Effect of a Hospital-Initiated Program Combining Transitional Care and Long-term Self-management Support on Outcomes of Patients Hospitalized With Chronic Obstructive Pulmonary Disease: A Randomized Clinical Trial

Hanan Aboumatar, MD, MPH; Mohammad Naqibuddin, MBBS, MPH; Suna Chung, MPH; Hina Chaudhry, MPH; Samuel W. Kim, BA; Jamia Saunders, MD, MS; Lee Bone, MPH; Ayse P. Gurses, MS, MPH, PhD; Amy Knowlton, ScD, MPH; Peter Pronovost, MD, PhD; Nirupama Putcha, MD, MHS; Cynthia Rand, PhD; Debra Roter, DrPH; Carol Sylvestor, RN, MS; Carol Thompson, MS, MBA; Jennifer L. Wolff, PhD; Judith Hibbard, PhD, MPH, FCCM; Robert A. Wise, MD.

IMPORTANCE Patients hospitalized for chronic obstructive pulmonary disease (COPD) exacerbations have high readmission rates and reduced quality of life.

OBJECTIVE To evaluate whether a hospital-initiated program that combined transition and long-term self-management support for patients hospitalized due to COPD and their family caregivers can improve outcomes.

DESIGN, SETTING, AND PARTICIPANTS Single-site randomized clinical trial conducted in Baltimore, Maryland, with 240 participants. Participants were patients hospitalized due to COPD, randomized to intervention or usual care, and followed up for 6 months after hospital discharge. Enrollment occurred from March 2015 to May 2016; follow-up ended in December 2016.

INTERVENTIONS The intervention (n = 120) involved a comprehensive 3-month program to help patients and their family caregivers with long-term self-management of COPD. It was delivered by nurses with special training on supporting patients with COPD using standardized tools. Usual care (n = 120) included transition support for 30 days after discharge to ensure adherence to discharge plan and connection to outpatient care.

MAIN OUTCOMES AND MEASURES The primary outcome was number of COPD-related acute care events (hospitalizations and emergency department visits) per participant at 6 months. The co-primary outcome was change in participants' health-related quality of life measured by the St George's Respiratory Questionnaire (SGRQ) at 6 months after discharge (score, 0 [best] to 100 [worst]; 4-point difference is clinically meaningful).

RESULTS Among 240 patients who were randomized (mean [SD] age, 64.9 [9.8] years; 61.7% women), 203 (85%) completed the study. The mean (SD) baseline SGRQ score was 62.3 (18.8) in the intervention group and 63.6 (17.4) in the usual care group. The mean number of COPD-related acute care events per participant at 6 months was 1.40 (95% CI, 1.01-1.79) in the intervention group vs 0.72 (95% CI, 0.45-0.97) in the usual care group (difference, 0.68 [95% CI, 0.22-1.15]; P = .004). The mean change in participants' SGRQ total score at 6 months was 2.81 in the intervention group and −2.69 in the usual care group (adjusted difference, 5.18 [95% CI, −2.15 to 12.51]; P = .11). During the study period, there were 15 deaths (intervention: 8; usual care: 7) and 339 hospitalizations (intervention: 202; usual care: 137).

CONCLUSIONS AND RELEVANCE In a single-site randomized clinical trial of patients hospitalized due to COPD, a 3-month program that combined transition and long-term self-management support resulted in significantly greater COPD-related hospitalizations and emergency department visits, without improvement in quality of life. Further research is needed to determine reasons for this unanticipated finding.

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Chronic obstructive pulmonary disease (COPD) was the fourth leading cause of death in the United States in 2016, and has been a leading cause of morbidity and disability. Patients with COPD receiving emergency department (ED) and hospital care are more likely to have lower education and income and comorbidities. A review of discharge bundle interventions to improve outcomes of hospitalized patients with COPD showed a modest effect on reducing hospitalizations, and no effects on mortality or quality of life. Transitional care studies of patients with COPD are few, often limited to addressing postacute care needs in the 30-day postdischarge period, and did not focus on long-term chronic disease self-management skills. However, this may be insufficient for improving patient outcomes and reducing future acute care use.

Studies on COPD self-management support, mostly conducted in outpatient settings, have demonstrated improvements in health-related quality of life (HRQOL) and reductions in COPD-related acute care events. These studies have included ongoing education, action plans, and long-term self-management support. To our knowledge, no similar interventions have been tested among hospitalized patients with COPD, although hospitalization may offer a unique opportunity to engage patients and family caregivers in self-management of this condition.

In this study, a patient-centered, hospital-initiated, 3-month program that combines transition support and chronic disease self-management (the BREATHE Program) was developed and evaluated. The program aimed to improve quality of life and reduce acute care use among patients with COPD. The study’s primary hypothesis was that compared with participants who received usual transitional care, participants randomized to receive this program would have a lower number of COPD-related acute care events and better HRQOL at 6 months after hospital discharge.

Methods

The Johns Hopkins Institutional Review Board approved this study. Written consent was obtained from all participants. Detailed study methods are described elsewhere. The trial protocol and statistical analysis plans are available in Supplement 1 and Supplement 2, respectively.

Study Design and Setting

This single-blinded randomized clinical trial had 2 groups (intervention and usual transitional care). The study took place at Johns Hopkins Bayview Medical Center, a 447-bed academic community hospital in Baltimore, Maryland, that serves the largest number of patients with COPD within the Johns Hopkins Health System (JHHS). Most hospitalized patients with COPD are treated at 1 of 4 medical units at the hospital. All patients admitted to these units starting in March 2015 were screened for eligibility. Enrollment ended in May 2016 and follow-up ended in December 2016.

Participants were eligible if they were either admitted to the Johns Hopkins Bayview Medical Center with a diagnosis of acute COPD exacerbation or had a previous COPD diagnosis and were receiving additional treatment to control COPD symptoms in the current hospitalization. Additional eligibility criteria included being aged older than 40 years, having a smoking history of more than 10 pack-years, understanding the English language, having no terminal illness (<6-month life expectancy) other than COPD, having no severe cognitive dysfunction (able to follow simple instructions), not being homeless, and expecting discharge to home. Eligibility was confirmed via medical record review and clinician confirmation. No participants were excluded based on discharge diagnosis.

Participants were randomized in a 1:1 ratio to either study group based on a regenerated sequence of assignments. Randomization was stratified by hospital unit, and a computer algorithm was used to perform a blocked randomization assignment within strata with randomly selected block sizes of 2, 4, or 6. Data collectors and outcomes assessors were blinded to group allocation; however, due to the nature of the intervention, participants and clinicians were not blinded.

Key Points

Question Can a hospital-initiated program result in reduced acute care use and better quality of life for patients hospitalized for chronic obstructive pulmonary disease (COPD)?

Findings In this single-site randomized clinical trial that included 240 patients with COPD, a 3-month program that combined transition and long-term management support, compared with usual care, resulted in a greater number of COPD-related hospitalizations and emergency department visits (1.40 vs 0.72 per participant); this comparison was statistically significant. There was no significant change in health-related quality of life (2.81 vs −2.69 in the 100-point St George’s Respiratory Questionnaire) at 6 months.

Meaning This type of program may result in more acute care use among patients with COPD, but requires further research to determine the reason for this unexpected finding.
The intervention was delivered by COPD nurses (ie, nurses with special training on supporting patients with COPD using standardized tools). The nurses met with the patient (and caregiver whenever possible) during the hospital stay and for 3 months after discharge. They provided self-management support and addressed barriers to care. The program followed a patient-centered partnership approach and was delivered during a series of sessions held at the hospital and after discharge via home visit or telephone.\textsuperscript{15}

**Comparison Group**
Participants in the comparison group received the usual transitional care provided at the study site. This included assigning a general transition coach to follow up the patient for 30 days after discharge, focusing on adherence to the discharge plan, and connecting to outpatient care. eTable 1 in Supplement 3 compares the intervention and usual care groups.

**Data Collection**
Patient consent, baseline assessment, and randomization were completed during hospital stay. The assessment included patient report on education, income, patient activation measure (assesses an individual’s knowledge, skill, and confidence for managing their health),\textsuperscript{16} comorbidities, and race/ethnicity (collected to report on minorities’ representation in randomized clinical trials, using 2 separate questions with specified response categories). Data collection telephone calls were conducted at 1 week and 1, 3, and 6 months after discharge. Acute care visits were assessed via medical record review for all visits within JHHS. Participants were asked at each telephone call if they had visited any non-JHHS hospital or ED and, if so, their records were requested and reviewed. For participants who could not be reached at 6 months, visits within the JHHS and any outside visits reported previously were reviewed. Records of each visit were independently reviewed by 2 physicians to determine whether the visit was COPD-related using predefined criteria.\textsuperscript{15} A third physician adjudicated any unresolved conflicts. Data on deaths were collected via medical record and death certificate reviews.\textsuperscript{15}

**Outcomes**
The study’s prespecified primary outcome was the number of COPD-related acute care events, defined as hospitalizations and ED visits, per participant over the 6 months after discharge. A co-primary outcome was the change in participants’ SGRQ score at 6 months after discharge. The COPD-related events outcome was the primary design variable to power the study, and we would not have considered this study positive without inferring a benefit on this outcome. The SGRQ outcome was chosen as a key supportive outcome given its patient-centeredness and importance to interpreting intervention effects. The SGRQ is a valid instrument for measuring HRQOL in patients with respiratory disease, with a total score and scores for symptom, physical activity, and impact domains (score range, 0 [best]-100 [worst]).\textsuperscript{17} Total score’s minimum clinically important difference is 4 points.\textsuperscript{17,18}

Prespecified secondary outcomes were (1) 6-month mortality rate and (2) time to death or first COPD-related hospitalization or ED visit. As part of post hoc supplementary analyses, the following outcomes were compared: (1) mean number of COPD-related and all-cause acute care events per participant and the individual components (hospital and ED visits separately) at each time point; (2) percentage of participants who had at least 1 COPD-related acute care event; (3) change in participants’ SGRQ domain scores; and (4) percentage of participants whose HRQOL improved, stayed the same, or deteriorated within each group.

Intervention implementation was tracked and adverse events, including hospitalizations, deaths, and falls resulting in an acute care visit, were monitored.

**Statistical Analyses**
Sample size was calculated to detect a difference of 0.25 in the mean cumulative number of COPD-related visits per participant between study groups, with 80% power and type I error of .05 (2-sided). The 0.25 difference, which was based on results of an earlier COPD self-management trial, is considered clinically meaningful.\textsuperscript{13,19-21} The estimated sample size was 120 per group.\textsuperscript{15}

Unadjusted analyses of the treatment effect under intention to treat were performed using negative binomial regression for the cumulative count of events, and linear regression for change in SGRQ total and domain scores. Additional analyses were conducted, adjusting for baseline SGRQ and unit for change in SGRQ scores and predictors of hospitalization (age, home oxygen use, and hospitalization within past year) and unit for acute care event counts.\textsuperscript{22-24}

All analyses included robust estimates of variance and accounted for within-unit correlation. Normality and homoscedasticity of residuals were evaluated for linear regression models. SGRQ scores for patients who died were substituted with 100. The effect of missingness on primary outcomes was evaluated by comparing the patient characteristics of those with and without the missing outcome. Survival analyses and Cox proportional hazard models were used to compare the probability of not dying or having a COPD-related acute care event, by study group, adjusting for predictors of hospitalization. The proportional hazard assumption was evaluated with a test of a zero slope for the log-hazard ratio.

Post hoc analyses included logistic regression to compare the odds of having at least 1 COPD-related event, and responder analysis of participants whose HRQOL improved, stayed the same, or deteriorated (categorized change in SGRQ score as improved if ≤−4, and deteriorated if >4).\textsuperscript{17,18,21} A sensitivity analysis was performed to evaluate the effect of missingness on HRQOL using a mixed-effects generalized linear model with robust variance estimates, clustering within hospital units, with patient as random effect, and using all available SGRQ total scores (baseline, 3 months, and 6 months).

Post hoc exploratory subgroup analyses to assess heterogeneity of treatment effects were performed to evaluate the difference in treatment effect in subgroups of patients whose...
characteristics might have affected the primary outcome. The analyses were performed for the subgrouping variables of age, sex, marital status, home oxygen use, heart failure diagnosis, and baseline patient activation level. The treatment effects were estimated by the inclusion of an interaction term in a negative binomial regression model, standardizing with inverse probability weighting to address the correlation between the multiple subgrouping variables.25

Analysis was performed in Stata versions 14 and 15 (StataCorp). Main analyses were prespecified.25 Statistical significance was considered for \( P < .05 \) (2-sided). No adjustment for multiple comparisons was performed, and therefore all analyses of secondary and other supplementary outcomes should be considered exploratory.

Results

Figure 1 depicts participant recruitment, enrollment, and follow-up. Of 802 patients screened for participation, 417 met eligibility criteria and 240 provided consent. Baseline characteristics of the participants were similar between the study groups, except for a higher percentage of smoking, home oxygen use, heart failure diagnosis, and use of combined \( \beta \)-agonist/anticholinergic and short-acting \( \beta \)-agonists in the intervention group (Table 1).

No data were missing for baseline covariates. The mean (SD) participant age was 64.9 (9.8) years and most participants were white (82.5%) and female (61.7%). eTable 2 in Supplement 3 summarizes study participants’ comorbidities. The cumulative number of events at 1, 3, and 6 months after discharge were counted based on medical record review for participants living at those time points. Sixteen participants (14%) in the usual care group and 15 participants (13%) in the intervention group were lost to follow-up. No significant differences were found in baseline characteristics of these participants compared with the overall study sample.

Primary Outcomes

Effect on COPD-Related Acute Care Events

The total number of COPD-related acute care events in this study was 238 (196 COPD-related hospitalizations and 42 COPD-related ED visits). The study primary outcome was the number of COPD-related acute care events per patient over 6 months after discharge. This outcome was assessed for all participants living at 6 months (intervention: \( n = 112 \); usual care: \( n = 113 \)). The mean number of COPD-related events per participant at 6 months was 1.40 (95% CI, 1.01-1.79) in the intervention group and 0.72 (95% CI, 0.45-0.97) in the usual care group (difference, 0.68 [95% CI, 0.22-1.15]; \( P = .004 \)).
Effect on HRQOL
Mean (SD) baseline SGRQ scores were 62.3 (18.8) in the intervention group and 63.6 (17.4) in the usual care group (Table 2). Data were available to calculate the 6-month change in SGRQ scores for 88 and 91 participants in the intervention and usual care groups, respectively (80% of living participants). Baseline characteristics for age, hospital unit, home oxygen use, hospitalization in past year, and forced expiratory volume among patients with missing change in SGRQ scores were compared with other study participants. No significant differences were found except for more missing scores among patients older than 60 years (eTable 3 in Supplement 3). At 6 months after discharge, the mean change in SGRQ total score was 2.81 and −2.69 for the intervention and usual care groups, respectively (difference, 5.50 [95% CI, −2.57 to 13.57]; P = .12). The difference was similar after adjustment for hospital unit and baseline SGRQ score (adjusted difference, 5.18 [95% CI, −2.15 to 12.51]; P = .11) (Table 2). Differences in SGRQ scores had wide confidence intervals, increasing uncertainty in estimating intervention effects on HRQOL.

Secondary Outcomes
There were 8 deaths (6.7%) in the intervention group and 7 deaths (5.8%) in the usual care group (P > .99).

Figure 2 depicts Kaplan-Meier plots for time to first COPD-related acute care event or death. The 6-month event-free survival probability for no death or COPD-related acute care event was 0.45 in the intervention group and 0.58 in the usual care group (log rank P = .02). The adjusted hazard ratio for an event was 1.46 (95% CI, 1.02-2.09; P = .04) (test of proportional hazard assumption met; P = .93). (eFigures 1 and 2 in Supplement 3 depict Kaplan-Meier plots by type of acute care event).

Supplementary Post Hoc Analyses
Figure 3 depicts the cumulative number of COPD-related and all-cause events per participant by event type and study group at 1, 3, and 6 months after discharge. The incidence rate of COPD-related events at 6 months for the intervention compared with the usual care group was 1.96 (95% CI, 1.03-2.98); P = .04). Of those participants, 22%, 10%, 5%, and 14% had 1, 2, 3, and 4 or more COPD-related acute care events in the intervention group compared with 20%, 12%, 3%, and 3% in the usual care group, respectively (Fisher exact P = .01).

Table 1. Study Participants’ Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>No. (%)</th>
<th>Intervention</th>
<th>Usual Care</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of participants</td>
<td>120</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>Age, mean (SD), y</td>
<td>63.9 (9.6)</td>
<td>66.0 (10.0)</td>
<td></td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>98 (81.6)</td>
<td>100 (83.3)</td>
<td></td>
</tr>
<tr>
<td>African American</td>
<td>20 (16.7)</td>
<td>18 (15.0)</td>
<td></td>
</tr>
<tr>
<td>American Indian/Alaska Native</td>
<td>2 (1.7)</td>
<td>2 (1.7)</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>48 (40.0)</td>
<td>44 (36.7)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>72 (60.0)</td>
<td>76 (63.3)</td>
<td></td>
</tr>
<tr>
<td>Education &lt;12th grade</td>
<td>44 (36.7)</td>
<td>53 (44.2)</td>
<td></td>
</tr>
<tr>
<td>Income ≤$20 000</td>
<td>75 (62.5)</td>
<td>76 (63.3)</td>
<td></td>
</tr>
<tr>
<td>Living alone</td>
<td>21 (17.5)</td>
<td>23 (19.2)</td>
<td></td>
</tr>
<tr>
<td>Has someone who helps with health care</td>
<td>75 (62.5)</td>
<td>77 (64.7)</td>
<td></td>
</tr>
<tr>
<td>Hospitalized in the past year</td>
<td>95 (79.2)</td>
<td>100 (83.3)</td>
<td></td>
</tr>
<tr>
<td>Body mass index, median (IQR)a</td>
<td>28.8 (23.1-35.3)</td>
<td>27.5 (23.7-34.1)</td>
<td></td>
</tr>
<tr>
<td>No. of years with COPD, median (IQR)</td>
<td>3 (2-3)</td>
<td>3 (2-3)</td>
<td></td>
</tr>
<tr>
<td>Continuous home oxygen therapya</td>
<td>58 (48.3)</td>
<td>41 (34.2)</td>
<td></td>
</tr>
<tr>
<td>FEV1/FVC % predicted, mean (SD)</td>
<td>33.3 (16.0)</td>
<td>35.8 (14.2)</td>
<td></td>
</tr>
<tr>
<td>FEV1/FVC % predicted, mean (SD)</td>
<td>56.1 (17.4)</td>
<td>57.4 (15.7)</td>
<td></td>
</tr>
<tr>
<td>Respiratory medicine class</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhaled steroids</td>
<td>61 (50.8)</td>
<td>63 (52.5)</td>
<td></td>
</tr>
<tr>
<td>Combined β-agonist and anticholinergic</td>
<td>61 (50.8)</td>
<td>40 (33.3)</td>
<td></td>
</tr>
<tr>
<td>Anticholinergic</td>
<td>46 (38.3)</td>
<td>44 (36.7)</td>
<td></td>
</tr>
<tr>
<td>Short-acting β-agonist</td>
<td>89 (74.2)</td>
<td>70 (58.3)</td>
<td></td>
</tr>
<tr>
<td>Theophylline or similar treatment</td>
<td>7 (5.8)</td>
<td>7 (5.8)</td>
<td></td>
</tr>
<tr>
<td>Long-acting β-agonist</td>
<td>59 (49.2)</td>
<td>61 (50.8)</td>
<td></td>
</tr>
<tr>
<td>Currently smoking</td>
<td>49 (40.8)</td>
<td>43 (35.8)</td>
<td></td>
</tr>
<tr>
<td>Patient Activation Measurea</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 1</td>
<td>22 (18.3)</td>
<td>16 (13.3)</td>
<td></td>
</tr>
<tr>
<td>Level 2</td>
<td>34 (28.3)</td>
<td>26 (21.7)</td>
<td></td>
</tr>
<tr>
<td>Level 3</td>
<td>41 (34.2)</td>
<td>59 (49.2)</td>
<td></td>
</tr>
<tr>
<td>Level 4</td>
<td>23 (19.2)</td>
<td>19 (15.8)</td>
<td></td>
</tr>
<tr>
<td>Charlson Comorbidity Index score, median (IQR)a</td>
<td>2.5 (1-4)</td>
<td>2 (1-4)</td>
<td></td>
</tr>
<tr>
<td>Diagnosis of heart failure</td>
<td>53 (44.2)</td>
<td>40 (33.3)</td>
<td></td>
</tr>
</tbody>
</table>

**Abbreviations:** COPD, chronic obstructive pulmonary disease; FEV1, forced expiratory volume in first second of expiration; FVC, forced vital capacity; IQR, interquartile range.

a Calculated as weight in kilograms divided by height in meters squared.

b Continuous home oxygen therapy refers to using supplemental oxygen at home, during both daytime and nighttime.

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Table 2. Mean Change in Health-Related Quality of Life, as Measured by St George's Respiratory Questionnaire, at 6 Months After Discharge by Study Groupa

<table>
<thead>
<tr>
<th>Measure</th>
<th>Co-primary Outcomea</th>
<th>Post Hoc Outcomesb</th>
<th>Adjusted Difference, Mean Change (95% CI)b</th>
<th>P Valuec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention</td>
<td>Usual Care</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (SD) Score</td>
<td>Mean (SD) Score</td>
<td>Change in Score,</td>
<td>Change in Score,</td>
<td>Adjusted Difference, Mean Change (95% CI)b</td>
</tr>
<tr>
<td>Baseline</td>
<td>At 6 mo</td>
<td>Mean (95% CI)</td>
<td>Mean (95% CI)</td>
<td></td>
</tr>
<tr>
<td>Total score</td>
<td>62.3 (18.8)</td>
<td>65.1 (22.0)</td>
<td>2.81 (−3.73 to 9.34)</td>
<td>−2.69 (−9.34 to 3.96)</td>
</tr>
<tr>
<td>Symptom score</td>
<td>65.7 (21.3)</td>
<td>64.9 (23.0)</td>
<td>−0.79 (−6.36 to 4.78)</td>
<td>−7.12 (−15.90 to 1.66)</td>
</tr>
<tr>
<td>Activity score</td>
<td>79.8 (21.2)</td>
<td>80.3 (21.4)</td>
<td>0.49 (−9.71 to 10.68)</td>
<td>−4.23 (−12.86 to 4.39)</td>
</tr>
<tr>
<td>Impact score</td>
<td>51.1 (21.9)</td>
<td>56.4 (26.0)</td>
<td>5.27 (−1.90 to 12.45)</td>
<td>−0.88 (−7.08 to 5.32)</td>
</tr>
<tr>
<td></td>
<td>Mean (SD) Score</td>
<td>Mean (SD) Score</td>
<td>Change in Score,</td>
<td>Change in Score,</td>
</tr>
<tr>
<td></td>
<td>Baseline</td>
<td>At 6 mo</td>
<td>Mean (95% CI)</td>
<td>Mean (95% CI)</td>
</tr>
<tr>
<td></td>
<td>51.5 (20.8)</td>
<td>50.6 (24.7)</td>
<td>−0.88 (−7.08 to 5.32)</td>
<td>6.20 (−2.10 to 14.51)</td>
</tr>
<tr>
<td></td>
<td>51.1 (21.9)</td>
<td>56.4 (26.0)</td>
<td>5.27 (−1.90 to 12.45)</td>
<td>−0.88 (−7.08 to 5.32)</td>
</tr>
</tbody>
</table>

a St George’s Respiratory Questionnaire measures health-related quality of life for patients with respiratory disease, provides a total score and 3 domain scores for symptom, activity, and impact (measuring respiratory symptoms, ability to do physical activity, and impact of illness on life, respectively); and the score range for total and domain scores is 0 (best) to 100 (worst), with a 4-point difference being clinically meaningful.17–21
b Adjusted for hospital enrollment unit and St George’s Respiratory Questionnaire score at baseline. Negative numbers suggest the intervention group did better.
c Analysis completed with linear regression. Normality of residuals was good. There was no evidence of heteroskedasticity of residuals with respect to group (P = .22, .87, .70, and .12 for total, symptom, activity, and impact scores, respectively).
d Data were available for patients as follows: total score: n = 91 in usual care, n = 88 in intervention; symptom score: n = 94 in usual care, n = 88 in intervention; activity score: n = 91 in usual care, n = 88 in intervention; and impact score: n = 93 in usual care, n = 88 in intervention.

HRQOL using mixed-effects generalized linear model, allowed for examination of 586 SGRQ total scores across 231 patients and showed findings that were consistent with the primary analysis. (Estimated differences in SGRQ at 6 months compared with baseline for the intervention and usual care groups were 2.51 [95% CI, −1.61 to 6.63] and −2.43 [95% CI, −6.37 to 1.50], respectively; see the eAppendix 2 and eTable 5 in Supplement 3 for more details.)

The exploratory subgroup analyses assessing the heterogeneity of treatment effects found significant intervention interactions with sex and with patient activation level (eFigure 4 in Supplement 3). Further analysis looking at the 4 subgroups of men and women with high and low activation levels revealed a significant interaction (overall test of interaction terms P < .001). Both men and women with high activation levels had a higher number of acute care events in the intervention group compared with the control group, although this effect was more pronounced among men (incidence rate ratio for men, 8.08 [95% CI, 3.72 to 17.53], and for women, 2.17 [95% CI, 1.02 to 4.63]). This effect persisted after adjustment and weighting for variables (eTable 6 in Supplement 3).

Intervention Implementation
The COPD nurse visited 103 of 120 participants at least once in the hospital. Intervention group participants had a mean of 6.1 sessions (interquartile range, 4-8) (eTable 7 in Supplement 3).

Adverse Events
Adverse events were reviewed at 3- to 6-month intervals. There were 339 hospitalizations and 3 falls resulting in acute care visits. No adverse events were attributed to the study intervention.
Figure 3. Cumulative Number of Chronic Obstructive Pulmonary Disease (COPD)-Related and All-Cause Events per Participant by Event Type and Study Group at 1, 3, and 6 Months After Discharge

A All-cause hospitalizations and emergency department visits

B COPD-related hospitalizations and emergency department visits

C All-cause hospitalizations

D COPD-related hospitalizations

E All-cause emergency department visits

F COPD-related emergency department visits

The boxes in the graphs show the median and interquartile range (IQR) of the data, with the bottom and top indicating the 25th and 75th percentiles, respectively; the upper whisker extends from the top of the box to the largest value no further than 1.5 times the IQR. The bottom whiskers extend from the bottom of the boxes to the smallest value no further than 1.5 times the IQR; outliers outside the whiskers range are also presented (dots). The circles and triangles indicate the mean number of events for usual care and the intervention, respectively. The black lines across the boxes indicate the median. Boxplots at each time point are staggered to avoid superimposition. Boxplots do not show when the 75th percentile of all data is zero. Whiskers do not show when all data points except for outliers are at zero.

a Emergency department visits that led to a hospitalization are not included in the emergency department visit counts.
Discussion

In a single-site randomized clinical trial of patients hospitalized due to COPD, a 3-month program that combined transition and long-term self-management support resulted in significantly greater COPD-related hospitalizations and ED visits. There was no significant difference in HRQOL.

COPD self-management interventions, mostly implemented in outpatient settings, have shown reductions in COPD-related hospitalizations but most excluded participants based on comorbidities and provided medical interventions (eg, steroid or antibiotics prescription for use as needed).

One study using a COPD action plan with self-initiated treatment was stopped prematurely for concerns of increased mortality. In the current study, patients with comorbidities were not excluded and the intervention offered no medical treatment services. The intervention, which was co-developed with patients, caregivers, and others (including clinicians of various disciplines and health care leaders), focused on engaging both patients and caregivers in COPD self-management. It included an action plan that focused on early recognition of signs and symptoms of acute exacerbations and contacting a physician early for those.

The increase in COPD-related acute care use in the intervention compared with usual care group found in this study was in the opposite direction from what had been hypothesized. This inconsistency necessarily raises a question about the validity of the study findings and means that study interpretation needs to be cautious and provisional.

If the findings represent a true effect, the post hoc subgroup analyses raise possible mechanisms, although these need to be considered speculative. The increase in acute care events was limited to patients with high activation status at baseline and was more common among men than women. Patients with greater activation may have responded to the intervention by being more vigilant about detecting signs of early exacerbations and taking action to get medical attention within 24 hours, as recommended by their action plan. Inability to access their regular physician within that timeframe, due to various reasons, could have led them to seek acute care services. In addition, increased communications with clinicians about exacerbation signs might have led to increased referrals to the emergency department (and subsequent hospitalizations). More acute care use by men than women may relate to less experience with seeking ambulatory care and lack of established connections with the health care system for routine care services. The latter has been demonstrated in other studies.

Limitations

This study has several limitations. First, the study was conducted at a single site, and therefore, the results may not be generalizable to all patients with COPD. Second, the study population included a high proportion of low-income and less-educated participants, and these participants may have greater challenges in accessing the health care system for urgent visits outside of coming to the emergency department. Third, there were small differences in the study groups at baseline (eg, higher percentages of current smokers and continuous home oxygen therapy use) that might have led to greater health care utilization in the intervention group. Fourth, for participants who could not be contacted at 6 months after discharge, it was not possible to measure their QOL and verify acute events treated outside the JHHS. However, these participants were similar between study groups and their baseline characteristics were not different from the rest of study participants. Fifth, spirometry evidence of airflow obstruction was not required for enrollment into the study and it is possible that some participants may have been incorrectly diagnosed as having COPD. Sixth, because the direction of the results were opposite of what was anticipated, the findings should be considered hypothesis-generating rather than definitive.

Conclusions

In a single-site randomized clinical trial of patients hospitalized due to COPD, a 3-month program that combined transition and long-term self-management support resulted in significantly greater COPD-related hospitalizations and emergency department visits, without improvement in quality of life. Further research is needed to determine reasons for this unanticipated finding.
Effect of Transitional Care and Long-term Self-management Support on Outcomes After Hospitalization

Original Investigation Research

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Additional Information: This article has been corrected version of an article that has been retracted (Aboumatar H, Naqibuddin M, Chung S, et al. Effect of a program combining transitional care and long-term self-management support on outcomes of hospitalized patients with chronic obstructive pulmonary disease: a randomized clinical trial. JAMA. 2018;320(22):2335-2343. doi:10.1001/jama.2018.17933).

REFERENCES

The accuracy of the scientific record is one of the most important priorities for authors and editors. To reflect this priority, JAMA issues corrections, retractions, retractions with replacement, and, in this issue, a retraction with republication of an article.

On November 12, 2018, JAMA published the article titled “Effect of a Program Combining Transitional Care and Long-term Self-management Support on Outcomes of Hospitalized Patients With Chronic Obstructive Pulmonary Disease: A Randomized Clinical Trial,” with an accompanying Editorial. JAMA was notified by the authors of a major coding error that reversed the results, finding that the intervention was associated with harm rather than benefit. The authors have provided a detailed explanation of the error. JAMA consulted peer reviewers who agreed that the corrected findings were important and, after additional internal review to assess validity, warranted publication in JAMA.

Because of the change in findings, the authors conducted additional analyses to elucidate potential sources of bias that could explain the unexpected results. These additional analyses, along with the context for interpreting the different findings, are why this paper is being published as a new article, and the original article is being retracted.

The new article, an accompanying new Editorial, and Letter of explanation from the authors are in this issue of JAMA. The original Editorial is hereby retracted. A Letter to the editor (and a reply), which focused on the intervention and not the specific findings, has not been retracted but has been corrected.

Unexpected findings in all studies, and particularly in randomized clinical trials because of their potential effect on clinical care, require careful reading. In the study design, it was hypothesized that the intervention would improve health outcomes, but rather it appears to have been associated with harm. This finding was unexpected, and the various analyses that have been conducted to try to explain the results should be considered exploratory.

JAMA remains committed to ensuring an accurate scientific record. In most cases, identification of major errors has come from the study authors, who have notified JAMA of these errors after they were discovered when reusing the same database. We urge authors to continue to report errors in their own work, so that along with editors, they can jointly decide whether a correction, retraction, retraction with replacement, or retraction with republication is required.