The Economic Burden of Pulmonary Hypertension Among Patients with Chronic Obstructive Pulmonary Disease and Interstitial Lung Disease

Anna Hemnes, MD[1]; Corey Ventetuolo, MD[2]; Scott Manaker, MD[3]; Joshua Noone, PhD[4]; Reuben Howden, PhD[4], Peter Classi, MS, MBA[5]; Margaret Sketch, PharmD, MPH[5]; Abigail Nails, MMB[5]; Andrew Nelsen, PharmD[5], Steve Mathai, MD[6]

[1]Vanderbilt University Medical Center, Department of Medicine; [2]Alpert Medical School of Brown University; Brown University School of Public Health; [3]University of Pennsylvania Perelman School of Medicine; [4]University of North Carolina Charlotte; [5]United Therapeutics Corporation; [6]Johns Hopkins University School of Medicine

Disclosures

- Anna Hemnes, Corey Ventetuolo, Scott Manaker, and Steve Mathai are research partners on this study but were not paid for their contributions on this study
- Peter Classi, Margaret Sketch, Abigail Nails, and Andrew Nelsen are employees of United Therapeutics, which funded the study
- Joshua Noone and Reuben Howden are academic partners at University of North Carolina Charlotte and were paid for their contributions to this study

Introduction/Background

- 5 groups of pulmonary hypertension (PH) based on etiology per World Health Organization (WHO) and World Symposium on Pulmonary Hypertension (WSPH)
- WHO Group 3 PH (WG3 PH) is PH due to lung diseases and/or hypoxia
  - Chronic obstructive pulmonary disease (COPD)
  - Interstitial lung disease (ILD)
- Prevalence estimates are wide ranging
  - PH in COPD ranges from 30% to 70%[1]
  - PH in ILD, specifically idiopathic pulmonary fibrosis, ranges from 8% to 84%[2]
- No FDA approved treatment options specifically for WG3 PH patients
- Burden of disease is not well understood

Study Objective

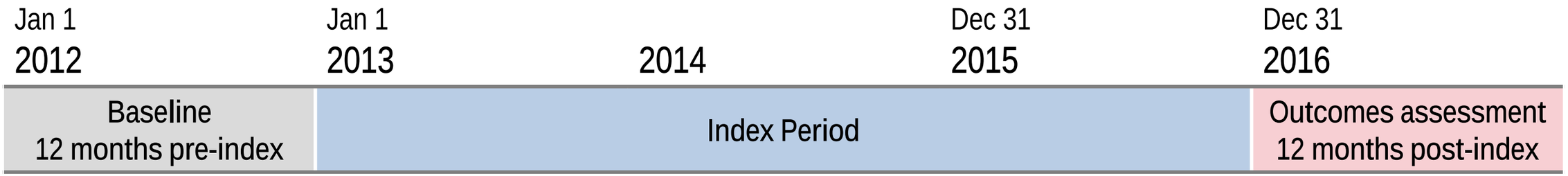
To evaluate the **healthcare economic burden of WG3 PH**, specifically the **incremental burden of PH in COPD and ILD patients**

- 2 study cohorts
  - COPD + PH (control: COPD without PH)
  - ILD + PH (control: ILD without PH)
- Primary outcomes of interest
  - Healthcare resource utilization
    - Hospitalizations
    - ER visits
  - Direct medical and pharmacy costs

Methods

- Retrospective analysis in the PharMetrics Plus Database (contains 70 million unique individuals in the U.S.) commercial claims dataset from 2012-2016
- Patients identified using ICD-9/ICD-10 codes and required to have ≥2 claims for each disease ≥30 days apart
  - COPD+PH and ILD+PH cohorts required to have COPD or ILD claim prior to PH claim
- Patients with WG2, WG4 and WG5 PH were excluded based on corresponding ICD9/10 codes
- Patients <18 years of age were excluded
- Continuous insurance enrollment was required 1 year pre and post index date
- Direct matching was employed to account for baseline differences in cohorts
- Bivariate analyses for case vs. control cohorts included t-tests, Wilcoxon-rank sum tests, and chi-squared tests for means, medians, and proportions, respectively

Study Selection Window



Independent variables:

- Age
- Gender
- Comorbidities
- Outcomes

Index Date:

- COPD+PH, ILD+PH cohorts: 1st claim for PH
- COPD without PH: 1st claim for COPD
- ILD without PH: 1st claim for ILD

Outcomes:

- Healthcare resource utilization
- Costs

Baseline Demographics and Clinical Characteristics

(pre-matching)

PRE-MATCH

	COPD					ILD				
	COPD with PH		COPD without PH		P-value	ILD with PH		ILD without PH		P-value
	N	SD/%	N	SD/%		N	SD/%	N	SD/%	
All patients	239		12,467			83		1,286		
Gender										
Female	145	60.67%	7,390	59.28%	0.664	63	75.90%	1,069	83.13%	0.091
Male	94	39.33%	5,077	40.72%		20	24.10%	217	16.87%	
Age (years)										
Mean	59.38	11.85	49.66	14.56	<0.001	54.05	12.92	48.32	12	<0.001
Select Comorbidities										
Congestive heart failure	124	51.88%	618	4.96%	<0.001	37	44.58%	23	1.79%	<0.001
Arrhythmia	127	53.14%	1880	15.08%	<0.001	35	42.17%	90	7.00%	<0.001
Valvular disease	128	53.56%	1041	8.35%	<0.001	43	51.81%	47	3.65%	<0.001
Pulmonary circulation disorder	239	100.00%	241	1.93%	<0.001	83	100.00%	8	0.62%	<0.001
Peripheral vascular disorders	61	25.52%	996	7.99%	<0.001	11	13.25%	44	3.42%	<0.001
Chronic pulmonary disease	239	100.00%	10892	87.37%	<0.001	79	95.18%	76	5.91%	<0.001
Renal failure	39	16.32%	276	2.21%	<0.001	13	15.66%	28	2.18%	<0.001
Liver disease	44	18.41%	985	7.90%	<0.001	13	15.66%	76	5.91%	<0.001
Rheumatoid arthritis/collagen	35	14.64%	841	6.75%	0.002	74	89.16%	408	31.73%	<0.001
Hospitalizations in the past 12 months										
Patients ≥ 1 event	89	37.24%	1,153	9.25%	<0.001	16	19.28%	83	6.45%	<0.001
Total events per patient, Mean	1.360	0.800	1.401	0.921	0.682	1.560	0.960	1.229	0.477	0.195
Emergency room visits in the past 12 months										
Patients ≥ 1 event	90	37.66%	3,048	24.45%	<0.001	26	31.33%	229	17.81%	0.002
Total events per patient, Mean	0.770	1.490	0.420	1.064	<0.001	0.490	1.017	0.296	0.894	0.053
Physician office visits in the past 12 months										
Patients ≥ 1 event	235	98.33%	12,004	96.29%	0.097	82	98.80%	1126	87.56%	0.002
Total events per patient, Mean	15.130	11.630	12.111	13.344	<0.001	14.610	9.099	8.892	11.454	<0.001

HCRU and Costs at 1-Year Follow Up

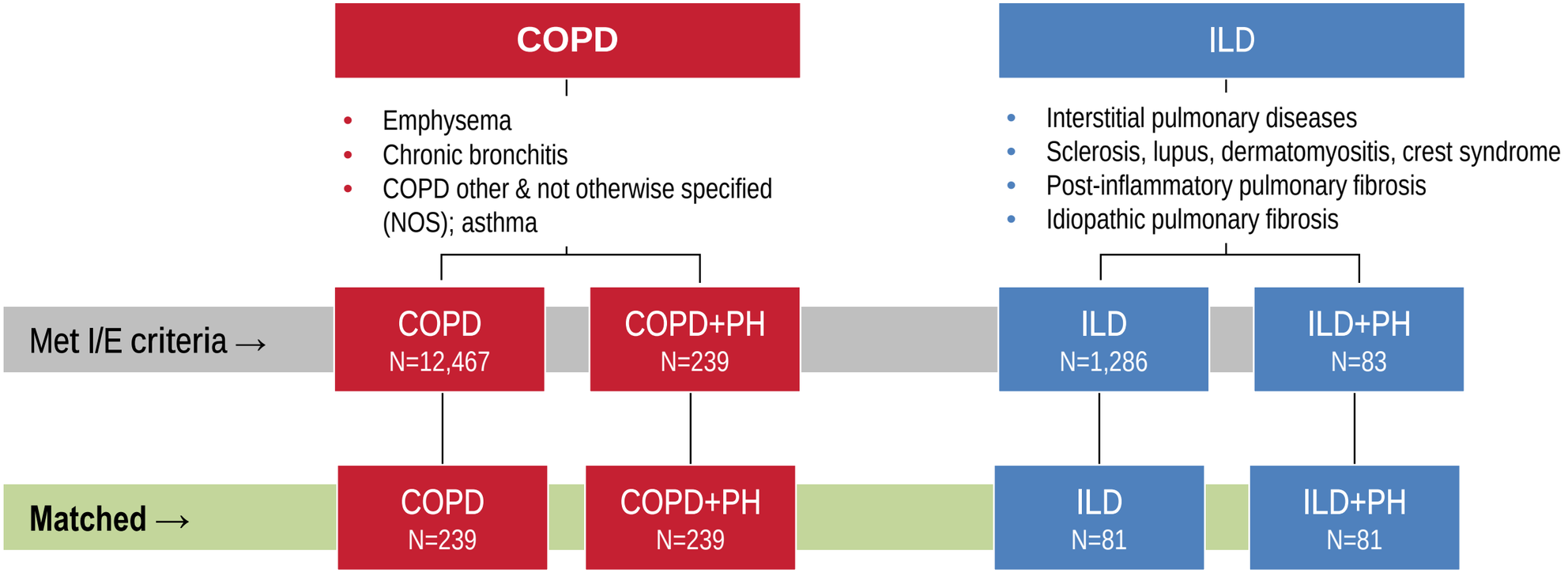
(pre-matching)

COPD				
	with PH	vs.	without PH	P-Value
Proportion with hospitalization event	35.15%		12.84%	p<0.001
Mean # of hospitalizations	0.594		0.201	p<0.001
Proportion with ER visit	38.49%		28.32%	p<0.001
Mean # of ER visits	0.891		0.533	p=0.004
Mean total medical + pharmacy costs	$39,176		$11,568	p<0.001

ILD				
	with PH	vs.	without PH	P-Value
Proportion with hospitalization event	16.87%		10.81%	p=0.089
Mean # of hospitalizations	0.325		0.169	p=0.099
Proportion with ER visit	27.71%		22.16%	p=0.241
Mean # of ER visits	0.398		0.440	p=0.785
Mean total medical + pharmacy costs	$34,462		$13,510	p<0.001

Matching

- Matched for disease subtype, then matched on age, gender, region



Baseline Demographics and Clinical Characteristics

(post-matching)

POST-MATCH

	COPD					ILD				
	COPD with PH		COPD without PH		P-value	ILD with PH		ILD without PH		P-value
	N	SD/%	N	SD/%		N	SD/%	N	SD/%	
All patients	239		239			81		81		
Gender										
Female	145	60.67%	145	60.67%	1	62	76.54%	62	76.54%	1
Male	94	39.33%	94	39.33%		19	23.46%	19	23.46%	
Age (years)										
Mean	59.381	11.846	59.368	11.77	0.991	54.09	12.63	54.23	12.62	0.941
Select Comorbidities										
Congestive heart failure	124	51.88%	30	12.55%	<0.001	36	44.44%	2	2.47%	<0.001
Arrhythmia	127	53.14%	46	19.25%	<0.001	33	40.74%	9	11.11%	<0.001
Valvular disease	128	53.56%	35	14.64%	<0.001	42	51.85%	5	6.17%	<0.001
Pulmonary circulation disorder	239	100.00%	9	3.77%	<0.001	81	100.00%	0	0.00%	<0.001
Peripheral vascular disorders	61	25.52%	40	16.74%	0.186	10	12.35%	3	3.70%	0.043
Chronic pulmonary disease	239	100.00%	215	89.96%	<0.001	81	100.00%	6	7.41%	<0.001
Renal failure	39	16.32%	10	4.18%	<0.001	12	14.81%	3	3.70%	0.015
Liver disease	44	18.41%	25	10.46%	0.012	13	16.05%	5	6.17%	0.046
Rheumatoid arthritis/collagen	35	14.64%	17	7.11%	0.008	73	90.12%	22	27.16%	<0.001
Hospitalizations in the past 12 months										
Patients ≥ 1 event	89	37.24%	39	16.32%	<0.001	15	18.52%	4	4.94%	0.007
Total events per patient, Mean	1.359	0.801	1.333	0.662	0.858	1.467	0.915	1.250	0.500	0.659
Emergency room visits in the past 12 months										
Patients ≥ 1 event	90	37.66%	69	28.87%	0.041	25	30.86%	12	14.81%	0.015
Total events per patient, Mean	0.769	1.498	0.389	0.712	<0.001	0.432	0.821	0.296	1.134	0.384
Physician office visits in the past 12 months										
Patients ≥ 1 event	235	98.33%	230	96.23%	0.159	80	98.77%	72	88.89%	0.009
Total events per patient, Mean	15.133	11.629	11.247	11.587	<0.001	14.457	9.154	7.795	9.766	<0.001

HCRU at 1-Year Follow Up

(post-matching)

COPD				
	with PH	vs.	without PH	P-Value
Proportion with hospitalization event	35.15%		17.15%	p<0.001
Mean # of hospitalizations	0.594		0.259	p<0.001
Proportion with ER visit	38.49%		31.38%	p=0.103
Mean # of ER visits	0.891		0.628	p=0.071

ILD				
	with PH	vs.	without PH	P-Value
Proportion with hospitalization event	17.28%		9.88%	p=0.169
Mean # of hospitalizations	0.33		0.10	p=0.021
Proportion with ER visit	28.40%		24.69%	p=0.594
Mean # of ER visits	0.41		0.35	p=0.620

Costs at 1-Year Follow Up

(post-matching)

PH was associated with higher mean healthcare costs

Total costs, inpatient total costs, emergency room costs, physician office costs, pharmacy costs, outpatient total cost

	COPD					ILD				
	COPD with PH		COPD without PH		P-value	ILD with PH		ILD without PH		P-value
	N	SD	N	SD		N	SD	N	SD	
All patients	239		239			81		81		
Healthcare costs [mean,SD]										
Total cost	$39,176.76	$69,851.29	$12,696.96	$32,996.26	<0.001	$35,110.80	$48,144.75	$11,210.85	$26,266.02	<0.001
Inpatient total cost	$14,518.68	$57,650.92	$4,529.35	$30,084.45	0.018	$7,556.93	$26,338.65	$1,234.25	$4,841.47	0.037
Emergency room cost	$557.36	$1,660.23	$384.87	$947.02	0.164	$234.17	$628.03	$193.28	$554.30	0.661
Physician office cost	$2,763.68	$5,006.64	$1,848.95	$4,246.70	0.032	$3,083.53	$4,906.69	$1,990.92	$1,793.76	0.063
Pharmacy cost	$5,094.29	$9,997.73	$2,243.04	$3,188.76	<0.001	$7,281.26	$19,678.37	$1,160.60	$2,597.36	0.007
Outpatient total cost	$24,658.07	$37,854.92	$8,167.60	$10,397.41	<0.001	$27,972.09	$36,541.05	$9,976.00	$24,724.01	<0.001

Limitations

- Unable to capture disease severities given nature of claims data
- During an inpatient hospitalization for COPD/ILD, patients may be more likely to get tests, such as an echocardiograph, and be subsequently diagnosed with PH
- Conditions (PH, COPD, ILD) identified using ICD9/10 codes so coding error may reduce sensitivity and specificity of algorithm
- While COPD and ILD preceded PH claim in this study, cannot confirm WG3 PH diagnosis
- Small sample size, particularly after matching

Conclusions

- When a diagnosis of PH is present with COPD or ILD, the incremental healthcare burden is substantial compared to patients without PH
- Results suggest there is a need for treatment options specifically targeted to patients with WG3 PH

References

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2. Han MK, McLaughlin VV, Criner GJ, Martinez FJ. Pulmonary diseases and the heart. *Circulation*. 2007;116:2992–3005.