



Effectiveness of Telemedicine in Patients With Respiratory Failure: Systematic Review of Randomized Controlled Trials

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BACKGROUND

Telemedicine refers to the practice of delivering medical care and services remotely through digital communication technologies. This approach allows healthcare professionals to evaluate, diagnose, and treat patients without the need for an in-person visit. It leverages a range of tools including video conferencing, mobile health apps, remote monitoring devices, and electronic health records (EHRs). Telemedicine potentially can be applied as a supporting care for patients with prolonged needs for hospital care. Yet, there have been very few studies on its effectiveness. This study aims to evaluate the effectiveness of telemedicine in patients with respiratory failure.

RESULTS

Three RCTs were included after screening with a total of 122 respiratory failure patients with mean aged 55-63 years. All three studies showed that Telemedicine homecare, compared with patients in hospital, present as an effective treatment option, showed a significant improvement in overall survival, sudden patient's hospitalization, and lower patient's treatment cost. During quality assessment using the JADAD scale, all studies were of good quality.

| First Author, year | Title | Research Country | Study Type | Median Age (IQR) | n patients | Treatment Period | Result | Conclusion |
|--------------------------|---|------------------|-----------------------------------|--|------------|------------------|---|---|
| Shimoyama et al. | Effectiveness of a telenursing intervention program in reducing exacerbations in patients with chronic respiratory failure receiving noninvasive positive pressure ventilation: A randomized controlled trial | Japan | Randomized Controlled Trial (RCT) | 70.0 (10.2) | 31 | 3 Months | At follow-up, the number of routine outpatient visits for acute exacerbations ($p = .045$), the number of hospitalizations ($p = .037$), the number of hospital days ($p = .031$), SGRQ ($p = .039$) score, and SCAQ ($p = .034$) score were significantly different. The increase in the number of unscheduled outpatient visits in the intervention group during follow-up was attributed to acute exacerbations and a significant decrease in the number of hospitalizations and hospital days. | After 3 months of exposure to the telenursing intervention program, both the number of hospitalizations for acute exacerbations and the number of hospital days decreased. In addition, there was an improvement in the self-care ability of the patients in the intervention group. |
| Van den Biggelaar et al. | A Randomized Trial of Initiation of Chronic Noninvasive Mechanical Ventilation at Home vs In-Hospital in Patients With Neuromuscular Disease and Thoracic Cage Disorder: The Dutch HomeRun Trial | Netherlands | Randomized Controlled Trial (RCT) | Home: 55.7 (14) Hospital: 58.2 (12) | 24 | 6 Months | A total of 96 patients were randomized, most of them diagnosed with neuromuscular disease. We found a significant improvement in PaCO ₂ within both groups (home: from 6.1 to 5.6 kPa [$P < .01$]; hospital: from 6.3 to 5.6 kPa [$P < .01$]), with no significant differences between groups. Health-related quality of life showed significant improvement on various subscales; however, no significant differences were observed between the home and hospital groups. From a societal perspective, a cost reduction of more than €3,200 (\$3,793) per patient was evident in the home group. | This nationwide, multicenter study shows that NIV initiation at home is noninferior to hospital initiation, as it shows the same improvement in gas exchange and health-related quality of life. In fact, from a patient's perspective, it might even be a more attractive approach. In addition, starting at home saves over €3,200 (\$3,793) per patient over a 6-month period. |
| Duiverman et al. | Home initiation of chronic non-invasive ventilation in COPD patients with chronic hypercapnic respiratory failure: a randomised controlled trial | Netherlands | Randomized Controlled Trial (RCT) | Home: 63.6 (8.6) Hospital: 63.1 (7.0) | 67 | 6 Months | Home NIV initiation was non-inferior to in-hospital initiation (adjusted mean difference in PaCO ₂ change home vs in-hospital: 0.04 kPa [95% CI -0.31 to 0.38 kPa]), with both groups showing a PaCO ₂ reduction at 6 months compared with baseline (home: from 7.2±0.9 to 6.4±0.8 kPa ($p<0.001$) and in-hospital: from 7.4±1.0 to 6.4±0.6 kPa ($p<0.001$)). In both groups, HRQoL improved without a difference in change between groups (Clinical COPD Questionnaire total score-adjusted mean difference 0.0 [95% CI -0.4 to 0.5]). Furthermore, home NIV initiation was significantly cheaper (home: median €3768 [IQR €3546-€4163] vs in-hospital: median €8537 [IQR €7540-€9175]; $p<0.001$). | In both groups, HRQoL improved without a difference in change between groups (Clinical COPD Questionnaire total score-adjusted mean difference 0.0 [95% CI -0.4 to 0.5]). Furthermore, home NIV initiation was significantly cheaper (home: median €3768 [IQR €3546-€4163] vs in-hospital: median €8537 [IQR €7540-€9175]; $p<0.001$). |

Table 1. Results Summary

| | Inclusion | Exclusion |
|----------------------|--|---|
| Publication Type | Original Research | Lectures, Books, Letters, Expert Opinions, Presentation, and Medical Poster |
| Study Type | Cohort, Clinical Trial, and Randomized Control Trial | Review Article |
| Publication Period | Last 5 Years | |
| Publication Language | English | Not Translated to English |

Table 2. Inclusion and Exclusion Criteria of The Study

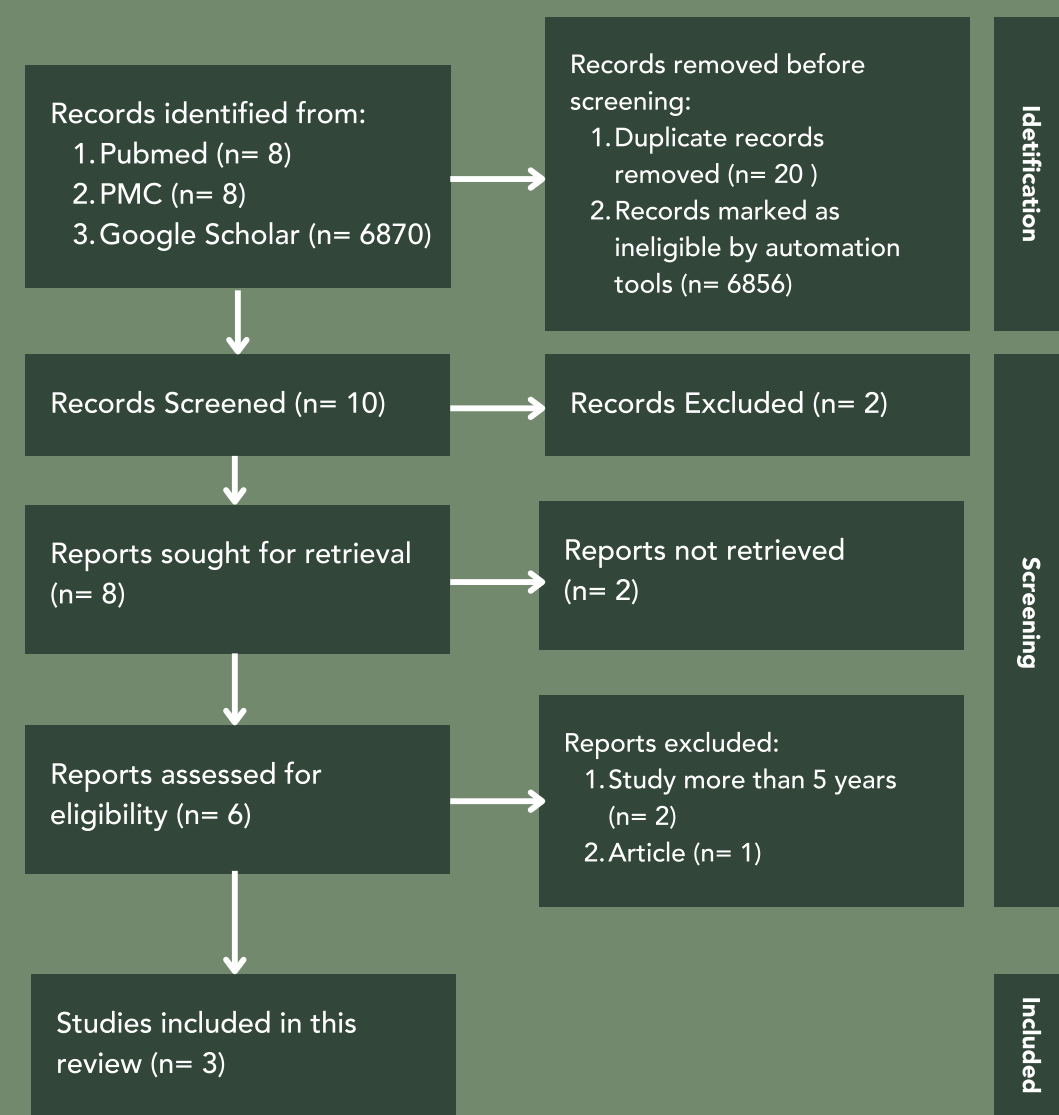
OBJECTIVES

This study aims to evaluate the effectiveness of telemedicine in patients with respiratory failure.

METHODS

All studies were derived from PubMed, PMC, and ScienceDirect by keywords "Respiratory Insufficiency" AND "Telemedicine" AND "Home Care". The search was occurring from July 1st, 2024 until July 20th, 2024. Three authors searched, extracted, and evaluated the studies with inclusion criteria as RCTs within the last five years, Randomized Clinical Trial study, and Study conducted in adult patients. We excluded studies on patients under 18 years old, animal studies and irretrievable full text articles. The JADAD Scale was used to determine the quality of the included studies.

Identification of Studies via Database & Registers



Flowchart 1. PRISMA Flowchart

| Study quality | Shimoyama et al. | Van den Biggelaar et al. | Duiverman et al. |
|--------------------------------------|------------------|--------------------------|------------------|
| Randomization present | 1 | 1 | 1 |
| Appropriate randomization utilized | 1 | 1 | 1 |
| Blinding present | 0 | 1 | 1 |
| Appropriate blinding method utilized | 0 | 1 | 1 |
| Appropriate long-term follow up | 1 | 1 | 1 |
| Total | 3 | 5 | 5 |

Table 3. Bias Score With JADAD Scale

CONCLUSION

Telemedicine is recommended as a novel option for respiratory failure patients due to its ability to significantly improve patients' experience doing their care and lowering patient's treatment cost.