervention and control groups regarding sociodemographic data, self-reported exacerbations, comorbidities, or smoking	Low RoB: an independent samples t-test, Fisher's exact test, Logistic regression, McNemar's test	Moderate RoB (18)
Visser CD, 2024	Low RoB	Low RoB	Low RoB	Low RoB: Chi-squared test for independent groups, the Fisher exact test, unpaired Student t-test, logistic regression analysis	Low RoB (20)

3.3. Effectiveness of intervention

3.3.1. Adherence to treatment and inhaler technique (IT)

Except for the study by Achterbosch *et al.*, nearly all studies reported on inhaler technique (IT) accuracy and adherence among 2037 participants [23]. Educational methods included face-to-face, intensive, personalized, and video teaching with the Teach-Back method, all improving technique and adherence.

In three RCTs, nurses used the Teach-Back method with placebo assessments every three months. After 12 months, IT usage improved significantly. Efil *et al.* noted higher adherence scores in the intervention group despite a small sample [14]. Barnestein *et al.* found 46.1% of patients performed IT correctly, significantly more than controls [15]. Vázquez *et al.* reported better patient performance with trained professionals [16]. However, nearly half still couldn't perform IT correctly at 12 months, and breath control remained unimproved, indicating unresolved challenges.

Three studies based on the Teach-Back method and face-to-face demonstrations suggested that increasing the frequency and duration of educational interventions may help patients master IT techniques, though these interventions are still insufficient to fully address patients' difficulties. Ahn *et al.* found that repeated teaching significantly enhanced IT execution, but the lack of a control group and standard evaluation methods requires cautious comparison with other research [25]. **Çiğdem** *et al.* found that extended repeated training and duration improved the use of IT, but the study's high risk of bias due to the lack of a double-blind design must be considered [21]. Lindh *et al.* reported that an additional educational intervention did not significantly reduce errors in IT implementation, suggesting limitations when used with elderly patients or those with poor lung function [18].

Hsiao *et al.* demonstrated that shared decision-making, adapted to patients' goals and desires, enhanced medication-taking behavior in patients with newly diagnosed COPD, with 82% following their prescriptions daily [22]. However, the lack of a control group means that the changes are not solely attributable to shared decision-making, necessitating further research. Press *et al.* showed that video learning with feedback had only 6% less IT accuracy than repeated face-to-face instruction [12]. Al-Kharouf *et al.* found that video learning achieved 93.4% IT accuracy compared to 67% for face-to-face verbal instruction. The research findings reveal that the Teach-Back method, supplemented with face-to-face demonstrations, video, and individualized learning strategies, is an effective component for IT education [13]. The Teach-Back method is crucial for evaluating patients' correct application of IT and for analyzing reasons and issues affecting adherence and correctness. In combination with a placebo and face-to-face demonstrations, the most effective method to enhance IT adherence and correctness was the Teach-Back approach. Increasing the frequency and duration of teaching based on this method helped improve patients' understanding and use of IT. Nurses using shared decision-making and motivational interviewing to identify patient issues during IT and providing personalized education based on these assessments seemed to be the most effective approach.

3.3.2. Respiratory control and COPD-related quality of life

Ten studies reported on respiratory distress and control post-IT education, utilizing various standard scales or tests for lung function. The majority of these studies reported outcomes using FEV1, FVC, CAT score, and mMRC dyspnea scale, with additional assessments employing the SGRQ, EuroQol-5D-5L, CARAT10, and the Clinical COPD Questionnaire.

Three studies on repeated, additional, and intensive education presented inconclusive results and low evidence for an effect on disease management. Ahn et al. (2020) showed no significant improvement in quality of life through repetitive face-to-face education [25]. Lindh et al. (2022) found no significant differences in CAT scores at a 6-month follow-up, indicating no substantial change in the severity of COPD symptoms [18]. Luley *et al.* found a significant median decrease in CAT scores of 5.0 points ($p < 0.0001$), but only small changes in FEV1 and FVC, suggesting that physiological lung function measures may not align with patient-reported symptom improvements [19]. In contrast, **Çiğdem** *et al.* established significant decreases in dyspnea scores for the intervention group compared to the control group ($p < 0.05$) using the Medical Research Council Dyspnea Scale and Modified Borg Dyspnea Scale [21]. This suggests that increasing teaching duration and one-to-one IT teaching may reduce the severity of dyspnea, although the subjective nature of this symptom and potential influences from psychological and general physical states were not fully accounted for in the study. The effectiveness of virtual education compared to traditional methods in disease control remains uncertain. Al-Kharouf *et al.* found improvement in the virtual intervention group with Asthma Control Test and CAT, with no significant difference

between groups [13]. Press *et al.* revealed no post-intervention comparative outcome differences, suggesting that it is premature to conclude the effectiveness of virtual inhaler education in disease control [12].

While the Teach-Back method as a long-term educational intervention aids in COPD recovery and control, personalized and intensive education show greater potential for improving disease control and quality of life. However, results vary due to the heterogeneity of educational programs, individual patient characteristics, and the duration and frequency of interventions. The variability in intervention duration across studies also complicates the effective comparison of results.

3.3.3. Inhaler satisfaction or self-efficacy of patients

Few studies used standardized measures to assess inhaler satisfaction or COPD self-efficacy. Ahn *et al.* and Hsiao *et al.* found interventions significantly boosted satisfaction and self-efficacy, but lacked control groups, limiting causality establishment [22, 25]. Hsiao *et al*. also noted comorbidities and severe airflow limitation linked to negative satisfaction [22]. Ansari *et al.* and **Çiğdem** *et al.* reported self-efficacy gains, with **Çiğdem** *et al.*'s RCT offering higher-quality evidence [17, 21]. Overall, repetitive, personalized, and motivational education may enhance satisfaction and self-efficacy, yet diverse study designs and biases highlight the need for comprehensive support and robust research.

The reviewed studies consistently demonstrated that educational interventions, especially those incorporating the Teach-Back method, personalized teaching, and video-based learning, significantly improved inhaler technique, adherence, satisfaction, and self-efficacy in COPD patients. The most effective approach appears to be the Teach-Back method, whether supplemented with face-to-face or video demonstrations. Personalized education using shared decision-making and motivational interviewing also addresses challenging aspects for these patients, thereby increasing outcomes. While there are limitations to the studies, and there is a need for more rigorously designed research, the evidence supports the inclusion of these educational strategies in the treatment plan for COPD patients to better manage the disease process and enhance quality of life.

4. Discussion

4.1. The effectiveness and limitations of nurse-led educational intervention

COPD management demands long-term inhaler use, but poor adherence remains. This underscores the need for better nurse-led inhalation technique (IT) education. Duarte-de-Araújo et al. found 48.2% of COPD patients couldn't use inhalers correctly after a month, an issue confirmed by 13 other studies (excluding Achterbosch *et al.*) [23, 26]. A review of 14 studies proved the Teach-Back method effective and vital. These studies compared Teach-Back with others, offering a base for further research on optimal educational approaches.

The Teach-Back method, a widely practiced patient teaching technique in medicine, requires patients to demonstrate or repeat learned content, ensuring understanding and knowledge retention. Three RCTs by Efil *et al.*, Vázquez *et al.*, and Barnestein *et al.* consistently showed improvements in self-management of inhaler techniques with quarterly follow-up and teaching sessions by nurses using placebo demonstrations combined with the Teach-Back method [14–16]. This approach resulted in more efficient disease control and patient recovery. However, Barnestein *et al.* found that while IT accuracy among patients significantly improved in the first 1–3 months, the rate of improvement decelerated between 3–12 months, regardless of patient preferences for educational methods. Furthermore, at the 12-month follow-up, nearly half of the patients still could not perform IT correctly,

suggesting that interpersonal variations were not effectively addressed. The challenges identified as barriers related to individual differences are consistent with those found by Wu *et al.*, including patients' health status, comprehension ability, and psychological stress [27]. Thus, while the Teach-Back technique appears highly effective in the short term, its long-term effectiveness is questionable.

Ahn *et al.* and **Çiğdem** *et al.* echoed the effectiveness of intensive educational interventions with increasing durations, adopting the Teach-Back technique combined with placebo demonstrations, showing significant positive effects on IT self-management, patient self-efficacy, and satisfaction [21, 25]. However, Lindh *et al.* found that an additional teaching session did not significantly improve IT use in older patients or those with poor lung function, suggesting that the Teach-Back technique, given enough time for teaching, is superior at overcoming barriers due to heterogeneity among people. These trials show high risks of bias, indicating methodological insufficiencies and not providing adequate evidence for its benefits in COPD management. Therefore, implementing such an intense education strategy may not be wise in places with scarce medical facilities.

4.2. The optimization direction of educational strategy

Kim *et al.*, Ansari *et al.*, and Hsiao *et al.* combined the Teach-Back method with personalized plans, showing significant positive effects on IT self-management, satisfaction, and self-efficacy [17, 20, 22]. Motivational interviewing and shared decision-making in these studies helped uncover barriers and difficulties faced by patients in the self-management process. A meta-analysis showed that motivational interviewing had reliable effects on behavior change and disease control in patients with COPD [28]. Shared decision-making helps understand patients' needs and concerns, leading to more personalized and feasible treatment regimens, ensuring higher adherence to medication. This resonates with the conclusion of this review. Given the limited nature of the literature regarding nurse-led IT training strategies for patients with COPD, these studies generally lack a control group or randomization, indicating the risk of bias and a lack of long-term follow-up; yet, this teaching approach is considered the most likely and efficient method.

Additionally, studies have shown that Video and gamification aids are effective supplements to COPD lung rehabilitation. Al-Kharouf *et al.* and Press *et al.* found that video-based instruction, combined with online assessments, is as effective as face-to-face teaching by nurses [12, 13]. Luley *et al.* confirmed that video learning, as a supplement to face-to-face instruction by nurses, is particularly effective for elderly patients and those with mild cognitive impairment [19]. With the widespread use of smartphones, video education is expected to become a high-potential auxiliary tool in nurse-led interventions, enhancing patients' IT self-management skills.

5. Conclusions

This review comprehensively assesses educational methods to enhance inhaler technique and adherence in COPD patients, revealing diverse approach effectiveness. However, it faces limitations: significant variations in study designs, teaching interventions (duration, frequency, session length), and assessment tools hinder meta-analysis and result in outcome heterogeneity, reducing result comparability. Given study heterogeneity and bias risk, evidence should be cautiously interpreted. Future research needs longer follow-ups, larger samples, standardized measurements, and data on other outcomes/adverse events for high-quality meta-analyses. Also, as long-term effects are unassessed, future studies should focus on the lasting impact of inhaler education for a fuller efficacy understanding over time.

Disclosure statement

The authors declare no conflict of interest.

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