

Supplementary Online Content

Aboumatar H, Naqibuddin M, Chung S, et al. 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 [published October 8, 2019]. *JAMA*. doi:10.1001/jama.2019.11982

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This supplementary material has been provided by the authors to give readers additional information about their work.

eTable 1. Comparison of Transitional Support Features of the BREATHE Program and Usual Transitional Care

Transition Support Feature	Usual Transitional Care	BREATHE Program
Assessing and addressing patient needs	-Variable. Based on the involved practitioner/s and their time availability	-Baseline assessment includes understanding of COPD, smoking and readiness to quit, inhaler technique, and other barriers to follow up care including transportation. -The COPD nurse follows a standard protocol that includes checklists for each session with the patient, with proactive identification of barriers and addressing those in collaboration with the rest of the healthcare team.
Advancing COPD self-management skills	-Hospital providers are focused on acute problems and discharge plan; outpatient services supporting COPD self-management are highly variable	-Comprehensive COPD self-management intervention that utilizes motivational interviewing principles and engages both patient and family-caregiver, starting during hospital stay, and continuing for 3 months
Discharge plan education	-Brief verbal education delivered by hospital nurse or physician to the patient with print out of discharge instructions. The quality of verbal communication may vary based on provider practice and time demands. -Family-caregiver presence during discharge planning education is variable	-As part of preparation for discharge, the nurse reviews the hospital discharge instructions, and how to use a COPD action plan at home to identify early signs of COPD exacerbation and proactively address them,. The nurse also ensures that the patient demonstrates correct inhaler use and pursed lip breathing techniques prior to their hospital discharge. -The COPD nurse aims to engage family-caregivers in discharge plan discussions as much as possible.
Post discharge transition support personnel and duration of services	-General nurse transition guide -Duration of 1 month post discharge	-COPD nurse -Duration of 3 months post discharge

Abbreviation: COPD, chronic obstructive pulmonary disease.

eTable 2. Select Comorbidities of Study Participants, by Study Group

Co-morbid conditions n(%)	Intervention	Usual Care
Renal Disease	24 (20.0%)	23 (19.2%)
Cerebrovascular Disease	4 (3.3%)	8 (6.7%)
Depression, under current treatment or treated during past 2 years	46 (38.3%)	52 (43.3%)
History of drug use	22 (18.3%)	28 (23.5%)

Abbreviation: SD, standard deviation.

eTable 3. Comparison of Baseline Characteristics of Participants With Missing Change in SGRQ Scores to Rest of Study Participants

Characteristic	Change in SGRQ score		P Value
	Not missing N=179	Missing N= 61	
Age greater than 60 years, n(%)	109 (61%)	49 (80%)	<u>0.006</u>
Female gender, n(%)	110 (61%)	38 (63%)	<u>0.91</u>
Home oxygen therapy, continuous, n(%)	71 (40%)	28 (46%)	<u>0.39</u>
Hospitalized in the past year, n(%)	144 (81%)	51 (84%)	<u>0.64</u>
FEV1 % predicted < 30%, n(%)	74 (41%)	28 (46%)	<u>0.53</u>
Single (not married or living with a partner) , n(%)	118 (66%)	44 (72%)	<u>0.37</u>
Income <20,000 \$, n(%)	111 (62%)	40 (66%)	<u>0.62</u>

Abbreviations: SGRQ, St George's Respiratory Questionnaire; FEV1, forced expiratory volume in 1 second

eTable 4. Incidence Rates and Ratios of COPD-Related and All-Cause Hospitalizations and ED Visits per Participant at 1 Month, 3 Months, and 6 Months Post-discharge

Measure	Incidence Rate [95% CI]		Unadjusted	Adjusted ^a	P Value ^b
	Usual Care	Intervention	IRR [95% CI]	IRR [95% CI]	
Combined # of COPD-related hospitalizations and ED visits					
Up to 1 month ^c	0.12 [0.09, 0.15]	0.27 [0.19, 0.35]	2.31 [1.50, 3.55]	2.15 [1.56, 2.96]	<0.001
Up to 3 months ^c	0.43 [0.28, 0.59]	0.78 [0.62, 0.94]	1.78 [1.27, 2.50]	1.59 [1.23, 2.05]	<0.001
Up to 6 months ^c	0.72 [0.59, 0.84]	1.40 [1.17, 1.63]	1.96 [1.57, 2.43]	1.59 [1.32, 1.92]	<.001
# COPD-related hospitalizations					
Up to 1 month ^c	0.12 [0.09, 0.15]	0.19 [0.11, 0.28]	1.66 [0.98, 2.81]	1.45 [1.00, 2.11]	0.052
Up to 3 months ^c	0.37 [0.24, 0.51]	0.60 [0.44, 0.77]	1.61 [1.09, 2.39]	1.35 [0.91, 2.02]	0.140
Up to 6 months ^c	0.61 [0.55, 0.67]	1.13 [0.92, 1.35]	1.86 [1.50, 2.29]	1.41 [1.28, 1.56]	<0.001
# COPD-related ED visits					
Up to 1 month ^c	d	0.08 [0.04, 0.11]	d	d	—
Up to 3 months ^c	0.06 [0.03, 0.10]	0.17 [0.16, 0.19]	2.83 [1.50, 5.34]	3.06 [1.60, 5.86]	0.001
Up to 6 months ^c	0.11 [0.03, 0.18]	0.27 [0.20, 0.33]	2.52 [1.10, 5.79]	2.85 [1.18, 6.88]	0.020
Combined # of all cause hospitalizations and ED visits					
Up to 1 month ^c	0.34 [0.17, 0.50]	0.46 [0.38, 0.53]	1.36 [0.83, 2.25]	1.40 [0.90, 2.19]	0.136
Up to 3 months ^c	1.04 [0.85, 1.24]	1.31 [1.22, 1.40]	1.26 [1.08, 1.46]	1.24 [1.02, 1.50]	0.031
Up to 6 months ^c	1.94 [1.55, 2.32]	2.43 [2.22, 2.64]	1.25 [1.11, 1.41]	1.18 [1.00, 1.40]	0.052
# All cause hospitalizations					
Up to 1 month ^c	0.24 [0.11, 0.38]	0.33 [0.24, 0.42]	1.36 [0.68, 2.70]	1.25 [0.69, 2.26]	0.469
Up to 3 months ^c	0.71 [0.48, 0.95]	0.94 [0.85, 1.03]	1.32 [0.90, 1.93]	1.25 [0.80, 1.97]	0.329
Up to 6 months ^c	1.21 [0.94, 1.49]	1.80 [1.59, 2.02]	1.49 [1.08, 2.04]	1.36 [0.95, 1.93]	0.089
# All cause ED visits					
Up to 1 month ³	0.09 [0.03, 0.15]	0.13 [0.09, 0.16]	1.38 [0.84, 2.26]	1.88 [0.74, 4.79]	0.184
Up to 3 months ³	0.33 [0.22, 0.44]	0.37 [0.23, 0.51]	1.12 [0.65, 1.93]	1.18 [0.65, 2.14]	0.596
Up to 6 months ³	0.73 [0.45, 1.00]	0.63 [0.32, 0.93]	0.86 [0.54, 1.38]	0.84 [0.59, 1.19]	0.325

^a Adjusted for age, home oxygen use, discharge unit, hospitalization in prior year; ^b Comparison using negative binomial regression (adjusted model); ^c Patients are excluded from analysis starting from the time period in which they died post hospital discharge making number analyzed at 1 month 237 (usual care = 119; intervention = 118); at 3 months 231 (usual care = 115; intervention = 116); at 6 months 225 (usual care = 113; intervention = 112); ^d Estimate could not be made due to 0 events in intervention group. Abbreviations: COPD, chronic obstructive pulmonary disease; ED, emergency department; CI, confidence interval; IRR, incidence rate ratio.

eTable 5. Mean Change in Quality of Life as Measured by SGRQ at 3 and 6 Months Post-discharge Compared to Baseline

	Total Score	Symptom Score	Activity Score	Impact Score
At 3 months post-discharge compared to baseline				
Usual Care (mean, SD) (n = 90)	-1.13 (17.14)	-6.44 ^a (21.46)	0.37 (19.47)	-0.40 (20.18)
Intervention (mean, SD) (n = 82)	-0.85 (19.44)	-3.33 (22.85)	-1.16 (18.56)	0.12 (24.14)
Unadjusted difference [95% CI] between groups	0.28 [-5.76, 6.32]	3.11 [-8.57, 14.79]	-1.53 [-5.26, 2.21]	0.52 [-11.24, 12.28]
Unadjusted P value ^d	0.892	0.459	0.284	0.897
Adjusted difference ^e [95% CI] between groups	0.56 [-8.00, 9.13]	2.64 [-8.03, 13.32]	-0.73 [-6.08, 4.61]	0.79 [-12.03, 13.60]
Adjusted P value ^{d,e}	0.847	0.488	0.692	0.857
At 6 months post-discharge compared to baseline				
Usual Care (mean, SD) (n = 91)	-2.69 (16.71)	-7.12 ^b (23.64)	-4.23 (19.14)	-0.88 ^c (18.86)
Intervention (mean, SD) (n = 88)	2.81 (21.31)	-0.79 (24.85)	0.49 (22.22)	5.27 (25.20)
Unadjusted difference [95% CI] between groups	5.50 [-2.57, 13.57]	6.33 [-3.58, 16.24]	4.72 [-5.05, 14.49]	6.15 [-1.85, 14.15]
Unadjusted P value ^d	0.119	0.135	0.222	0.092
Adjusted difference ^e [95% CI] between groups	5.18 [-2.15, 12.51]	5.35 [-1.11, 11.81]	3.62 [-4.60, 11.84]	6.20 [-2.10, 14.51]
Adjusted P value ^{d,e}	0.110	0.078	0.255	0.098

^a Number of patients analyzed: Usual care n = 91; ^b Number of patients analyzed: Usual care n = 94; ^c Number of patients analyzed: Intervention n = 93; ^d Analysis completed with linear regression; ^e Adjusted for hospital enrollment unit and SGRQ score at baseline. Abbreviations: SD, standard deviation; CI, confidence interval.

eTable 6. Intervention Effects on COPD-Related Hospital and ED Visits at 6 Months, for Males and Females With High and Low Activation Levels^a

Subgroup	Female, Low PAM ^b (n= 52)	Female, High PAM ^b (n= 84)	Male, Low PAM ^b (n= 40)	Male, High PAM ^b (n= 49)
Unadjusted Analysis^c- Overall test of Interaction terms: P <0.001				
Predicted Incidence Rate [95% CI], Usual Care	1.5 [1.02,1.98]	0.52 [0.21,0.84]	1 [0.40,1.60]	0.24 [0.04,0.45]
Predicted Incidence Rate [95% CI], Intervention	1.14 [0.56, 1.72]	1.13 [0.62,1.64]	1.65 [0.69, 2.62]	1.95 [0.32,3.58]
Incidence Rate Ratio [95% CI]	0.76 [0.43,1.36]	2.17 [1.02,4.63]	1.65 [0.95,2.88]	8.07 [3.72,17.53]
P value	0.358	0.045	0.076	<0.001
Adjusted Analysis^c- Overall test of Interaction terms: P <0.001				
Predicted Incidence Rate [95% CI] , Usual Care	2.14 [1.12,3.16]	0.54 [0.27,0.80]	1.25 [0.48,2.01]	0.34 [0.09,0.60]
Predicted Incidence Rate [95% CI], Intervention	0.91 [0.21,1.62]	1.04 [0.89,1.19]	1.40 [0.62,2.17]	1.90 [1.13,2.66]
Incidence Rate Ratio [95% CI]	0.43 [0.14,1.36]	1.94 [1.08,3.49]	1.12 [0.86,1.45]	5.49 [3.88,7.78]
P value	0.149	0.028	0.401	<0.001

^aThe treatment effects were estimated by the inclusion of an interaction term in a negative binomial regression model, standardizing with inverse probability weighting and adjusted for age, home oxygen use, hospitalization in prior year, and discharge unit.

^bPAM score assesses an individual's knowledge, skill, and confidence for managing one's health and health care. Lower PAM scores indicate less activated patients while higher PAM scores indicate more activated patients. In this analysis, PAM levels were categorized as Low PAM versus High PAM (Low PAM includes Levels 1 and 2; High PAM includes Levels 3 and 4). PAM Level 1= Patients tend to be overwhelmed and unprepared to play an active role in their own health; Level 2= Patients lack knowledge and confidence for self-management; Level 3= Patients are beginning to take action, but lack confidence and skill to support behaviors; Level 4= Patients have adopted many of the behaviors to support their health, but may not be able to maintain them in the face of life stressors.

^c Patients were excluded from analysis if they died during the 6 months study period. The number of alive participants at 6 months were: usual care = 113; intervention = 112




Abbreviations: PAM, Patient Activation Measure; CI, confidence interval.

eTable 7. Intervention Implementation

	Total	Hospital^a	Outpatient
# of sessions			
Mean (SD)	6.1 (6.0)	1.4 (0.7)	4.7 (2.9)
25 th Percentile	4	1	3
75 th Percentile	8	2	6
Mode of intervention			
<i>In person</i>			
Mean (SD)			1.4 (1.9)
25 th Percentile			0
75 th Percentile			2
<i>By phone</i>			
Mean (SD)			3.3 (2.2)
25 th Percentile			2
75 th Percentile			5
Duration (minutes)			
Time in minutes, Mean (SD)	23.8 (14.2)	31.2 (16.1)	21.6 (17.0)
25 th Percentile	13.2	20.0	9.0
75 th Percentile	29.9	36.0	30.1
Caregiver Participation			
% (25 th Percentile, 75 th Percentile)			
% sessions held with a caregiver present	24.3 (0, 44.9)	14.0 (0, 0)	24.4 (0, 47.7)
% sessions held with a caregiver present among participants who reported having someone who helped with their health care (n = 75)	34.0 (0, 66.7)	18.4 (0, 0)	34.2 (0, 75.0)

^aAll hospital sessions were held in-person. Abbreviation: SD, standard deviation.

eAppendix 1. Action Plan

COPD Green Zone: Go 	Action
<p>Comfortable doing daily activities</p> <p>Breathing is 'as usual'</p> <p>Cough and sputum (color and amount) are 'as usual'</p>	<p>Keep doing what is working for you!</p> <p>Continue your medications and stay active</p> <p>Practice Pursed-lip Breathing</p> <p><i>Thank the people in your life who help when you are not feeling well</i></p>
COPD Yellow Zone: Caution 	Action
<p>More tired than normal</p> <p>Having more difficulty breathing during usual activities</p> <p>Coughing and having more phlegm than normal</p> <p>Sputum is thicker, blood stained, or a different color than normal</p> <p>Have more swelling in feet or ankles</p> <p>Need to prop myself with pillows to breathe easier and get to sleep</p>	<p>Check your oxygen equipment and tubing</p> <p>Use your rescue inhaler</p> <p>Do pursed-lip breathing; Take small sips of water</p> <p>Think calming thoughts (e.g. "I will be ok")</p> <p>If you do not feel better soon, call your doctor to be seen within 24 hours.</p> <p>If you cannot reach the doctor, call the Pulmonary Clinic Nurse</p> <p>Let your family know what is going on</p>
COPD Red Zone: Danger 	Action
<p>Hard to breathe just sitting still</p> <p>Can hardly speak because of coughing so much</p> <p>Feeling confused or drowsy</p>	<p>Call 911 immediately</p> <p><i>It may help in the meantime to:</i> Use your rescue inhaler, do pursed-lip breathing, take small sips of water, and call a family member or friend to be with you</p>

Important Telephone Numbers

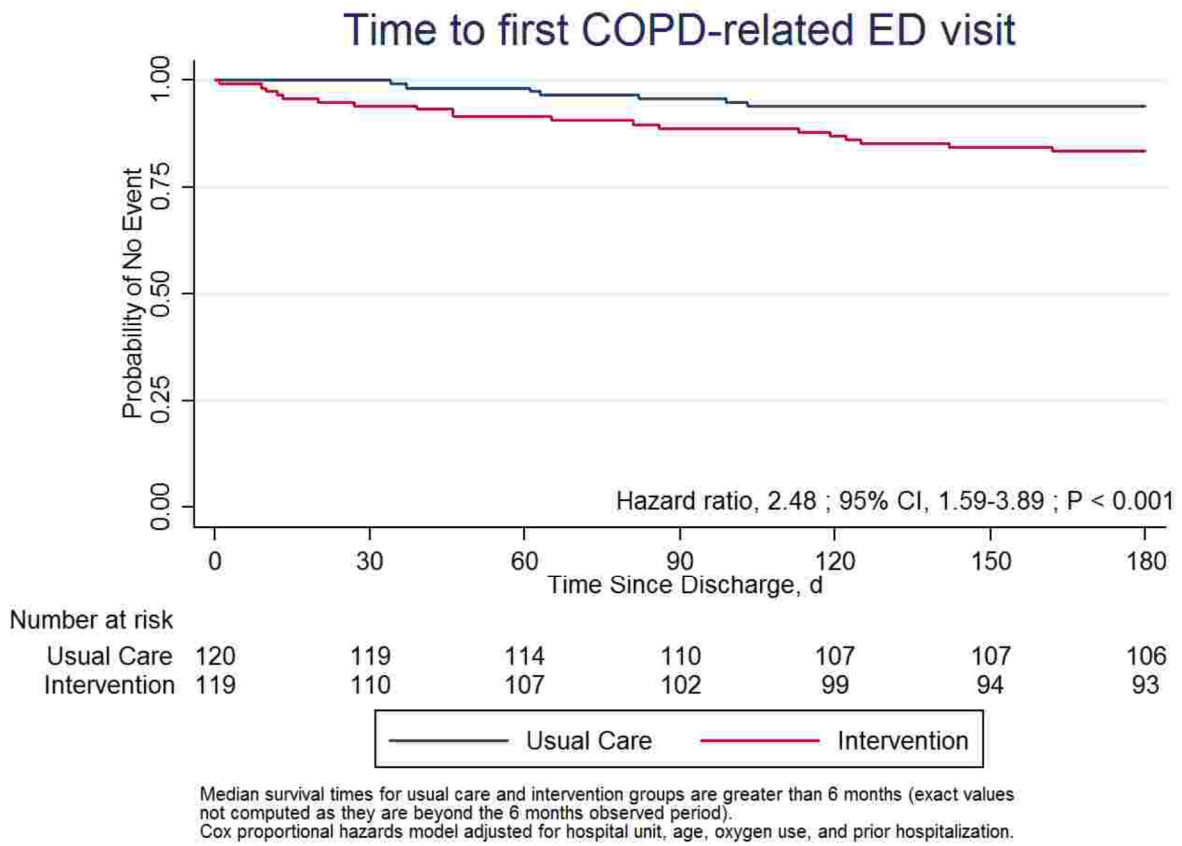
Your Doctor _____ Emergency contact (family or friend) _____
Pulmonary Clinic Nurse Tel # _____

This publication is intended for informational purposes and cannot serve as a substitute for the care provided by a healthcare professional. Please seek medical guidance before making changes in self-care practices and medical therapies.

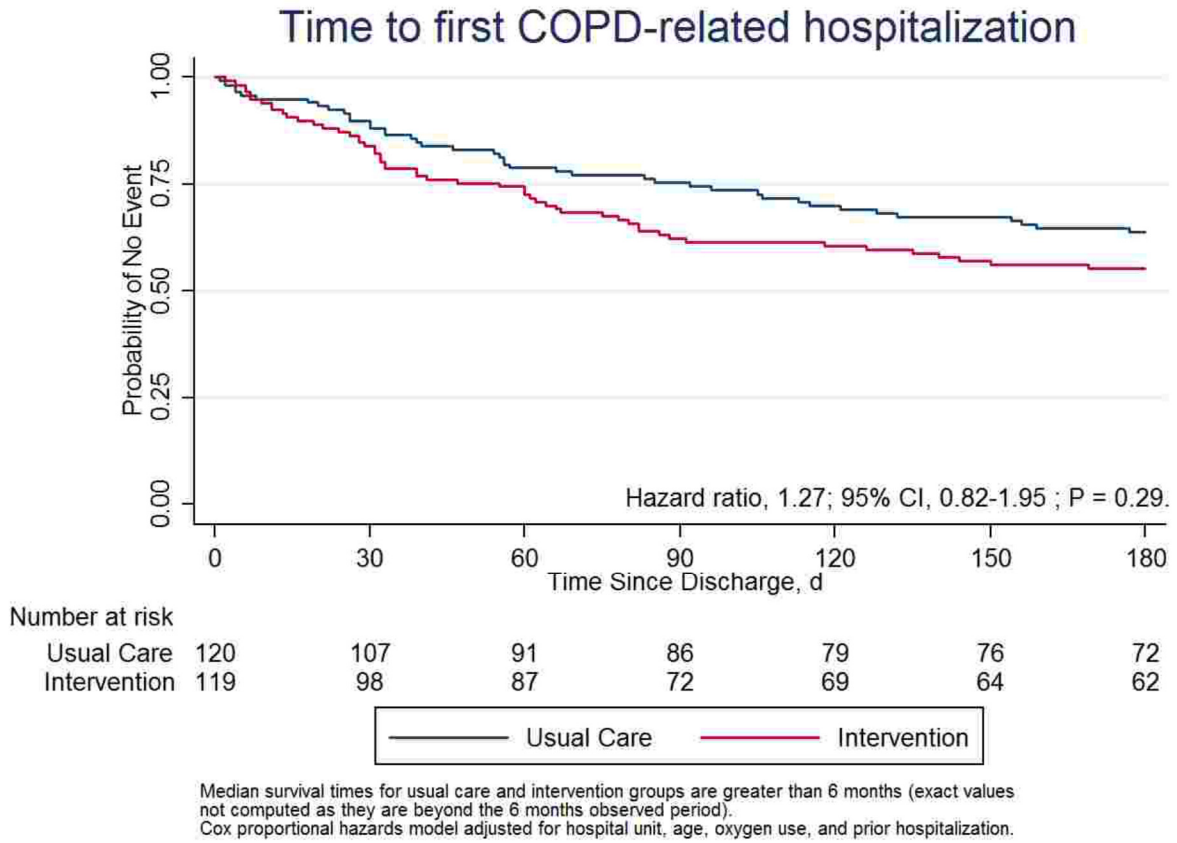
eAppendix 2. Sensitivity Analysis Examining Intervention Effects on Health-Related Quality of Life

To further examine the impact of study intervention on health-related quality of life, a sensitivity analysis was performed using a mixed-effects generalized linear model with all available SGRQ data (baseline, 3 months and 6 months post-discharge) for each patient. This analysis compared the baseline to 6-month change with robust variance estimates, clustering by hospital unit, patient as random effect, and treatment arm as fixed effect. This allowed for analysis of a total of 586 observations across 231 patients (instead of 179 patients with both baseline and 6-month scores in main analyses for change in SGRQ scores). The predicted means for SGRQ total scores at baseline and 6 months for usual care were 63.4 [95%CI 61.5,65.3] and 61.0 [95%CI 58.5,63.5]; and for intervention were 62.0 [95%CI 59.6, 64.4] and 64.5 [95%CI 61.3,67.7], respectively. The analysis showed no significant interaction between the arms and the scores at baseline and 6 months (coefficient 4.94; 95% CI -0.24, 10.12; $p= 0.06$). The estimated differences in SGRQ from baseline to 6 months within each study arm were similar to the findings in the main analysis. (Intervention Difference: +2.51, Std error: 2.10; Usual Care Difference: -2.43, Std error: 2.01)

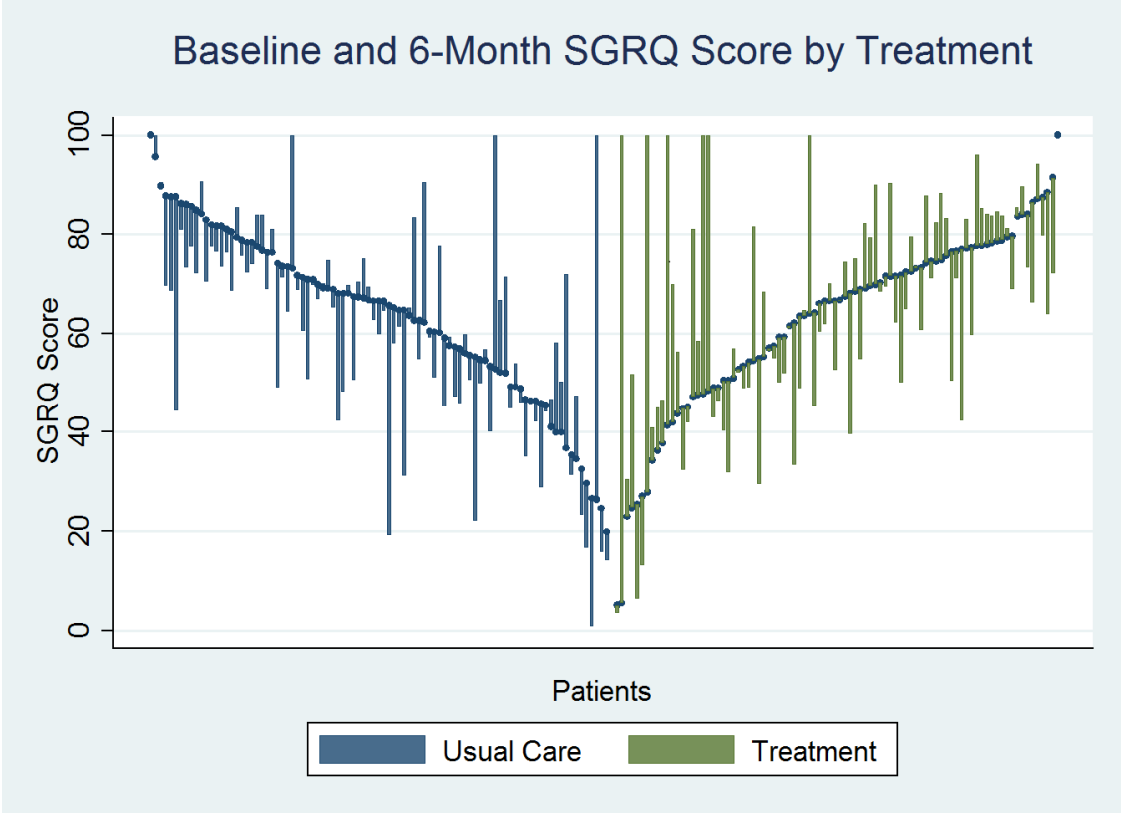
eFigure 1. Time to First COPD-Related ED Visit



eFigure 2. Time to First COPD-Related Hospitalization



eFigure 3. Baseline and 6-Month SGRQ Score by Treatment



eFigure 4. Forest Plot of Subgroup Treatment Effects

