Clinical and cost-effectiveness of telehealth-supported home oxygen therapy on adherence, hospital readmission, and health-related quality of life in patients with chronic obstructive pulmonary disease: A systematic review and meta-analysis of randomized controlled trials

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Abstract

Background: Tele-monitoring and management play a crucial role in optimizing home oxygen therapy for patients with chronic obstructive pulmonary disease. As the use of tele-monitoring to improve adherence, reduce hospital readmissions, and enhance health-related quality of life grows, existing evidence remains inconsistent and warrants further examination.

Objective: This study aims to evaluate the clinical and cost-effectiveness of telehealth-supported home oxygen therapy on adherence, hospital readmission, and health-related quality of life in patients with chronic obstructive pulmonary disease.

Methods: A comprehensive search was conducted across six databases (PubMed, Cochrane Central, Embase, Web of Science, PsycINFO, and CINAHL) through October 1, 2024. Meta-analysis and heterogeneity testing were performed using R software, and standardized mean differences with 95% confidence intervals were calculated to assess intervention effects.

Results: Seven studies, involving 1,230 patients, were included in the analysis. Telehealth-supported home oxygen therapy significantly reduced hospital readmissions (SMD: ?0.40, 95% CI: [?0.60, ?0.21]) and improved health-related quality of life (SMD: 0.44, 95% CI: [0.15, 0.72]). However, it did not have a significant impact on therapy adherence (SMD: 0.19, 95% CI: [?0.76, 1.14]). Sensitivity analysis confirmed the stability of the results for hospital readmission. Additionally, three economic studies indicated that while telehealth interventions may involve higher initial costs, they are likely to lead to long-term savings by reducing hospital admissions.

Conclusions: Telehealth-supported home oxygen therapy significantly reduces hospital admissions and improves health-related quality of life among patients with chronic obstructive pulmonary disease. However, it does not significantly enhance adherence. Tailored interventions, designed to address patient demographics, combined with supportive policies, could further improve outcomes. Future studies should incorporate economic evaluations to guide policy decisions regarding the implementation of telehealth-supported home oxygen therapy. Clinical Trial: PROSPERO CRD42024598539

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CRediT contributions statement

Cuirong Hu: Conceptualization; Methodology; Software; Formal analysis; Writing - original draft.

Xinqi Liao: Methodology; Formal analysis; Resources; Writing - original draft.

Yi Fang: Data Curation; Visualization.

Shu Zhu: Writing - Review & Editing; Validation.

Xia Lan: Project administration; Validation.

Guilan Cheng: Conceptualization; Methodology; Writing - Review & Editing; Supervision.

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Keywords: Telehealth-supported home oxygen therapy; adherence; hospital readmission; health-related quality of life; randomized controlled trials; meta-analysis

Trial Registration: PROSPERO CRD42024598539

1. INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a common lung condition that causes restricted airflow and breathing difficulties.[1] The latest estimates indicate that the global prevalence of COPD was 10.6% in 2020, with more than 480 million people living with the disease.[2] Regardless of disease stage, individuals with COPD experience a range of symptoms due to the disease itself, complications, or treatments, which impair their psychosomatic well-being.[3] Furthermore, insensitive diagnostic tools, delayed recognition, and late presentation place patients with COPD at risk for poor health, reduced quality of life, frequent emergency visits and hospitalizations, and even increased morbidity and mortality.[4] COPD imposes a substantial financial strain on healthcare systems worldwide, with exacerbations representing the largest share of associated costs.[5] Given the growing number of COPD patients worldwide, delaying disease progression and ultimately preventing the disease have become essential clinical goals and a global health priority.

Although the most effective treatment for COPD patients, especially those with chronic hypercapnia or respiratory failure, is still under discussion, home oxygen therapy, such as long-term oxygen therapy (LTOT) and home noninvasive positive pressure ventilation (NPPV), is a well-recognized treatment that improves survival.[6] Furthermore, home oxygen therapy based on telehealth support has become an increasingly essential tool for optimizing follow-up care and reducing healthcare costs among COPD patients, particularly in the wake of the COVID-19 pandemic.[7,8] Evidence suggests that for stable hypercapnic COPD patients, the use of tele-monitoring during home NPPV initiation is non-inferior to in-hospital NPPV initiation and is associated with a 50% reduction in care costs.[9] Telehealth-supported home oxygen therapy can, on the one hand, collect information about compliance and ventilator parameters, as well as monitor vital signs and physiological indices;[10] on the other hand, it can serve as a digital intervention to detect and manage the onset of acute COPD exacerbations, thereby improving patient outcomes.

Most studies in this field have focused on evaluating the acceptability, usability, and feasibility of telehealth-supported home oxygen therapy interventions for COPD patients. However, existing research has primarily provided qualitative insights into patient experiences and has not demonstrated clinically significant effects on patient outcomes.[11] Additionally, several studies have reported conflicting results regarding the impact of tele-monitoring programs, whether centered on home oxygen therapy or integrated into broader COPD disease management programs, on hospitalization and health-related quality of life in COPD patients.[12] While some narrow reviews have summarized tele-monitoring home oxygen therapy for COPD,[13] no quantitatively pooled findings from randomized controlled trials have been reported regarding its impact on therapy adherence, hospital readmissions, and health-related quality of life. Furthermore, to our knowledge, there is a lack of comprehensive economic evaluations in the literature examining the cost-effectiveness of these tele-monitoring home oxygen therapy interventions.

Therefore, the objective of this meta-analysis was to (1) assess the clinical effectiveness of existing randomized controlled trials in evaluating the impact of tele-monitoring home oxygen therapy interventions on adherence, hospital readmissions, and health-related quality of life among COPD patients, and (2) examine the cost-effectiveness of these interventions in this patient population.

2. METHODS

This review adhered to the guidelines set out in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement and was registered in PROSPERO.[14]

2.1 Search strategy

We extensively searched six electronic databases: PubMed, Cochrane Central Register of Controlled Trials, Embase, Web of Science, PsycINFO (via EBSCO), and CINAHL (via EBSCO). This search spanned from the databases' inception until October 1, 2024. For each database, we adapted Medical Subject Headings terms and database-specific keywords, including "chronic obstructive pulmonary disease," "internet-based intervention," "oxygen therapy," and "randomized controlled trial." To ensure comprehensive coverage, we manually reviewed the reference lists of prior systematic reviews and relevant publications to identify additional studies of interest. We did not search the grey literature. Details of the search strategy are provided in Supplementary Table 1.

2.2 Eligibility criteria

Our inclusion criteria were: (1) Population: patients diagnosed with chronic obstructive pulmonary disease; (2) Intervention: the experimental groups received telehealth-supported home oxygen therapy, which involved internet-based platforms and tools. Home oxygen therapy included long-term oxygen treatment trials, home non-invasive ventilation, and home continuous positive airway pressure; (3) Control: patients in the control groups received usual home oxygen therapy without telehealth support; (4) Outcomes: studies needed to report at least one of the following indicators—adherence, hospital readmission, or health-related quality of life; (5) Study design: only randomized controlled trials published in English were included.

The exclusion criteria were: (1) reviews, conference abstracts, case studies, protocols, or qualitative studies; (2) studies lacking complete data; (3) studies where full text was unavailable; (4) duplicate publications.

2.3 Study selection and data extraction

We used EndNote version 20 to remove duplicate studies, and the remaining records were screened using the web application Rayyan.[15] Two authors independently reviewed studies based on titles and abstracts, followed by a full-text review of eligible articles. Any disagreements were resolved through discussion or, if needed, consultation with a third author.

Data extraction was also performed independently by two authors using a standardized form. The extracted data included (1) the first author, publication year, and the country where the study was conducted; (2) participants' age, sample size, disease stage, and baseline FEV_1; (3) the type, format, and duration of the interventions; (4) comparator interventions for the control groups; and (5) the results and outcome measures. Furthermore, data extraction focused on the effect size at the final follow-up time point reported in each study. Any discrepancies were addressed through discussion.

2.4 Data synthesis and analysis

A descriptive synthesis was performed to summarize the characteristics of the included studies. Meta-analysis and heterogeneity testing were carried out using the meta package in R software (version 4.2.2). Given the variation in outcome assessment tools among the included studies, we calculated the standardized mean difference (SMD) and 95% confidence interval (CI) to evaluate the intervention effects in comparison with control groups. Heterogeneity across studies was quantified using the I^2 statistic and P-value, as high heterogeneity was anticipated due to differences in specific interventions, participant characteristics, and follow-up durations.[16] Consequently, we adopted a random-effects model to obtain more conservative effect estimates. Subgroup analysis and publication bias assessments were not conducted due to the limited number of included studies.[17] Sensitivity analysis was performed using a leave-one-out approach to test the robustness of pooled results. Statistical significance was set at a P-value < 0.05 in this study.

2.5 Quality assessment

The revised Cochrane risk of bias tool (version 2)[18] was utilized to evaluate the methodological quality and bias risk of the included randomized controlled trials across five key domains: the randomization process, deviations from intended interventions, incomplete outcome data, outcome measurement, and selective reporting of results. Each domain was assessed based on a series of signaling questions, which helped guide the assignment of bias ratings for each domain as low risk, some concerns, or high risk. The overall risk of bias for a study was determined as follows: "low risk" if all domains were rated as low risk; "some concerns" if at least one domain raised concerns without any being rated as high risk; and "high risk" if one or more domains were rated as high risk.[18] The assignment or intention to treat was the outcome of interest. All included studies were independently evaluated by two authors.

2.6 Quality of Evidence

Two reviewers independently assessed the quality of evidence for adherence, health-related quality of life, and readmission, rating each as high, moderate, low, or very low in accordance with the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) method.[19] Five categories were carefully evaluated: risk of bias, imprecision, inconsistency, indirectness, and publication bias. Given that all included studies were randomized trials, the initial quality rating was set to “high” and subsequently downgraded to moderate, low, or very low if any category was judged as “serious,” “very serious,” “likely,” or “very likely.”[20] We utilized the web application GRADEpro Guideline Development Tool to create the GRADE evidence profile.[21]

3. RESULTS

3.1 Search results

Initially, 682 records were retrieved from six databases, with one additional eligible study identified through manual searching. After removing 267 duplicates, 416 articles remained for title and abstract screening. Next, we conducted a thorough full-text review of 21 studies, resulting in the inclusion of seven studies in this review. The PRISMA flowchart is shown in Figure 1.

3.2 Characteristics of the included studies

3.2.1 Study characteristics

This systematic review included seven randomized controlled trials,[7,12,22-26] conducted across four countries: China,[7] the United States,[23-25] Spain,[12,22] and Italy,[26] with publication years ranging from 2009 to 2024.[7,26] All included studies enrolled patients in the home setting. Further details are available in Table 1.

3.2.2 Characteristics of patients

A total of 1,230 individuals with chronic obstructive pulmonary disease participated in the studies, with 709 receiving telehealth-supported home oxygen therapy and 521 receiving only home oxygen therapy. The mean age of participants ranged from 61 to 75 years.[12,26] Three studies focused on patients with stable COPD (no recent exacerbation),[7,12,22] while one study included patients with recent exacerbation.[23] The baseline FEV1 (% predicted) ranged from 25 to 39.[7,26]

3.2.3 Characteristics of telehealth-supported home oxygen therapy

The telehealth interventions were organized by delivery format, including Internet of Things,[7] applications,[12,22] telephone calls,[25,26] call centers,[23] and websites.[24] Intervention durations varied from three to twelve months. Regarding specific types of home oxygen therapy, three studies examined the effects of LTOT,[12,22,25] while the remaining studies focused on non-invasive ventilation,[7,23] continuous positive airway pressure,[24] and home mechanical ventilation.[26]

Generally, the telehealth-supported home oxygen interventions in the included studies aimed to provide real-time remote monitoring of each patient's clinical information and ventilator parameters. In cases of alarms or alerts, healthcare professionals would contact patients by telephone or other internet-based tools, offering preliminary assessments,[7,12,22,23,26] promoting adherence,[7,23-25] enhancing symptom management,[7,12,22-26] addressing problems on a case-by-case basis, and arranging emergency home visits when necessary.

3.2.4 Characteristics of controls

Participants in the control groups received home oxygen therapy without telehealth support, along with standard home oxygen management throughout the study period in all included studies.[7,12,22-26]

3.2.5 Outcome measures

The outcomes assessed were adherence, readmission, and health-related quality of life. Health-related quality of life was measured using two scales: the Severe Respiratory Insufficiency Questionnaire and the EuroQol Five Dimensions Questionnaire.[7,12,22] Data on adherence and readmission were objectively obtained from medical records.

3.3 Meta-analysis results

3.3.1 Adherence

Three studies investigated the effectiveness of telehealth-supported home oxygen therapy on adherence among individuals with COPD. Given the high heterogeneity across studies, a random effects model was applied for analysis. The aggregated findings indicated no significant improvement in adherence after receiving telehealth-supported home oxygen therapy (SMD: 0.19, 95% CI: [−0.76, 1.14]) (see Figure 2-a). Sensitivity analysis demonstrated that removing any individual study did not alter the overall trend; however, excluding one specific study[23] shifted the effect from positive to negative, likely due to its focus on a smaller, less stable COPD sample (See Supplementary Figure 1).

3.3.2 Hospital readmission

Three studies evaluated the effectiveness of telehealth-supported home oxygen therapy on hospital readmission among individuals with COPD. A random effects model was applied due to study variability. The combined results demonstrated a statistically significant effect of telehealth-supported home oxygen therapy in reducing hospital readmission for individuals with COPD (SMD: −0.40, 95% CI: [−0.60, −0.21]) (see Figure 2-b). Sensitivity analysis confirmed the stability of these results (See Supplementary Figure 2).

3.3.3 Health-related quality of life

Three studies examined the impact of telehealth-supported home oxygen therapy on health-related quality of life among individuals with COPD. A random effects model was used to calculate the pooled effect size. The combined results indicated a significant improvement in health-related quality of life for individuals receiving telehealth-supported home oxygen therapy (SMD = 0.44, 95% CI: [0.15, 0.72]) (see Figure 2-c). Sensitivity analysis revealed that the pooled result became non-significant when one study was removed,[7] likely due to its large sample size, higher reported effect, and unique characteristics, which had a strong influence on the overall estimate (See Supplementary Figure 3).

3.4 Economic outcomes

Three studies reported on the cost of telehealth-supported home oxygen therapy interventions.[7,22,26] Jiang et al. conducted a cost-effectiveness analysis comparing internet-of-things-based management of home noninvasive ventilation for COPD patients to standard management. The study found a marginal increase in quality-adjusted life years (QALY) for the intervention group (0.45, 95% CI: [0.39–0.52]) compared to the control group (0.44, 95% CI: [0.38–0.51]).[7] Jódar-Sánchez et al. performed a cost-utility analysis from the healthcare payer perspective, which demonstrated an incremental cost-effectiveness ratio of €223,726 per QALY for the telehealth group compared to the control group.[22] Vitacca et al. also conducted a cost-effectiveness analysis, including the costs of telemedicine services, healthcare services, and private expenses. The study found that after accounting for the cost of tele-assistance, the average overall cost per patient was 33% lower than for usual care, indicating significant cost savings without compromising care quality.[26] The details of the economic evaluations are presented in Table 2.

3.5 Risk of bias and quality of evidence

According to the revised Cochrane risk-of-bias tool, one study was judged to have a low risk of bias.[7] Five studies were rated as having “some concerns” due to incomplete reporting of intervention allocation details, raising concerns about deviations from intended interventions.[12,22,26] Additionally, missing outcome data and selective reporting were identified as sources of bias.[23,24] One study was appraised as high risk for missing adherence data due to incomplete oxygen equipment worksheets and follow-up records.[25] The summaries of risk of bias are provided in Figure 3 and Supplementary Figure 4.

According to the GRADE approach, the quality of evidence was rated as low for adherence, high for hospital readmission, and high for health-related quality of life. The downgrading factors primarily stemmed from the risk of bias in included studies, imprecision of results, and heterogeneity across studies. The evaluation details are presented in Supplementary Table 2.

4. DISCUSSION

4.1 Summary of main results

To our knowledge, this study is the first systematic review and meta-analysis of randomized controlled trials evaluating the clinical and cost-effectiveness of telehealth-supported home oxygen therapy in terms of adherence, hospital readmissions, and health-related quality of life. This systematic review of randomized controlled trials included a total of 1,230 patients with chronic obstructive pulmonary disease. Compared with control groups, telehealth-supported home oxygen therapy interventions reduced hospital readmissions and improved health-related quality of life but did not significantly increase adherence. Given that the overall methodological quality of most included studies raised some concerns or indicated a high risk of bias, and that the quality of evidence for adherence was low, more high-quality randomized controlled trials are needed to draw robust conclusions.

4.2 Principal findings

4.2.1 Adherence

The results of this meta-analysis demonstrated that telehealth-supported home oxygen therapy interventions did not significantly increase adherence among patients with chronic obstructive pulmonary disease, consistent with findings from previous studies.[7,27] One key reason for this lack of improvement in adherence may be that many patients experience symptom relief during the early stages of e-health home oxygen therapy, leading them to mistakenly believe that continued treatment is unnecessary,[28] particularly without ongoing behavioral and psychological support.[29] Additionally, since most COPD patients are older adults, many face challenges operating telemedicine devices and home oxygen equipment, as well as accessing online health information,[30] leading to poor compliance. Although telehealth interventions enable timely information retrieval, rural-dwelling individuals may encounter barriers due to certain beliefs about home oxygen therapy.[23] Furthermore, unstable internet connectivity in rural areas may compromise the effectiveness of remote monitoring. Adherence to home oxygen therapy is crucial for clinical outcomes in COPD patients, including improved quality of life and reduced mortality.[31] Therefore, tailored telehealth-supported home oxygen interventions targeting specific populations, such as older adults and rural-dwelling individuals, are warranted.[27] Additionally, the low certainty of the evidence may contribute to the statistically insignificant effect on adherence. Thus, any conclusions regarding adherence should be interpreted with caution.

4.2.2 Hospital readmission

The results of this meta-analysis demonstrated that telehealth-supported home oxygen therapy interventions significantly reduced hospital readmissions among COPD patients, consistent with findings from previous studies.[32] These interventions enable healthcare professionals to telemonitor clinical information and ventilator parameters,[33] which are more accurate and timely than those in the control group.[7] Additionally, health management teams conducted telephone check-ins and home visits in response to alerts or emergencies, ensuring early detection of exacerbations in COPD patients.[34] Systematic monitoring, early identification, and prompt management of acute needs contribute to reducing hospital readmissions among COPD patients.[35,36] Telehealth-supported home oxygen therapy interventions, facilitated by remote devices such as the Internet of Things, websites, applications, or phone calls, keep patients engaged and provide access to assistance anytime and anywhere. As a result, this intervention meets patients' needs and reduces hospital readmissions.[37]

4.2.3 Health-related quality of life

The meta-analysis found that telehealth-supported home oxygen therapy significantly improved health-related quality of life, which is in agreement with previous studies.[7] A significant improvement in health-related quality of life was observed in the intervention group, with improvements across domains such as respiratory complaints, physical functioning, psychological well-being, and associated symptoms.[7,22] Telehealth-supported home oxygen therapy interventions address the needs of COPD patients and provide timely access to healthcare providers, contributing to better health-related quality of life.[38] In addition to receiving professional guidance on managing physical and psychological symptoms and resolving ventilator issues, patients gain valuable knowledge on how to cope with and live with COPD, which enhances their confidence and quality of life.[38] The data collected directly from patients can be delivered and stored in their electronic health records, making it easier for healthcare providers to track and monitor their health status over time.[39] However, more high-quality clinical trials are needed to further investigate the impact of telehealth-supported home oxygen therapy on health-related quality of life in the future.

4.3 Economic findings

This review analyzed the cost-effectiveness of telehealth-supported home oxygen therapy for COPD patients. Three studies highlighted the significant economic burden that COPD imposes on healthcare systems.[7,22,26] Jiang et al.[7] found that the average total 1-year cost per patient for stable COPD in the intervention group was ¥9,524, compared to ¥7,451 in the control group. However, the overall costs in the intervention group were lower, with the cost difference primarily attributed to the expenses related to healthcare professional contacts, telemedicine tools, and the effectiveness of Internet-of-Things-based management of home noninvasive ventilation. Jódar-Sánchez et al.[22] adopted a healthcare payer perspective, meaning that cost savings would be fully absorbed by the healthcare system. However, this perspective overlooks out-of-pocket costs borne by COPD patients and their families, such as caregiving expenses.[40] Therefore, future intervention studies need to conduct a more comprehensive cost analysis. Vitacca et al.[26] concluded that in patients with chronic respiratory failure who are on oxygen or home mechanical ventilation, nurse-centered tele-assistance prevents hospitalizations and is cost-effective. This study considered costs from a broader societal perspective, including those borne by the healthcare system, patients, and other relevant parties.

Overall, all studies demonstrated that although the costs of maintaining telemedicine equipment, telephone consultations, and home visits by healthcare professionals were higher compared to the control group, reduced hospitalizations due to exacerbations led to lower overall healthcare costs.[7,22,26] This suggests that, despite higher initial costs, telehealth and home oxygen therapy interventions may result in long-term cost savings by preventing hospital admissions.

4.4 Limitation

This study has several limitations. First, heterogeneity may have increased due to differences in study characteristics, including the format, intensity, duration, and length of follow-up of telehealth-supported home oxygen therapy interventions, as well as variations in COPD stages and outcome measures. Second, the sensitivity analysis showed that the overall results were heavily influenced by specific studies. Excluding a large-scale study altered significance,[7] while removing a smaller, COPD-focused study reversed the effect,[23] indicating potential instability and underscoring the need for more diverse, high-quality research. Third, only articles published in English were included, so findings from non-English studies remain unknown, potentially influencing the pooled results and limiting the global generalizability of the findings. Therefore, the results of this review should be interpreted with caution.

5. CONCLUSIONS

Our review revealed that telehealth-supported home oxygen therapy significantly reduced hospital admissions and improved health-related quality of life, but had no significant effect on improving adherence among people living with COPD. High-quality longitudinal studies are needed to further examine whether this intervention can enhance adherence in COPD patients. In addition to introducing relevant policies and regulations at higher levels, tailored telehealth-supported home oxygen therapy, based on COPD patients' demographic characteristics, is warranted to improve their well-being. Moreover, including economic analyses in future research would help policymakers make informed decisions regarding the implementation of telehealth-supported home oxygen therapy.

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Table1 Characteristics of included studies

Study	Country	Participants				Interventions			Control	Outcomes	
		Age, y, mean±SD	Sample size	Disease stage	Baseline FEV_1 (% predicted)	Type	Format	Duration		Result	Measurement
Jiang2024	China	Treatment group: 72.8±6.5; control group: 72.7±7.1	Treatment group: n=73; control group: n=75	Stable	Treatment group: 25.6±8.2; control group: 25.8±10.0	Home NPPV	Internet of Things	12 months	Home NPPV alone	Primary: HRQoL; secondary: readmission, adherence, and costs	Severe respiratory insufficiency questionnaire; medical recording data
Jódar-Sánchez2014	Spain	Treatment group: 74.4±7.6; control group: 70.8±10.4	Treatment group: n=24; control group: n=21	Stable	NR	LTOT	Application	4 months	LTOT alone	HRQoL, hospitalisations, and costs	EuroQol-5D questionnaire; medical recording data
Leonard2021	United States	Whole sample: 64.5±5.9	Treatment group: n=10; control group: n=10	Unstable	Whole sample: 35.2	Home NIV	Call center	12 months	Home NPPV alone	Primary: adherence; secondary: readmission	Medical recording data
Martinez2022	United States	Treatment group: 64.8±9.3; control group:	Treatment group: n=153; control group: n=141	NR	NR	Home CPAP	Website	3 months	Home CPAP alone	Primary: adherence; secondary: sleep quality	Medical recording data; Pittsburgh sleep quality inventory and

Prieto-Centurion2023	United States	64.1±9.8 Proactive group: 68.0±8.8; reactive group: 66.0±8.4; usual care: 67.0±9.0	Proactive group: n=154; reactive group: n=148; usual care: n=142	NR	NR	LTOT	Telephone call	3 months	LTOT alone	Adherence	Medical recording data
Segrelles Calvo2014	Spain	Treatment group: 75.0±9.7; control group: 72.7±9.3	Treatment group: n=29; control group: n=30	Stable	Treatment group: 38.3±11.9; control group: 37.1±10.8	LTOT	Application	7 months	LTOT alone	HRQoL and hospitalizations	EuroQol-5D questionnaire; medical recording data
Vitacca2009	Italy	Treatment group: 61.2±17.6; control group: 61.1±17.4	Treatment group: n=118; control group: n=102	NR	Treatment group: 39.0±23.0; control group: 34.0±16.0	Home mechanical ventilation	Telephone call	12 months	Home mechanical ventilation alone	Hospitalizations, exacerbations, and costs	Medical recording data

Note: NIV, Non-invasive ventilation; NPPV, non-invasive positive pressure ventilation; LTOT, long-term oxygen therapy; CPAP, continuous positive airway pressure; HRQoL, health-related quality of life; EuroQol-5D questionnaire, EuroQol Five Dimensions Questionnaire; NR: not report.

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Table 2 Economic evaluation of telehealth-supported home oxygen therapy interventions

Study	Type of economic evaluation interventions	Costs included	Economic outcome	Finding
Jiang2024	Cost-effectiveness analysis	Costs included hospitalization due to exacerbations, telemedicine equipment, telephone consultations, home visits by healthcare professionals, ventilator equipment, and oxygen supply.	● Total cost (¥) NPPV plus IOT: 11094 NPPV alone: 14922 ● Stable COPD costs (¥) NPPV plus IOT: 9524 NPPV alone: 7451 ● Total QALYs NPPV plus IOT: 0.45 NPPV alone: 0.44	The incremental cost-effectiveness ratio comparing the intervention group to the control group was ¥208,551 per QALY, which is below three times the GDP per capita.
Jódar-Sánchez2014	Cost-utility analysis	Costs included specialized care, hospitalization for COPD and other chronic diseases, clinical call center services, mobile phone use, medical parameter monitoring, and tele-modem hub equipment.	● Average cost (€) TG without comorbidity: 855 CG without comorbidity: 1354 ● Average QALYs TG without comorbidity: 0.0288 CG without comorbidity: 0.0082	The analysis yielded an incremental cost-effectiveness ratio of €223,726 per QALY.
Vitacca2009	Cost-effectiveness analysis	Costs included telemedicine services (call center, pulse oximetry device), healthcare services (hospitalizations, admissions, medical visits), and private expenses (transportation).	● Total cost (€) TA: 8907 Control: 14728	After deduction of TA costs, the average overall cost for each patient was 33% less than that for usual care.

Note: NPPV, non-invasive positive pressure ventilation; IOT: internet of things; TG: telehealth group; CG: control group; TA: tele-assistance; QALYs: quality-adjusted life years; GDP: gross domestic product.

Supplementary Files

Figures

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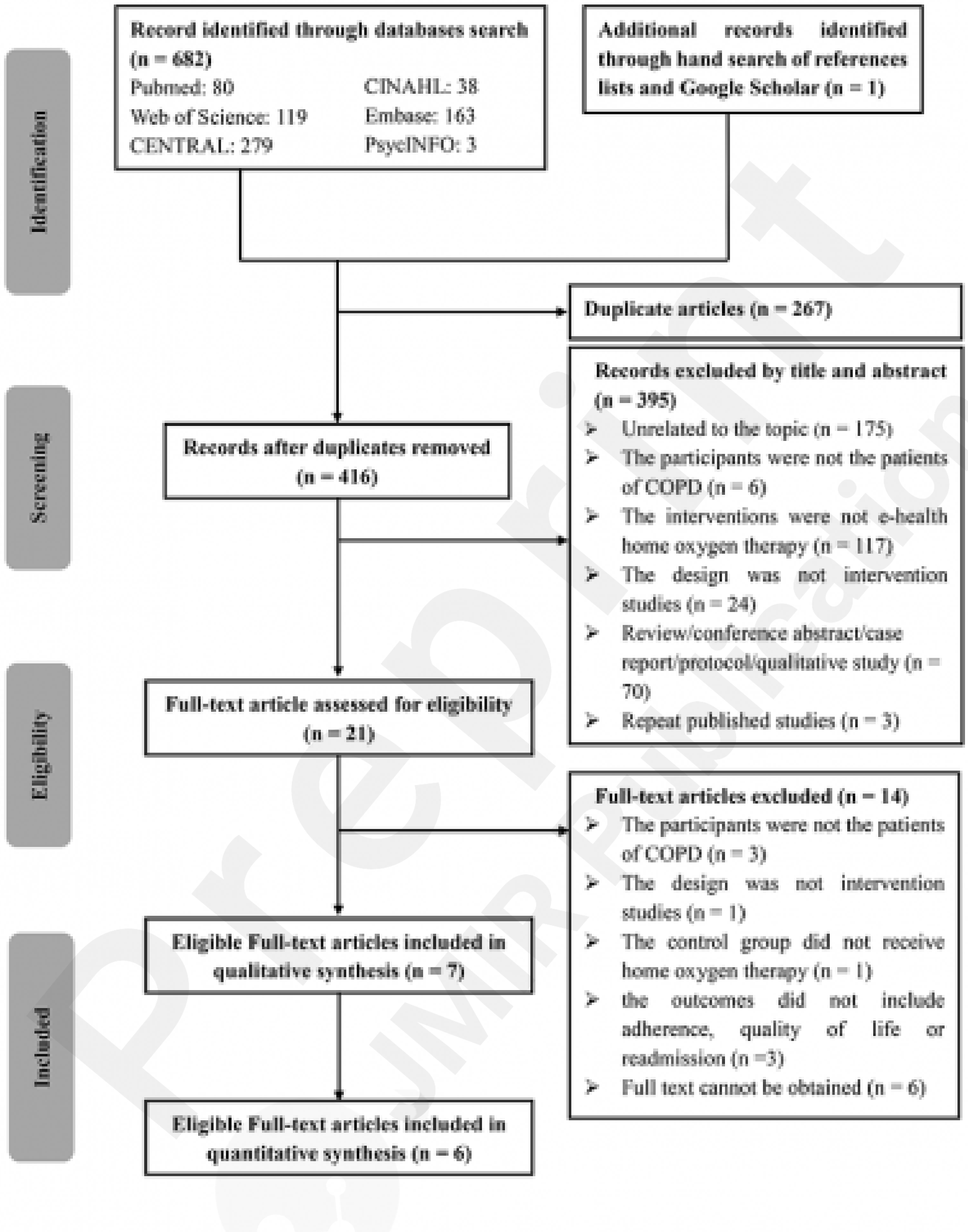

Figure 1. PRISMA flow diagram.

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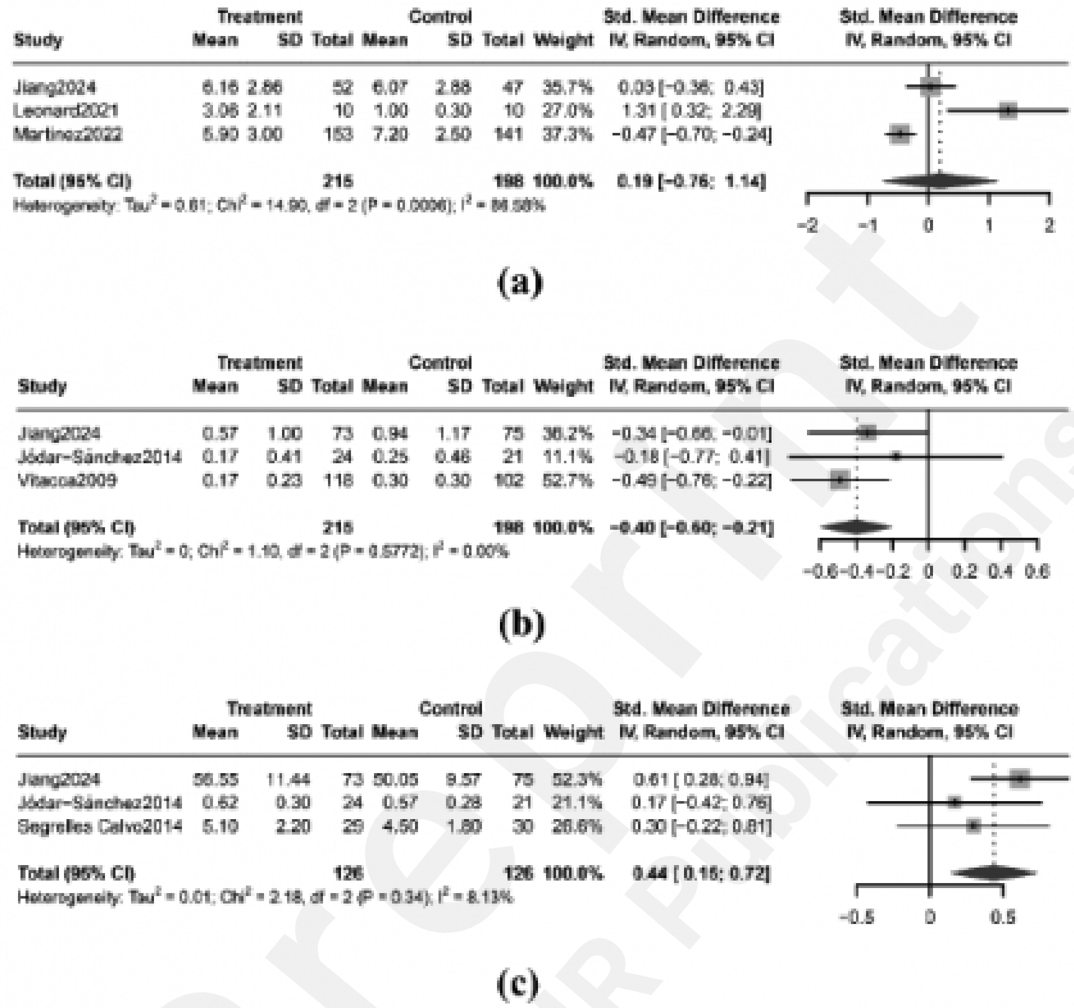

Figure 2. Forest plot of the effect of telehealth-supported home oxygen therapy on (a) adherence; (b) hospital readmission; and (c) health-related quality of life.

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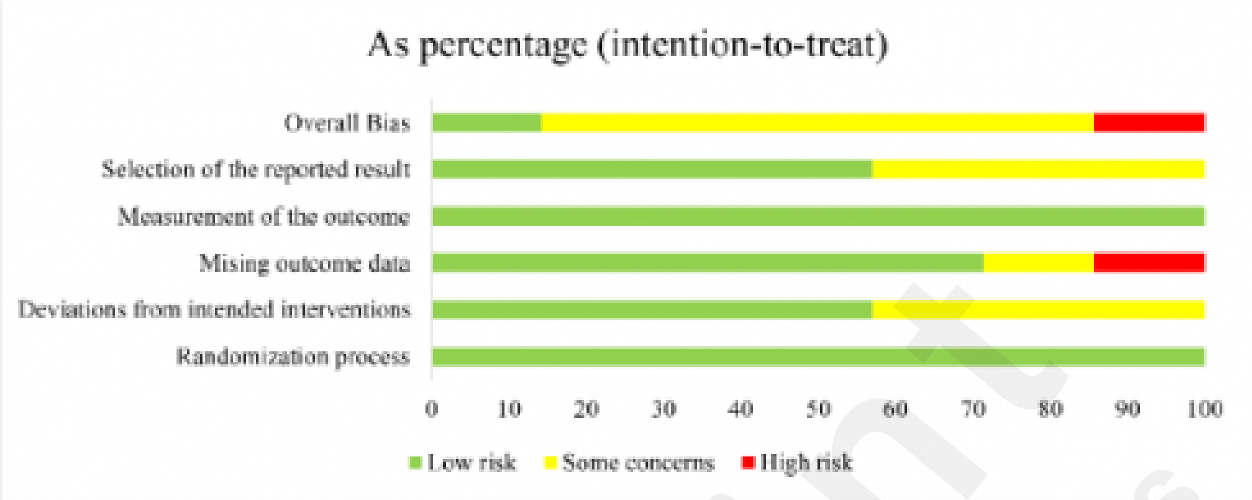

Figure 3. Risk of bias summary of the included studies.

Multimedia Appendixes

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