Online Supplement

Original Research

Hospitalization Outcomes of Patients with Asthma, COPD, and Asthma-COPD Overlap **Syndrome**

Mrinalini Modak, MD^{1*} Wiktoria M. Rowlands, MD^{1*} Joelle Sleiman, MD² Amy H. Attaway, MD, MSc³ Eugene R. Bleecker, MD³ Joe Zein, MD, PhD⁴

¹Department of Medicine, The University of Oklahoma, Health Sciences Center, Oklahoma City, Oklahoma, United States

²Department of Medicine, c, Staten Island, New York, United States

³The Respiratory Institute, Cleveland Clinic, Cleveland, Ohio, United States

⁴Department of Medicine, Mayo Clinic, Scottsdale, Arizona, United States

*W.M. Rowlands and M. Modak contributed equally to this manuscript.

Supplementary Materials

Title: Hospitalization Outcomes of Patients with Asthma, COPD, and Asthma-COPD Overlap Syndrome.

Mrinalini Modak, MD¹; Wiktoria M. Rowlands, MD¹*. Joelle Sleiman, MD²; Amy H. Attaway, MD, MSc³; Eugene R. Bleecker, MD³; Joe Zein, MD, PhD⁴

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Supplementary Table 1: ICD 9 codes used to define chronic bronchitis vs. emphysema

	Chronic Bronchitis	Emphysema		
ICD 9 Code	Diagnosis	ICD 9 Code	Diagnosis	
491	Chronic bronchitis	492	Emphysema	
491.0	Simple chronic bronchitis	492.0	Emphysematous bleb	
491.1	Mucopurulent chronic bronchitis	492.8	Emphysema not elsewhere classified (NEC)	
491.20	Obstructive chronic bronchitis w/o exacerbations			
491.21	Obstructive chronic bronchitis with acute exacerbation			
491.22	Obstructive chronic bronchitis without acute exacerbation			
491.8	Chronic bronchitis not elsewhere classified (NEC)			
491.9	Chronic bronchitis not otherwise specified (NOS)			

Supplementary Table 2: Demographics and clinical characteristics of the study cohort during index admission stratified by COPD subsets: emphysema and chronic bronchitis

	Total	ACO	Chronic Bronchitis	Emphysema	Asthma	р
n (% of N)	2,522,013 (100)	120,200 (4.8)	1,561,520 (61.9)	171,425 (6.8)	668,867 (26.5)	
Demographics						
Age in years, median [IQR]	66 [75; 56]	63 [74; 54]	69 [77; 60]	68 [77; 59]	56 [68;45]	<0.001
Female sex, % (SE)	59.9 (0.1)	69.9 (0.2)	55.0 (0.1)	52.2 (0.2)	71.6 (0.1)	<0.001
NDX, median [IQR]	10 [14; 7]	12 [16; 9]	10 [14; 8]	13 [17; 9]	9 [13; 6]	<0.001
Current Smoker, % (SE)	32.2 (0.2)	27.2 (0.3)	38.2 (0.2)	31.9 (0.7)	24.3 (0.2)	<0.001
Past Smoker, % (SE)	22.8 (0.2)	21.5 (0.3)	26.3 (0.2)	36.4 (0.7)	17.7 (0.2)	<0.001
Primary Insurance Type,% (SE)						-
Medicare	63.0 (0.2)	59.7 (0.3)	71.1 (0.1)	68.9 (0.3)	43.1 (0.2)	<0.001
Medicaid	13.6 (0.1)	16.0 (0.2)	10.6 (0.1)	10.9 (0.2)	20.8 (0.2)	<0.001
Private	14.8 (0.1)	15.5 (0.1)	11.5 (0.1)	13.0 (0.2)	22.9 (0.2)	<0.001
Other	8.6 (0.1)	8.8 (0.1)	6.8 (0.1)	7.2 (0.1)	12.6 (0.1)	<0.001
Median Household Income by Zi	p Code, % (SE)					
< \$41,999	37.9 (0.5)	38.3 (0.6)	37.9 (0.5)	37.3 (0.6)	38.1 (0.6)	<0.001
\$42,000 - 51,999	27.3 (0.3)	27.0 (0.4)	28.2 (0.3)	27.7 (0.4)	25.0 (0.3)	<0.001
\$52, 000 - 67,999	20.7 (0.3)	20.7 (0.4)	20.6 (0.3)	21.7 (0.4)	20.6(0.4)	<0.001
> \$68,000	14.1 (0.3)	14.0 (0.4)	13.3 (0.3)	13.3 (0.4)	16.3 (0.4)	<0.001
Comorbidities, % (SE)						
Obesity (BMI >30)	19 (0.1)	26.8 (0.03)	15.3 (0.1)	17.3 (0.2)	26.6 (0.2)	<0.001
Diabetes	30.3 (0.1)	34.3 (0.2)	30.0 (0.1)	31.3 (0.2)	29.9 (0.1)	<0.001
CHF	20.6 (0.1)	18.8 (0.2)	23.3 (0.1)	29.2 (0.2)	12.5 (0.1)	<0.001
Depression	16.1 (0.1)	18.7 (0.2)	16.4 (0.1)	14.8 (0.2)	15.2 (0.1)	<0.001
HTN	64.4 (0.1)	67.7 (0.3)	66.8 (0.1)	67.2 (0.3)	57.7 (0.2)	<0.001
High Severity [#]	.36.2 (0.2)	36.6 (0.3)	38.9 (0.2)	51.3 (0.3)	26.1 (0.2)	<0.001
High risk of Mortality [#]	28.1 (0.1)	24.9 (0.3)	31.0 (0.2)	44.5 (0.3)	17.6 (0.2)	<0.001

Data expressed as weighted mean (SE) or weighted percent (SE).

NDX stands for number of diagnoses at discharge. CHF = Congestive heart failure. HTN = hypertension. SE: standard error.

Three-group comparisons were done using the Kruskal-Wallis rank test for continuous variables, and the chi-square test for categorical variables.

[#]High severity and high-risk mortality are defined as patients belonging to All Patient Refined Diagnosis-Related Group (APR-DRG) severity class 3 or 4 and risk of mortality class 3 or 4, respectively.

Supplemental Table 3: Outcomes of index admission and 30-day readmission stratified by COPD subsets: emphysema and chronic bronchitis

	Total	ACO	Chronic Bronchitis	Emphysema	Asthma	р		
Index Admission								
n (% of N)	2,522,013 (100)	120,200 (4.8)	1,561,520 (61.9)	171,425 (6.8)	668,867 (26.5)			
LOS in days, median [IQR]	3 [5; 2]	4 [6; 2]	3 [5; 2]	3 [5; 2]	3 [5; 2]	<0.001		
Cost in \$, median [IQR]	5917.1 [9247.7; 3943.1]	6281.6 [9711.0; 4223.3]	6006.0 [9283.5; 4052.5]	6925.8 [11841.9; 4396.0]	5422.0 [8511.2; 3564.4]	<0.001		
Mortality, % (SE)	1.6 (0.1)	0.70 (0.1)	1.3 (0.1)	7.8 (0.1)	0.85 (0.1)	<0.001		
30-day readmission rate								
All-cause, % (SE)	14.2 (0.1)	11.5 (0.2)	16.0 (0.1)	13.4 (0.1)	10.7 (0.1)	<0.001		
Asthma-related, % (SE)*	2.9 (0.1)	1.6 (0.1)	NA	NA	3.2 (0.1)	<0.001		
30-Day All-Cause Readmis	ssion							
n (% of N)	358,328 (100)	13,842 (3.9)	249,818 (69.7)	22,910 (6.4)	71,757 (20.0)			
Days to Readmission, median [IQR]	12 [20; 6]	12 [20; 5]	12 [20; 6]	11 [19; 5]	12 [21; 5]	<0.001		
LOS in days, median [IQR]	4 [7; 2]	4 [7; 2]	4 [7; 3]	4 [7; 3]	4 [6; 2]	<0.001		
Cost in \$, median [IQR]	7877.9 [13619.2; 4881.4]	7652.1 [13095.6; 4778.3]	8040.2 [13833.2; 5001.6]	8670.0 [15392.5; 5169.5]	7166.8 [12370.4; 4424.9]	<0.001		
Mortality, % (SE)	4.4 (0.1)	3.0 (0.1)	5.0 (0.1)	6.3 (0.3)	2.2 (0.1)	<0.001		
30-Day Asthma-Related R	eadmission	•	•			•		
n (% of N)	23,055 (100)	1,868 (8.1)	NA	NA	21,187 (91.9)			
Rate of readmission, % (SE)*	2.9 (0.1)	1.6 (0.1)	NA	NA	3.2 (0.1)	<0.001		
Days to Readmission, median [IQR]	13 [21; 5]	.14 [21; 6]	NA	NA	13 [21; 5]	0.52		
LOS in days, median [IQR]	3 [5; 2]	3.6 [6; 2]	NA	NA	3.0 [5; 2]	<0.001		
Cost in \$, median [IQR]	5757.5 [9156.3; 3709.9]	6084.7 [9318.0; 4040.9]	NA	NA	5724.0 [9136.5; 3674.6]	<0.001		
Mortality, % (SE)	0.7 (0.1)	1.1 (0.3)	NA	NA	0.6 (0.1)	0.23		

Frequencies presented are weighted counts. Data expressed as weighted median [IQR] or weighted percent (SE). LOS = length of stay.
*: Excluding patients with COPD: Per HCUP analysis guidelines, we presented the exact number instead of a relative percentage when n < 10.
Three-group comparisons were done using the Kruskal-Wallis rank test for continuous variables, and the chi-square test for categorical variables.

Supplemental Table 4: Unadjusted and adjusted[#] analysis of outcome during hospitalization: chronic bronchitis vs. ACO, emphysema vs. ACO, asthma vs ACO

	Chronic Bronchit	is (vs. ACO)	Emphysema (vs. ACC	0)	Asthma (vs. ACO)		
	Exponential of slope (95% CI)	Adjusted Exponential of slope (95% CI)	Exponential of slope (95% CI)	Adjusted Exponential of slope (95% CI)	Exponential of slope (95% CI)	Adjusted Exponential of slope (95% CI)	
Index admissio	n						
LOS	0.94 (0.93; 0.94)	0.92 (0.91; 0.93)	0.96 (0.95; 0.97)	0.91 (0.90; 0.92)	0.82 (0.82; 0.83)	0.88 (0.87; 0.88)	
Cost	0.96 (0.95; 0.97)	0.94 (0.93; 0.94)	1.14 (1.12; 1.15)	1.06 (1.05; 1.07)	0.86 (0.85; 0.87)	0.91 (0.90; 0.91)	
30-Day All-caus	se readmission						
LOS	1.06 (1.02; 1.09)	1.04 (1.01; 1.08)	1.04 (1.00; 1.08)	1.01 (0.97; 1.05)	0.90 (0.87; 0.94)	0.95 (0.92; 0.98)	
Cost	1.04 (1.01; 1.06)	1.02 (1.00; 1.05)	1.11 (1.08; 1.14)	1.07 (1.04; 1.10)	0.92 (0.90; 0.94)	0.94 (0.92; 0.97)	
30-Day Asthma	-related readmission	1					
LOS	.NA	NA	NA	NA	0.85 (0.80; 0.89)	0.97 (0.90; 1.06)	
Cost	NA	NA	NA	NA	0.79 (0.75; 0.84)	0.97 (0.92; 1.02)	
	Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)	Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)	Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)	
Index admissio	n ,	,	,	, ,	,	, ,	
In-hospital Mortality	1.95 (1.71; 2.21)	1.43 (1.26; 1.64)	12.11 (10.60; 13.83)	7.63 (6.65; 8.75)	1.22 (1.06; 1.40)	1.59 (1.38; 1.83)	
30-Day All-caus	se readmission						
In-hospital Mortality	1.70 (1.45; 2.00)	1.36 (1.16; 1.61)	2.17 (1.81; 2.61)	1.62 (1.34; 1.95)	0.76 (0.06; 0.90)	0.90 (0.76; 1.08)	
30-Day Asthma	-related readmission	1	•	•			
In-hospital Mortality	. NA	NA	NA	NA	0.59 (0.30; 1.18)	0.73 (0.35; 1.51)	

^{*}Adjusted for demographic features, insurance and income status, and all known chronic comorbidities including obesity. LOS and Cost were analyzed using linear regression with a log transformation. Mortality was analyzed with logistic regression.

LOS = length of stay. CI: confidence interval.

Supplemental Table 5: Respiratory and non-respiratory complications during hospitalization stratified by COPD subsets: emphysema and chronic bronchitis

	Total	ACO	Chronic Bronchitis	Emphysema	Asthma	p	
Index Admission							
n (% of N)	2,522,013 (100)	120,200 (4.8)	1,561,520 (61.9)	171,425 (6.8)	668,867 (26.5)		
Respiratory failure, %	17.7(0.2)	18.5 (0.3)	15.1 (0.1)	45.2 (0.4)	16.4 (0.2)	<0.001	
Sepsis, %	0.6 (0.01)	0.5 (0.03)	0.6 (0.01)	1.3 (0.01)	0.4 (0.01)	<0.001	
Shock, %	0.45 (0.01)	0.2 (0.02)	0.3 (0.01)	2.3 (0.01)	0.3 (0.01)	<0.001	
AKI, %	7.6 (0.1)	7.0 (0.1)	8.0 (0.07)	12.3 (0.2)	5.6 (0.1)	<0.001	
Delirium, %	0.3 (0.01)	0.23 (0.02)	0.3 (0.01)	0.5 (0.03)	0.16 (0.01)	<0.001	
Encephalopathy, %	0.7 (0.02)	0.7 (0.04)	0.7 (0.02)	2.9 (0.01)	0.4 (0.01)	<0.001	
Stroke, %	0.1 (0.01)	0.1 (0.02)	0.1 (0.01)	0.4 (0.03)	0.08 (0.01)	<0.001	
30-day All-cause readmi	ssion	. , ,		, ,			
n (% of N)	358,328 (100)	13,842 (3.9)	249,818 (69.7)	22,910 (6.4)	71,757 (20.0)		
Respiratory failure, %	17.1 (0.2)	15.5 (0.5)	16.6 (0.2)	31.66 (0.5)	14.6 (0.3)	<0.001	
Sepsis, %	7.0 (0.1)	7.0 (0.4)	7.2 (0.1)	9.7 (0.3)	5.3 (0.2)	<0.001	
Shock, %	2.5 (0.04)	2.2 (0.2)	2.7 (0.1)	4.0 (0.2)	1.6 (0.1)	<0.001	
AKI, %	13.3 (0.1)	12.5 (0.5)	13.7 (0.1)	17.2 (0.4)	10.7 (0.2)	<0.001	
Delirium, %	0.6 (0.02)	0.5 (0.1)	0.6 (0.03)	0.8 (0.1)	0.4 (0.04)	0.0003	
Encephalopathy, %	1.7 (0.01)	1.9 (0.2)	1.7 (0.1)	4.2 (0.2)	1.0 (0.06)	<0.001	
Stroke, %	0.7 (0.02)	1.0 (0.1)	0.7 (0.03)	0.7 (0.08)	0.7 (0.05)	0.10	
30-Day Asthma-Related	Readmission						
n (% of N)	23,055 (100)	1,868 (8.1)	NA	NA	21,187 (91.9)		
Respiratory failure, %	17.2 (0.5)	16.5 (1.4)	NA	NA	17.3 (0.5)	0.61	
Sepsis, %	0.4 (0.07)	0.9 (0.4)	NA	NA	0.4 (0.07)	0.27	
Shock, %	0.2 (0.05)	0.7 (0.4)	NA	NA	NA	0.18	
AKI, %	5.1 (0.2)	5.8 (0.9)	NA	NA	5.0 (0.2)	0.39	
Delirium, %	0.1 (0.05)	0.8 (0.6)	NA	NA	NA	0.23	
Encephalopathy, %	0.3 (0.05)	0.6 (0.4)	NA	NA	0.3 (0.05)	0.34	
Stroke, %	NA (OF)	NA	NA	NA	NA	0.02	

Data expressed as weighted percent (SE).

AKI = acute kidney injury.

Per HCUP analysis guidelines, we presented the exact number instead of a relative percentage when n < 10.

Three-group comparisons were done using the Kruskal-Wallis rank test for continuous variables, and the chi-square test for categorical variables.