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Effects of Remote Health Monitoring on Quality of Life and Hospitalization Outcomes in Patients with Chronic Obstructive Pulmonary Disease: A Systematic Review and Meta-analysis

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ADMINISTRATIVE INFORMATION

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 9 August 2026 and was last updated on 9 August 2026.

INTRODUCTION

Review question / Objective Routine COPD follow-up is usually based on planned outpatient visits. Some patients seek care only after their symptoms become worse. Changes in symptoms, early deterioration, and poor treatment adherence may therefore be missed between visits. Remote health monitoring collects symptoms, vital signs, or other disease data at home. These data are sent to healthcare workers. The care team can review the information, give advice, change treatment, or arrange further care when needed. Mobile phones, digital platforms, and home devices have made this type of monitoring easier to use. However, remote monitoring programs are not all the same. They differ in what they measure, how often data are sent, how warning signs are defined, how staff respond, and what care the control group receives. Simply stating that a study used a monitoring

device may not show the true effect of the program.

Studies have not reached the same conclusion about remote health monitoring for COPD. Some studies found fewer hospitalizations and better health-related quality of life. Other reviews found little or no clear benefit. Sul et al. reviewed 28 randomized controlled trials and found no significant improvement in quality of life or healthcare use. Jang et al. reported fewer emergency visits in patients with severe COPD exacerbations, but the effect on hospitalizations was limited. A 2021 Cochrane review also found that the evidence for hospitalization and quality-of-life outcomes was uncertain. Differences in patients, intervention methods, follow-up time, and outcome definitions may explain these mixed results.

Hospitalization can be measured in different ways, and these measures do not mean the same thing. The number or rate of hospitalizations shows the

total use of hospital care during follow-up. One patient may have several admissions. In contrast, the outcome of at least one hospitalization only records whether a patient was admitted or not. It does not show repeated admissions. Combining these outcomes may lead to an unclear conclusion. Quality of life also needs careful handling. Disease-specific scales and general health scales measure different parts of health. Pooling them without distinction may make the findings harder to interpret.

This review compared remote health monitoring plus usual care with usual care alone in adults with COPD and examined quality of life and hospitalization outcomes. COPD-related hospitalization frequency or incidence rates were analyzed separately from the risk of experiencing at least one hospitalization to clarify whether remote health monitoring has different effects on the burden of recurrent hospitalization events and on the patient-level risk of hospitalization. Random-effects models were applied, together with heterogeneity assessments, prediction intervals, and sensitivity analyses, to provide a more comprehensive evaluation of the available evidence and to inform the appropriate use of remote health monitoring in the long-term management of COPD.

Condition being studied Studies involving adults aged 18 years or older with COPD were eligible for inclusion. COPD was diagnosed according to international guidelines or relevant national diagnostic criteria adopted by the individual studies.

METHODS

Search strategy The search strategy was developed around three core concepts: COPD, remote health monitoring, and randomized controlled trials. Search terms included “chronic obstructive pulmonary disease,” “COPD,” “telemonitoring,” “remote monitoring,” “telehealth,” “mobile health,” and “home monitoring,” together with their synonyms and study-design terms such as “randomized controlled trial.”

The complete search results, database-specific search strategies, and study-selection process were documented and reported in accordance with PRISMA 2020.

Participant or population Studies involving adults aged 18 years or older with COPD were eligible for inclusion. COPD was diagnosed according to international guidelines or relevant national diagnostic criteria adopted by the individual studies. Studies involving mixed populations with

other chronic diseases were included only when data for the COPD subgroup could be extracted separately.

Intervention The intervention was defined as remote health monitoring delivered outside hospital settings in addition to usual care. To be considered remote health monitoring, the intervention was required to meet at least one of the following criteria: patients or caregivers transmitted information on symptoms, physiological parameters, or disease status to a healthcare team through electronic devices, mobile applications, or home-monitoring equipment, and healthcare professionals reviewed the transmitted data, identified abnormalities, provided health guidance, or initiated clinical management.

Comparator Eligible comparators included usual care, standard medical follow-up, or disease-management programs that did not incorporate an equivalent remote-monitoring component.

The following studies were excluded:

1. studies providing health education alone or a single educational session;
2. studies providing only appointment reminders or intermittent telephone contact without continuous monitoring;
3. interventions that did not include both patient information collection and feedback from healthcare professionals;
4. observational studies, case reports, conference abstracts, study protocols, and studies from which valid outcome data could not be obtained.

When multiple publications were derived from the same study cohort, reports were linked and consolidated according to the study population, intervention characteristics, and reported outcomes to avoid duplicate inclusion of the same participants.

Study designs to be included Randomized controlled trials (RCTs), including individually randomized and cluster-randomized trials, were eligible for inclusion. Crossover trials were included only when independent data from the randomized treatment periods were available.

Eligibility criteria Studies involving mixed populations with other chronic diseases were included only when data for the COPD subgroup could be extracted separately.

Information sources PubMed, Embase, the Cochrane Central Register of Controlled Trials (CENTRAL), Web of Science, China National Knowledge Infrastructure (CNKI), Wanfang Data, and the VIP Database were systematically

searched from database inception to June 30, 2024, without language restrictions.

ClinicalTrials.gov, the reference lists of included studies, and relevant systematic reviews were also searched to identify additional potentially eligible studies.

Main outcome(s) Eight randomized controlled trials involving 1,131 patients were included in the analysis of disease-specific quality of life. The pooled results indicated that patients receiving remote health monitoring showed a trend toward greater improvement in quality of life compared with controls; however, the difference was not statistically significant (Hedges' $g=0.19$, 95% CI -0.04 to 0.43 , $P=0.095$), with moderate heterogeneity among studies ($I^2=53.7\%$). A sensitivity analysis including 16 trials using broader quality-of-life measures showed a pooled effect size of 0.16 (95% CI -0.0005 to 0.32 , $P=0.051$). Eleven trials involving 1,350 patients were included in the analysis of COPD-related hospitalization frequency or incidence. Remote health monitoring lowered the frequency of COPD-related hospitalizations (rate ratio= 0.77 , 95% CI 0.63 – 0.93 , $P=0.013$). Two core studies also assessed whether patients had at least one hospitalization. No significant difference was found between the two groups (risk ratio= 0.89 , 95% CI 0.53 – 1.49 , $P=0.217$).

Quality assessment / Risk of bias analysis The Cochrane Risk of Bias 2 tool (RoB 2) was used to assess the methodological quality of the included randomized controlled trials.

The assessment covered the following domains:

- 1.bias arising from the randomization process;
- 2.bias due to deviations from the intended interventions;
- 3.bias due to missing outcome data;
- 4.bias in the measurement of outcomes;
- 5.bias in the selection of the reported results.

Because blinding of participants and intervention providers is generally difficult in remote health monitoring trials, particular attention was given to whether the absence of blinding could have influenced outcome assessment, whether loss to follow-up affected between-group comparisons, and whether selective outcome reporting was present.

Strategy of data synthesis Statistical analyses were performed using R software, version 4.6.0, and the metafor package.

For continuous outcomes, Hedges' g was calculated as the standardized effect estimate to reduce small-sample bias. Quality-of-life scores

were aligned in the same direction before effect estimates were pooled.

Rate ratios were used to analyze the number or incidence rate of COPD-related hospitalizations, whereas risk ratios were used to evaluate the risk of experiencing at least one hospitalization. All effect estimates were reported with 95% confidence intervals (CIs).

Given the expected differences across studies in participant characteristics, intervention modalities, follow-up duration, and healthcare settings, all meta-analyses were conducted using random-effects models. Between-study variance was estimated with the restricted maximum likelihood method. The Hartung-Knapp method was used to calculate the confidence intervals of the pooled results.

We assessed heterogeneity with Cochran's Q test, I^2 , and τ^2 . We also calculated prediction intervals to show the possible range of effects in a similar future study.

We used leave-one-out analysis to check whether one study strongly changed the main result. For quality of life, we also performed a sensitivity analysis that included more types of quality-of-life measures. Hospitalization frequency and the risk of at least one hospitalization were analyzed separately.

Funnel plots and formal publication-bias tests were not used when only a few studies were available. In this situation, these tests have low power and may give an unreliable result.

All statistical tests were two-sided, and a P value of <0.05 was considered statistically significant.

Subgroup analysis Studies involving mixed populations with other chronic diseases were included only when data for the COPD subgroup could be extracted separately.

Sensitivity analysis Generic health-related quality-of-life measures were additionally included in a sensitivity analysis to assess the robustness of the findings to different definitions of quality of life.

Country(ies) involved China.

Keywords Chronic obstructive pulmonary disease; remote health monitoring; telemonitoring; health-related quality of life; hospital admission; meta-analysis.

Contributions of each author

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