Original Research
Feasibility of Using Daily Home High-Flow Nasal Therapy in COPD Patients Following a Recent COPD Hospitalization

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Citation: Criner GJ, Criner L-YH, George SA, Thomas JK, Jacobs MR. Feasibility of using daily home high-flow nasal therapy in COPD patients following a recent COPD hospitalization. Chronic Obstr Pulm Dis. 2021; Published online November 4, 2021. doi: https://doi.org/10.15326/jcopdf.2021.0236

Running Head: Home high-flow nasal therapy in COPD
Abbreviations

HFNT – High Flow Nasal Therapy
AECOPD – Acute Exacerbation of COPD
COPD – Chronic Obstructive Pulmonary Disease
SGRQ – Saint George’s Respiratory Questionnaire
CAT – COPD Assessment Test
6 MWD – 6 Minute Walk Distance
FiO₂ – Fraction of Inspired Oxygen
NIV – Non-invasive Ventilation
L – Liters
O₂ – Oxygen
PAP – Positive Airway Pressure
CPAP – Continuous Positive Airway Pressure
NPPV – Non-invasive Positive Pressure Ventilation
BMI – Body mass index
SpO₂ – blood oxygen saturation determined by pulse oximetry
mMRC – Modified Medical Research Council dyspnea score
GOLD – Global Initiative for Chronic Obstructive Lung Diseases
BODE – Body mass index, airflow obstruction, dyspnea and exercise capacity index
SD – Standard Deviation
LPM – Liters per minute
C – Temperature in degrees centigrade
SEM – Standard Error of the Mean
ABGs – Arterial Blood Gases
VAS – Visual analog scale
FVC – Forced vital capacity
FEV$_1$ – Forced expiratory volume in one second
FEF – Forced expiratory flow
PaCO$_2$ – Partial pressure of carbon dioxide
mmHg – millimeters of Mercury
pH – scale of acidity of the blood
HCO$_3$ – bicarbonate
SABA – Short-acting beta agonist
LABA – Long-acting beta agonist
SAMA – Short-acting muscarinic antagonist
LAMA – Long-acting muscarinic antagonist
ICS – Inhaled corticosteroid

MesH words: high flow nasal therapy, noninvasive ventilation, chronic obstructive pulmonary disease

Abstract word count: 237

Body word count: 2838

Table count: 3

Figure count: 5

**Statement of Funding Support:** Funding, equipment and supplies were provided by Fisher & Paykel Healthcare
Abstract

**Rationale:** High-flow nasal therapy (HFNT) has beneficial effects in patients hospitalized with acute hypoxemic respiratory failure. HFNT has not been extensively studied following hospitalization for an Acute Exacerbation of COPD (AECOPD).

**Objective:** We explored the feasibility of conducting a multicentered trial to evaluate the use of HFNT to increase the time to next moderate/severe exacerbation in patients recently hospitalized for a COPD exacerbation. In this pilot study we measured the hours of home daily HFNT use, maximally tolerated flow rates and temperature, and side effects for a period of 90 days.

**Methods:** Patients were enrolled in a 90-day open-labeled pilot study of HFNT to determine the safety and feasibility of home use for daily outpatient COPD management. Patients ≥ 40 years of age with prior hospitalization within the past 12 weeks for an acute COPD exacerbation were enrolled. COPD as the primary diagnosis in all patients.

**Results:** Thirty patients presented for HFNT titration. Two dropped out; one after receiving a lung transplant and the other was lost to follow-up. The remaining 28 patients completed 90 days of HFNT. None withdrew from HFNT due to intolerance. Use of HFNT averaged 6.8 (2.1) hours daily.

**Conclusions:** Daily home HFNT for up to three months is feasible in COPD patients following hospitalization for an acute exacerbation. Improvements observed in disease specific quality of life, respiratory symptoms and 6 MWD suggest the need for a prospective multicenter controlled clinical trial.
Introduction

Acute exacerbations account for 68% of COPD total care costs in the U.S.; hospitalizations account for the majority of costs.(1) COPD is the 3rd leading cause of re-hospitalization; re-hospitalization is associated with significant morbidity and mortality and also increases costs.(2) The Agency for Health Care Policy Research reported that 21% of U.S. COPD patients were readmitted within 30 days and in 85% of readmissions, COPD was the primary or secondary diagnosis.(3) Although many drug therapies prevent COPD exacerbations, as of yet, none primarily reduce mortality rates.(2, 4) Therapies that reduce ventilatory workload, are well tolerated, and easy to implement are needed as treatments for patients with COPD, especially in patients at risk for repeated hospitalization.

High Flow Nasal Therapy (HFNT) is an approach that may help manage patients with COPD at risk for repeated exacerbations, especially those at risk for repeated hospitalization. HFNT delivers warmed, humidified air-oxygen blends with flow rates up to 60L/min with FiO₂ from 21-100%. HFNT enhances oxygenation by closely matching the patient’s inspiratory flow rate and minimizing ambient air entrainment during spontaneous breathing.(5) Because of its higher flow rate, HFNT washes out nasopharyngeal dead space (6), improves ventilation efficiency (7) and provides a small but incremental flow-based increase in positive airway pressure(8). These are associated with an increase in end-inspiratory lung volume, reduced airway resistance and increased functional residual capacity. (9, 10) HFNT has been reported to be better tolerated than standard nasal oxygen therapy because the delivered warmed, humidified gases reduces airway cooling and desiccation and may thereby moisten secretions and facilitate mucociliary clearance. (11, 12)
Clinical trials using HFNT in acute hypoxemic respiratory failure have shown HFNT to be superior to O2 or noninvasive ventilation (NIV) in ventilator free days and 90 day mortality (13) and non-inferior to NIV in preventing reintubation after cardiothoracic surgery (14). HFNT has been reported superior to O2 in decreasing reintubation in critically ill patients at risk for reintubation (15), and reducing hospitalization stay following thoracic resection.(16) HFNT improves oxygenation for the same level of FiO2 compared to a Venturi mask but with better patient comfort, fewer desaturations, less interface displacements, and a lower reintubation rate.(17, 18) In contrast to data about HFNT use in the above patient populations, data about its use in patients with COPD in the outpatient setting is limited.(19-22) The mechanisms of potential benefit in this population have been described(23), but home use of HFNT is not available. The success of any clinical trial is largely driven by site investigators’ resources and capabilities, and the willingness of study participants to complete all study-related procedures and adhere to the proposed intervention. With that in mind, we performed a single-center study of HFNT use that incorporated many of the procedures and interventions that might be used in a multicentered trial to determine study feasibility. In this 90-day pilot study we measured the hours of daily HFNT use, the ranges of maximally tolerated flow rates and temperature, as well as any side effects that resulted in poor tolerance or termination of HFNT use.

Methods

Study participants were recruited from the pulmonary care unit of the Ambulatory Care Center of Temple University Hospital. Eligibility requirements were age ≥ 40 years; hospital admission for an acute exacerbation of COPD within the past 12 weeks. All patients had to have recovered from their COPD exacerbation and be clinically stable. Patients must have had COPD as the
primary diagnosis and had smoked ≥10 pack years. The main exclusion criteria were upper airway or nasal complications that prohibited the use of HFNT. Patients using of any PAP-therapy (e.g., CPAP or NPPV) ≤ 4 weeks of study entry were excluded. Women of childbearing potential had a urine pregnancy test to ensure that they were not pregnant. Patients provided informed consent and expressed a willingness to participate in all study-related activities.

**Study Design**

The overall trial design is presented in Figure 1. Patients who met eligibility criteria and provided informed consent were scheduled for an outpatient visit. Prior to any other study-related procedures patients were screened for a high likelihood of sleep apnea (STOPBang scores ≥ 5 or STOPBang score ≥ 2 plus BMI > 35 kg/m²; (24) or Berlin questionnaire scores suggesting a high likelihood of sleep apnea with increased risk of sleep-related accidents; (25) excessive daytime sleepiness (i.e., either a high (>15) score on the Epworth Sleepiness Scale or “fall asleep” accident or “near miss” accident in prior 12 months). (26)

**Intervention**

All study participants were asked to use the myAirvo™ 2 device (Fisher & Paykel Healthcare) for a minimum of 4 hours per night. The myAirvo™ 2 device is a humidifier with integrated flow generator that delivers high flow warmed and humidified respiratory gases to spontaneously breathing patients. The flow rate was initially set at 25 L/min and titrated upward to maintain a SpO₂ of 90% or more at a temperature of 34-37°C. Airflow was delivered through the Optiflow™+ nasal cannula (Fisher & Paykel Healthcare) sized for patient comfort.

**Measurements**

Demographic data including age, gender, race, current medications, and comorbid conditions was collected at enrollment. At the baseline visit vital signs were obtained as were dyspnea
scores (modified Borg score(27, 28), mMRC(29)). Arterial blood gases after 5 minutes of inspiring supplemental oxygen to keep $\text{SaO}_2 \geq 90\%$ were collected as well as the use of accessory muscles of ventilation. Pre-and post-bronchodilator spirometry was performed. Patients completed the COPD assessment test,(30) and the St. George’s Respiratory Questionnaire.(31) Patients performed a 6-minute walk test.(32) The patient’s GOLD grade(33) was determined and BODE scores were calculated.(34) For the primary outcome of patient comfort a 100 mm visual analog scale was used anchored at 0 (no discomfort) and 100 (maximal imaginable discomfort). A 5-point Likert scale was used for patient to report their sensation of shortness of breath from “Marked Deterioration” to “Marked Improvement”. Patient comfort and sensation of shortness of breath were recorded at the baseline visit and at each of five subsequent clinic visits. Based on these reports, changes were made to flow rates and temperatures as needed.

Patients were provided with an electronic daily COPD symptom diary to record breathlessness, cough, consistency and quantity of sputum production and the presence of wheezing, sore throat, or nasal congestion as well as daily peak flow readings.(35) Patients were provided with a PersonalBest® (Philips Respironics) peak flow meter and asked to make three peak flow maneuvers. The best of the three maneuvers was recorded on the electronic symptom diary. After a 2-week run-in period for symptom reporting, the patient returned to initiate HFNT therapy. Follow-up clinic visits and telephone contacts are shown in Figure 1.

At the conclusion of the study patients were offered the opportunity to continue to use HFNT therapy if they wished to do so.

**Sample Size**
This pilot study was powered to detect an unacceptably high rate of safety issues or unforeseen problems. The sample size was estimated based on the method described by Viechtbauer, et.al. for detecting problems that arise in pilot studies. Using a 95% confidence threshold and 10% probability that a safety event occurred (defined as the need to discontinue HFNT due to intolerance) the required sample size was 29 patients.

**Statistical Analysis**

Descriptive statistics (mean (SD) or median (IQR)) are reported for continuous variables to characterize the patient population in terms of demographic factors and severity of airflow obstruction. Changes in arterial blood gases, 6 MWD, CAT and SGRQ scores, and spirometry values were analyzed using paired t-tests. All tests were performed using JMP® Pro 14.2.0, © 2018 SAS Institute Inc.

**Study Conduct, Approval, and Registration**

This trial was conducted in accordance with the Declaration of Helsinki principles. The study protocol was approved by the Western Institutional Review Board (WIRB, Approval Number: 20170689), and written informed consent was obtained from all study participants before they entered the trial. This trial was registered with ClinicalTrials.gov (NCT03221387) prior to the enrollment of the first study participant.

**Funding Source**

Fisher & Paykel Healthcare contributed towards the funding for this study.

**Results**

Forty-one patients who were recently hospitalized for a COPD exacerbation were consented for the study (Figure 2). Two of these were subsequently excluded because of a high risk of having sleep apnea (by questionnaire) and one by a sleep study that revealed sleep apnea. Eight patients
did not return for the high flow titration visit and did not receive study intervention. Two patients who did start high flow therapy subsequently dropped out before the end of the 90-day evaluation visit (one received a lung transplant and another was lost to follow-up). This report reflects the findings of the 28 patients who completed the 90-day visit. Baseline characteristics of the study participants are presented in Table 1.

**Nasal High Flow parameters**

HFNT was delivered at 35 LPM in 24 patients and 30 LPM in 4 patients. Prior to the application of HFNT, sixteen patients (57%) maintained adequate oxygen saturations with a FiO2 of 21% (room air). The remaining 12 patients required supplemental oxygen with FiO2 ranging between 26% and 32%. No changes were made to the oxygen prescription after application of the device. All patients left the oxygen titration visit with heated humidified high flow at 37°C. One patient subsequently asked that the temperature be reduced to 34°C at a follow-up visit.

**Primary outcomes**

Of the 30 patients initially enrolled in the study, 28 continued to use HFNT throughout the 90-day observation period. Patients used HFNT for an average of 6.8 (SD 2.1) hours daily. Visual analog scores for patient comfort are shown in Figure 3. The scores among all patients averaged between 20 mm and 30 mm for each of the clinic visits although there was substantial variability in scores, hence they are reported as mean score ± SEM.

The effect of HFNT on the sensation of breathlessness tended to improve over the course of the study with 25 of 28 patients reporting a slight to marked improvement in the sensation of breathlessness by visits 4 and 5. (Table 2)

**Secondary outcomes**
There were no statistically significant changes in any of the secondary outcomes, which included spirometry, ABGs, 6 MWD, SGRQ, and the COPD Assessment Test. (Table 3)

**COPD symptom reports**

COPD symptom reports showed that approximately 84% of all potential daily symptom reports were made; median symptom reporting compliance was 85% (IQR 75% - 93%).

Trends for each of the COPD symptoms and peak flow readings are shown in Figures 5 and 6. Over the course of the 90-day study only seven reports of increased temperature were made by six different patients. Cough and wheezing were the most frequently reported COPD symptoms and tended to decrease over the study period. Nasal congestion and sore throat were less frequently reported, and the number of reports remained stable. Dyspnea scores remained unchanged. Average peak flow readings increased slightly during the reporting period from just over 200 L/min to around 235 L/min. Several changes were observed in the characteristics of sputum production. The number of patients who reported no sputum production trended upward over the course of the study with patients reporting decreases in thick, thin, and watery sputum consistency. Very few individuals reported production of green or brown sputum. The numbers of patients who produced white or yellow sputum decreased over time with the majority moving towards no sputum production.

**Discussion**

In our study of HFNT in patients recently discharged from the hospital for a COPD exacerbation, we met our primary objective of assessing the feasibility of daily use over 90 days. In this population of patients with very severe COPD and recent hospitalization, we found acceptable daily usage of HFNT at optimal HFNT settings of flow and humidification and no untoward side effects or technical issues. No patients who were started on HFNT needed to be removed for
lack of efficacy or intolerance, although two patients dropped out: one after receiving a lung transplant and the other lost to follow-up despite multiple attempted contacts. While we asked patients to use HFNT for a minimum of four hours daily, the overall daily use was greater than at and averaged about six hours per day. Patients agreed to and were able to complete all study related assessments.

Pearson has defined comfort as a physical sensation, a psychological state or a combination of both.(36) Measurement of comfort is by definition, subjective. In a comparison study between nasal high-flow therapy and Venturi mask oxygen therapy by Maggiore, patients were asked about discomfort with the nasal interface and symptoms of airway dryness.(17) This was done by using a 0 to 10 scale correlating with no discomfort and maximum discomfort respectively. Visual analog scales have also been used. (36) We utilized a 100 mm visual analog scale to assess patient discomfort while using the device. Mean VAS scores averaged near 30 mm at the start of the study and decreased over time; however, there was substantial variability in the comfort scores even in the same patient between visits. When used for the assessment of pain, a score of 30 mm or less is typically defined as “mild pain”. (37) It appears that many patients experienced mild discomfort around the nares using the device at some point over the course of the study, though none discontinued using the device due to this mild discomfort.

Although there were no statistically significant differences in the secondary outcomes, there was a 24-meter increase in 6-minute walk distance, and a 3.4-point drop in the SGRQ. The improvement in 6-minute walk distance parallels the observation in another controlled trial of HFNT vs usual care.(21) Their same study showed a stabilization of the SGRQ in the HFNT
group compared to a slight worsening in the usual care group. Despite being unpowered to reach this endpoint, our study also showed a 2.6-point drop in the COPD Assessment Test, which just failed to reach statistical significance (p = 0.07).

Most of the symptom scores reported in the daily electronic diary remained essentially unchanged over the study including nasal congestion, Borg dyspnea score, presence of sore throat, and peak flow readings. What did trend downward were the number of reports of wheezing and cough, and changes in the color, consistency, and volume of sputum. Patients who produced white or yellow sputum transitioned to none; those producing thick or thin sputum transitioned to watery or no sputum production; and those who were producing a tablespoonful or more of sputum daily transitioned to no or lower levels of sputum production. The reasons for the shift to no or lower levels of sputum production are not unknown but the application of heated and humidified HFNT has been reported to facilitate secretion removal. It may be that HFNT users find it easier to cough and clear secretions, but this was not objectively measured in our pilot study. A recent study by Choate and colleagues shows that those who experience more cough and sputum production have worse clinical, and quality of life outcomes. Even so, there is no evidence to suggest that reducing cough or altering the volume, consistency or color of sputum results in improvements in clinical or QOL measures. Our study was not powered to show improvements in these outcomes.

By study’s end, 25 of 28 patients reported a slight to marked improvement in the sensation of breathlessness. This occurred even though there were no measurable changes in the Borg dyspnea scale, daily peak flow measures, arterial blood gases or spirometry, which suggests that
factor(s) other than dyspnea may be represented by this measurement. The finding of improvement in the sensation of breathlessness is consistent with a report of the qualitative experiences of domiciliary HFNT users and their relatives obtained by Storgaard.(39) Her structured interviews identified six “themes” that related to therapy adherence. These included a perceived lower work of breathing; reduced COPD symptoms; improvement in sleep quality; increased activity of daily living; feeling safe; and technology use. Perhaps a reduction in respiratory rate in patients with severe obstruction when using HFNT resulted in a prolongation of expiratory time and decrease in the extent of air-trapping, a known consequence of severe exacerbation in patients hospitalized with a COPD exacerbation.(41) Further studies will need to measure the impact of HFNT on air trapping.

Limitations
This study has several limitations. First, as a feasibility study the number of enrolled patients was small and performed at a single clinical center. Second, all patients were assigned to the intervention and served as their own control. Third, the use of the VAS and Likert scale to assess the sensation of shortness of breath have not been validated.

Conclusions
This single center study demonstrates the feasibility of using daily home HFNT in COPD patients recently discharged from the hospital for a COPD exacerbation. The therapy was well tolerated, and no patient needed to be removed from the intervention. The trends for improvements in quality of life measured by SGRQ, COPD assessment test, and 6-minute walk distance suggests that home HFNT may have benefit in patients following a recent COPD exacerbation.
hospitalization. These findings require validation by a well-powered, prospective, multicentered, controlled trial.

Acknowledgements:

Author contributions: GJC, LHC, and MRJ formulated the overall study design. LHC, SG, and JKT assisted in data collection and consolidation. MRJ performed statistical analysis. MRJ and LHC drafted the manuscript. GJC reviewed and revised the manuscript.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declaration of Interest: GJC has received grant funding from Fisher & Paykel. JKT, MRJ, SAG and LHC have no conflicts of interest.
References


37. Hawker GA, Mian S, Kendzerska T, French M. Measures of adult pain: Visual Analog Scale for Pain (VAS Pain), Numeric Rating Scale for Pain (NRS Pain), McGill Pain Questionnaire (MPQ), Short-Form McGill Pain Questionnaire (SF-MPQ), Chronic Pain Grade Scale (CPGS), Short Form-36 Bodily Pain Scale (SF-36 BPS), and Measure of Intermittent and Constant Osteoarthritis Pain (ICOAP). Arthritis Care & Research. 2011;63(S1):S240-S52. doi: 10.1002/acr.20543.


<table>
<thead>
<tr>
<th>Characteristic</th>
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<tr>
<td>Age, years</td>
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<tr>
<td>Male sex (number, %)</td>
<td>15, 53.6%</td>
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<tr>
<td>Race (Caucasian/Black/Declined (number, %)</td>
<td>14 (50%); 13 (46%); 1 (3.5%)</td>
</tr>
<tr>
<td>Smoking (pack-years) median (IQR)</td>
<td>43 (28 – 60)</td>
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<tr>
<td>BMI mean kg/m²</td>
<td>25.7 (4.3)</td>
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<tr>
<td>GOLD stage 2/3/4 (number, %)</td>
<td>1, 3.5% / 12, 42.6% / 15, 53.6%</td>
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**Spirometry**

<table>
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<th>Value</th>
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<tr>
<td>FVC, L</td>
<td>1.90 (0.62)</td>
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<td>FEV₁, L</td>
<td>0.75 (0.3)</td>
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<td>FEV₁/FVC</td>
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<tr>
<td>FEF 25-75, L</td>
<td>0.27 (0.11)</td>
</tr>
</tbody>
</table>

**mMRC N, %**

| 1   | 4, 14.3% |
| 2   | 3, 10.7%  |
| 3   | 13, 46.4% |
| 4   | 8, 28.6%  |

| 6 MWD | 223 (76) |
| BORG | 2.46 (1.56) |
| BODE Index | 6.5 (1.8) |
| SGRQ (total score) | 58.5 (12.9) |
| CAT | 21.6 (7.9) |

**Arterial blood gases**

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<td>PaO₂ mm Hg</td>
<td>66 (11.3)</td>
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<tr>
<td>PaCO₂ mmHg</td>
<td>41.5 (5.8)</td>
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<tr>
<td>pH</td>
<td>7.44 (0.03)</td>
</tr>
<tr>
<td>HCO₃ mEq/L</td>
<td>27.5 (3.8)</td>
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</table>

**Medication Combinations**

<table>
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<th>Medication Combinations</th>
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<tbody>
<tr>
<td>SAMA + SABA + LAMA</td>
<td>1</td>
</tr>
<tr>
<td>ICS + SABA</td>
<td>4</td>
</tr>
<tr>
<td>ICS + SABA + SAM</td>
<td>3</td>
</tr>
<tr>
<td>ICS + SABA + LABA</td>
<td>2</td>
</tr>
<tr>
<td>ICS + SABA + SAM + LABA</td>
<td>2</td>
</tr>
<tr>
<td>ICS + SABA + LABA + LAMA</td>
<td>15</td>
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<tr>
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<td>1</td>
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</tbody>
</table>

Definition of abbreviations: BMI; body mass index; FVC, forced vital capacity; FEV₁, forced expiratory volume in one second; FEF, forced expiratory flow; mMRC, modified Medical Research Council dyspnea score; 6 MWD, 6 minute walk distance; BODE, body, obstruction, dyspnea, exercise score; SGRQ, Saint George’s respiratory questionnaire; CAT, COPD assessment test; SABA, short acting bronchodilator; LABA, long acting bronchodilator; SAMA, short acting muscarinic antagonist; LAMA, long acting muscarinic antagonist; ICS, inhaled corticosteroid.
Table 2. Sensation of shortness of breath (Likert scale)

<table>
<thead>
<tr>
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<th>Visit 1</th>
<th>Visit 2</th>
<th>Visit 3</th>
<th>Visit 4</th>
<th>Visit 5</th>
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<tbody>
<tr>
<td>Slight deterioration</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No change</td>
<td>11</td>
<td>5</td>
<td>7</td>
<td>3</td>
<td>3</td>
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<tr>
<td>Slight improvement</td>
<td>12</td>
<td>14</td>
<td>12</td>
<td>16</td>
<td>18</td>
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<tr>
<td>Marked improvement</td>
<td>3</td>
<td>8</td>
<td>6</td>
<td>9</td>
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Table 3. Secondary outcomes

<table>
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<td>1.90 (0.62)</td>
<td>1.97 (0.57)</td>
<td>0.33</td>
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<tr>
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<td>0.75 (0.3)</td>
<td>0.75 (0.3)</td>
<td>0.93</td>
</tr>
<tr>
<td>FEV&lt;sub&gt;1&lt;/sub&gt;/FVC</td>
<td>0.39 (0.09)</td>
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<td>0.22</td>
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<td>FEF 25-75, L</td>
<td>0.27 (0.11)</td>
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<td>6 MWD (meters)</td>
<td>223 (76.5)</td>
<td>247 (81.6)</td>
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<td>BORG</td>
<td>2.46 (1.56)</td>
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<td>58.5 (12.9)</td>
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<td>CAT</td>
<td>21.6 (7.9)</td>
<td>19.0 (7.5)</td>
<td>0.07</td>
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<tr>
<td><strong>Arterial blood gases</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PaO&lt;sub&gt;2&lt;/sub&gt; mm Hg</td>
<td>66 (11.3)</td>
<td>68 (15.2)</td>
<td>0.44</td>
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<td>PaCO&lt;sub&gt;2&lt;/sub&gt; mmHg</td>
<td>41.5 (5.8)</td>
<td>41.5 (5.4)</td>
<td>0.57</td>
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<tr>
<td>pH</td>
<td>7.44 (0.03)</td>
<td>7.44 (0.02)</td>
<td>0.75</td>
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<tr>
<td>HCO&lt;sub&gt;3&lt;/sub&gt; mEq/L</td>
<td>27.5 (3.8)</td>
<td>27.4 (3.4)</td>
<td>0.79</td>
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</table>
Figure 1 Study Design

Feasibility of using daily home HFNT during Sleep and/or Daytime in Hypercapnic COPD patients following recent (< 12 wks.) hospitalization for AECOPD for 90 days

AECOPD Hospitalization → Baseline Data² → Subjects Receive HFNT for 90 days → Repeat Baseline Data⁵

Meets entry Criteria¹
³ Phone calls days 1, 3, 17, 37, 58, 80 (±3)
⁴ Clinic visit days 7, 28, 49, 70, 90 (±5)

¹ > 40 yrs. Age and Hospitalized for AECOPD; able to sign IC and willing to do tests
² Vital signs, respiratory patient discomfort, Likert scale for clinical improvement, dyspnea (modified Borg Score, mMRC) ABG 5 minutes after inspiring O₂ to maintain SaO₂ >90%, spirometry, 6 MWT, questionnaires (CAT, SGRQ), set baseline diary for respiratory symptoms
³ Inquire about any problems and assess for adherence, troubleshoot
⁴ Vital signs, respiratory patient discomfort, Likert scale for clinical improvement, dyspnea, side effects of HFNT, and review daily electronic diary of respiratory symptoms
⁵ Same as #2
Figure 2 Study flow

41 recently hospitalized patients consented

38 scheduled for oxygen titration visit

3 screen failed (sleep apnea)
  - 2 STOPBang/Berlin questionnaire
  - 1 Sleep study

8 Did not attend oxygen titration visit

30 completed oxygen titration visit

Dropped out of study before 90 day visit
  - 1 lung transplant
  - 1 withdrew consent

28 completed 90 day visit
Figure 3. Nasal cannula discomfort score

![Graph showing mean VAS score ± SEM over visits.](image-url)
Figure 4. Daily Symptom Reports

Cough

Dyspnea Score

Nasal congestion

Sore Throat

Sputum Color

Sputum Consistency

Sputum Quantity

Wheezeing
Figure 5. Average reported peak flows