Examining the Direct and Indirect Healthcare Cost Among Pulmonary Arterial Hypertension Patients

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BACKGROUND

- Pulmonary arterial hypertension (PAH) is a rare, progressive, and fatal disease associated with elevated pulmonary arterial pressure resulting in right heart failure and death.[1]
- PAH has a negative impact on patient's ability to perform activities of daily living resulting in significant economic burden of time lost at work. In an international study, about 85% of surveyed patients with PAH reported that their work or employment was affected by PAH.[2]
- Previous studies suggest the proportion of PAH patients unable to work due to their PAH is substantial, ranging between 45% and 71%.[3,4]
- While several studies have estimated the direct cost of PAH, data on both the direct and indirect are scarce.[5]
- The incremental impact of PAH on indirect costs is important since it can serve as input to economic evaluations of treatment options and predicting cost for employer-sponsored insurance.

OBJECTIVE

This study compared the direct and indirect healthcare costs and productivity loss associated with patients with and without a diagnosis of PAH in the United States.

METHODS

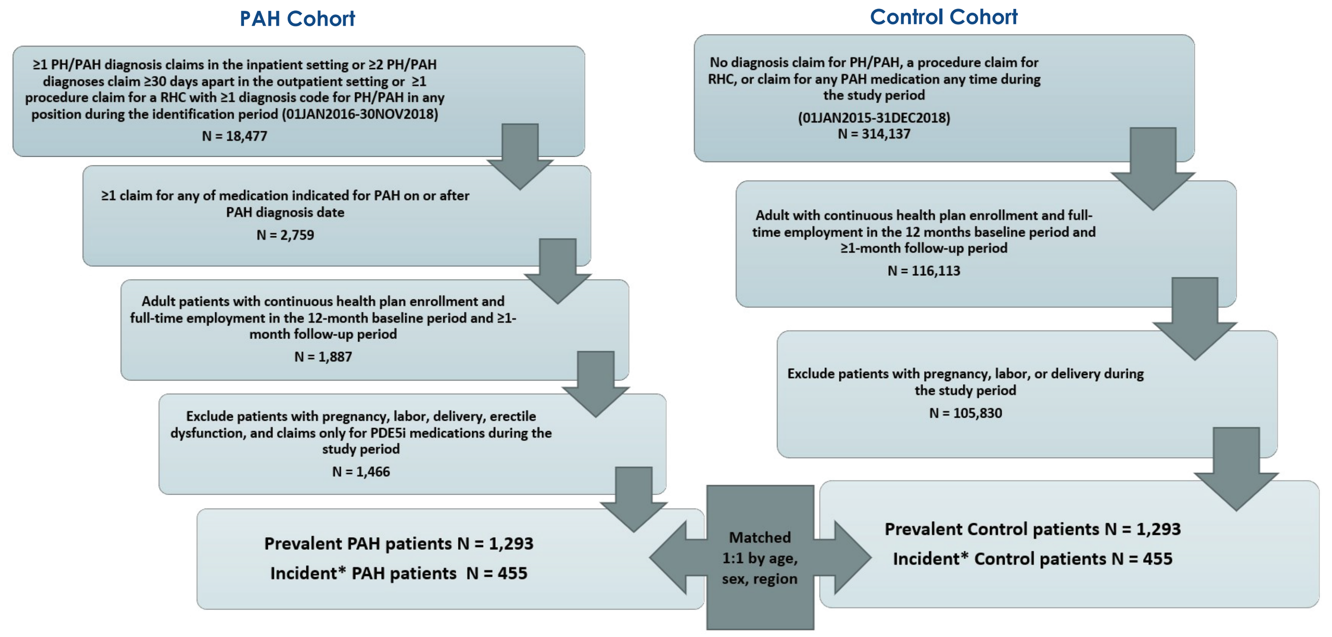
This is a retrospective database study using IBM MarketScan data linked with Health and Productivity Management (HPM) database from 01JAN2015-31DEC2018 (study period).

The PAH population was stratified as incident and prevalent PAH populations. Incident and prevalent PAH patients (case) were matched 1:1 to those in their corresponding control cohort.

- Case Cohort: Adult patients with PAH identified during the identification period (01JAN2016-30NOV2018) were included in this cohort. The date of the first diagnosis claim for PH/PAH was defined as the index date.
- Control Cohort: Adult patients without PAH diagnosis during the study period were included in this cohort. A random date during the identification period was selected as the index date for control patients (Figure 1).

The analysis was carried out for patients with PAH who had ≥1 month of follow-up. Sensitivity analysis was conducted among patients with PAH who had 12-month follow-up period for both prevalent and incident populations.

Figure 1. Patient Selection



*Patients without PH/PAH diagnosis or medical claim or PAH medication or RHC procedure during the baseline period.
PAH: pulmonary arterial hypertension; PDE5i: phosphodiesterase (Type 5) enzyme inhibitors; PH: pulmonary hypertension; RHC: right heart catheterization

Study Variables

- Patient demographics and clinical characteristics, including age, sex, geographic region, Charlson Comorbidity Index (CCI) score, individual comorbidities and healthcare costs and utilization during the 12-month baseline period

Study Outcomes

The following outcome variables were examined for the follow-up period and reported as per patient per month (PPPM).

- Direct healthcare costs: All-cause healthcare resource utilization and cost
- Indirect healthcare costs: Short term disability (STD; days), long term disability (LTD; days), productivity loss (STD and LTD days), and associated costs

Descriptive Analysis

- All baseline variables were analyzed descriptively. Counts and percentages were provided for categorical variables. Means and standard deviations were provided for continuous variables. P-values were calculated using chi-square test for categorical variables and t-tests for continuous variables. In addition, standardized differences were computed for each variable.

Multivariate Analysis

- Generalized linear models (GLMs) were used to compare direct and indirect healthcare costs and productivity loss between PAH and control patients controlling for age, sex, geographic region, health insurance status) and clinical characteristics (e.g., CCI score, individual comorbidities, marginal effects, p-values) for each comparison were obtained.

RESULTS

- A total of 1,293 patients each were identified for the case and control cohorts in the prevalent population, and 455 patients in each cohorts in the incident population, after 1:1 matching by age and sex.
- The mean age of the patients in prevalent population was 52.8 years and 53.6 years for the incident population.
- Majority of the patients with PAH were men in the prevalent and incident populations (approximately 53% and 58%, respectively).
- Patients with PAH in both populations had higher CCI scores as compared to controls (average CCI score in the cohort was 3.4; controls: 0.8-0.9) (Table 1).

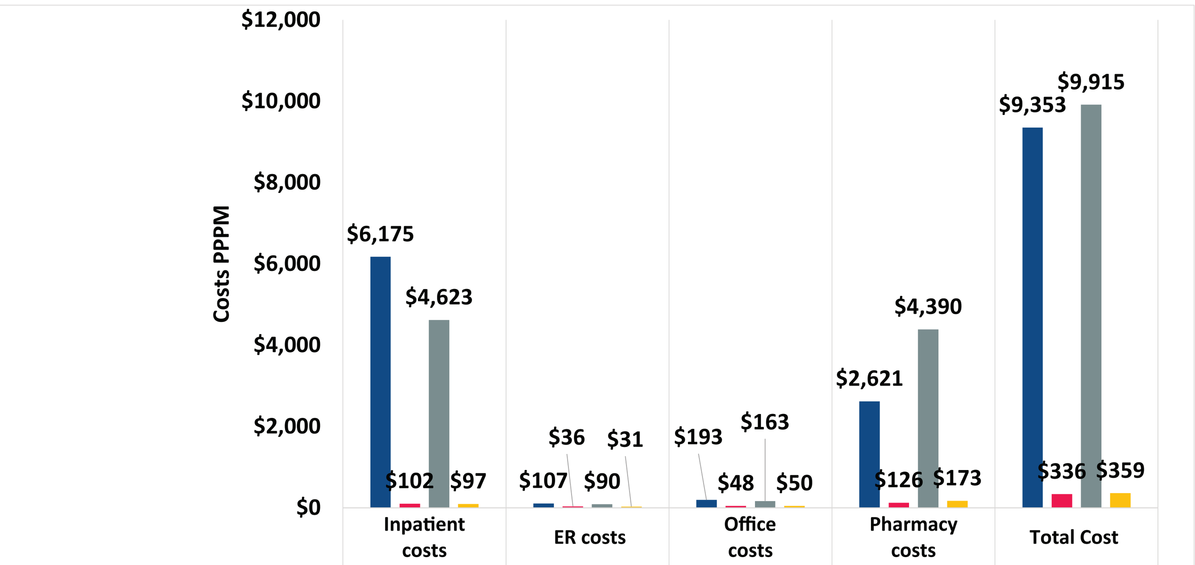
Table 1. Descriptive Baseline Characteristics in the Prevalent and Incident PAH Populations Post Match

	PREVALENT POPULATION		INCIDENT POPULATION	
	PAH Cohort (N=1293) N/Mean (%/SD)	Control Cohort (N=1293) N/Mean (%/SD)	PAH Cohort (N=455) N/Mean (%/SD)	Control Cohort (N=455) N/Mean (%/SD)
Age (in years)	52.8 (10.0)	52.8 (10.0)	53.6 (9.3)	53.6 (9.3)
Age Group (in years)				
18-34	80 (6.2%)	80 (6.2%)	22 (4.8%)	22 (4.8%)
35-44	146 (11.3%)	146 (11.3%)	45 (9.9%)	45 (9.9%)
45-54	356 (27.5%)	356 (27.5%)	125 (27.5%)	125 (27.5%)
55-64	711 (55.0%)	711 (55.0%)	263 (57.8%)	263 (57.8%)
Sex				
Male	679 (53%)	679 (53%)	264 (58.0%)	264 (58.0%)
Female	614 (47%)	614 (47%)	191 (42.0%)	191 (42.0%)
Charlson Comorbidity Index score	3.4 (2.8)	0.8 (1.5)	3.4 (2.9)	0.9 (1.7)
Top 10 Individual Comorbidities				
Apnea	274 (21.2%)	37 (2.9%)	48 (10.5%)	9 (2.0%)
Obesity	319 (24.7%)	125 (9.7%)	131 (28.8%)	46 (10.1%)
Lower respiratory disease	382 (29.5%)	112 (8.7%)	91 (20.0%)	23 (5.1%)
Chronic obstructive pulmonary disease	219 (16.9%)	18 (1.4%)	73 (16.0%)	10 (2.2%)
Dyspnea	749 (57.9%)	62 (4.8%)	245 (53.8%)	19 (4.2%)
Pneumonia	844 (65.3%)	682 (52.7%)	179 (39.3%)	124 (27.3%)
Coronary artery disease	270 (20.9%)	59 (4.6%)	93 (20.4%)	20 (4.4%)
Hypertension	841 (65.0%)	398 (30.8%)	311 (68.4%)	146 (32.1%)
Diabetes mellitus	388 (30.0%)	143 (11.1%)	152 (33.4%)	46 (10.1%)
Kidney disease (excluding end-stage renal disease)	216 (16.7%)	28 (2.2%)	69 (15.2%)	5 (1.1%)

PAH: pulmonary arterial hypertension; SD: standard deviation

- The average total all-cause healthcare cost was substantially higher for the prevalent PAH patients as compared to controls ($9,915 vs $359 PPPM) and were mainly driven by inpatient (46.6%-66.0%) and pharmacy (28.0%-44.3%) costs for prevalent and incident patients with PAH respectively.
- A similar trend was observed for incident PAH patients compared to controls ($9,353 vs $336 PPPM) on average total all-cause healthcare costs.
- Incident PAH patients had higher inpatient costs PPPM ($6.175 vs $4,623) and utilization compared to prevalent PAH patients (Figure 2).

Figure 2. Adjusted Direct Healthcare Costs in the Prevalent and Incident PAH Populations



	Inpatient costs	ER costs	Office costs	Pharmacy costs	Total Cost
Incident PAH Cohort N=455	$6,175	$107	$193	$2,621	$9,353
Incident Control Cohort N=455	$102	$36	$48	$126	$336
Prevalent PAH Cohort N=1,293	$4,623	$90	$163	$4,390	$9,915
Prevalent Control Cohort N=1,293	$97	$31	$50	$173	$359

Significant p-value (<0.05) across all variables
ER: emergency room; PAH: pulmonary arterial hypertension; PPPM: per patient per month

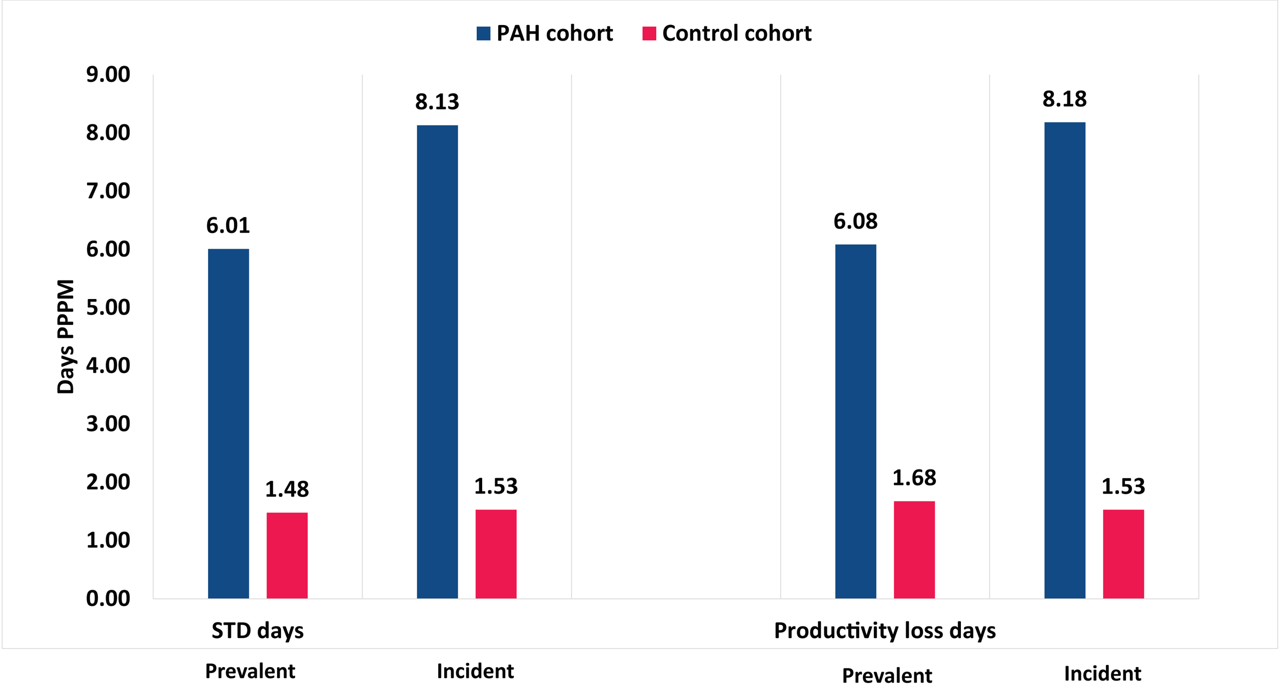
- Healthcare resource utilization was significantly higher among PAH patients compared to controls. Specifically, patients with PAH had more inpatient stays PPPM (0.07 vs 0.00 days) and longer LOS PPPM (0.63 vs 0.02 days) compared to controls among prevalent PAH patients (Table 2).
- Prevalent PAH patients had significantly longer STD days PPPM (6.0 vs 1.48 days) and productivity loss days PPPM (6.08 vs 1.68 days) as compared to controls.
- A similar trend was observed for incident PAH patients compared to controls; productivity loss PPPM (8.18 vs 1.53 days).
- Also, incident PAH patients had higher productivity loss days PPPM (8.18 vs 6.08 days) compared to prevalent PAH patients (Figure 3).

Table 2. Adjusted Direct Health Care Utilization in the Prevalent and Incident PAH Populations

	Prevalent Population		Incident Population	
	PAH Cohort N=1,293	Control Cohort N=1,293	PAH Cohort N=455	Control Cohort N=455
Number of inpatient stays (PPPM)	0.07	0.00	0.10	0.00
LOS for inpatient stays (days) (PPPM)	0.63	0.02	0.92	0.01
Number of outpatient ER visits (PPPM)	0.07	0.02	0.08	0.02
Number of ambulatory visits (PPPM)	3.09	1.00	3.38	0.92
Number of pharmacy claims (PPPM)	2.84	0.99	2.76	0.92

significant p-value (<0.05) across all variables
ER: emergency room, LOS: length of stay, PAH: pulmonary arterial hypertension, PPPM: per patient per month

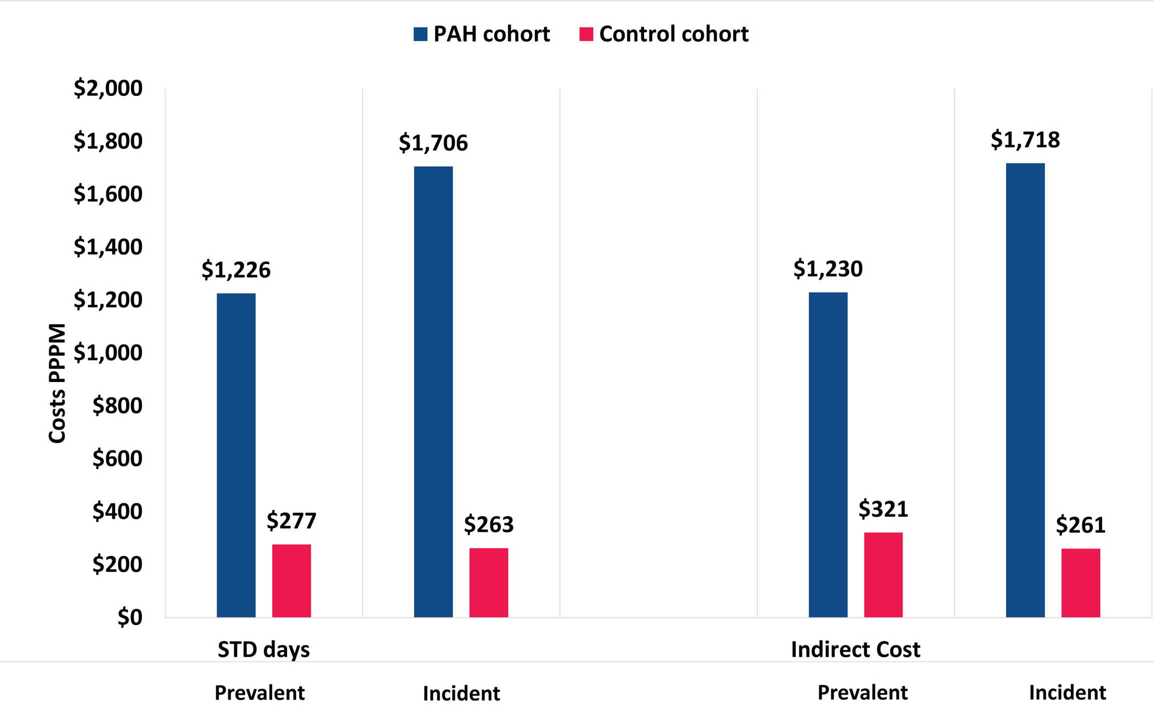
Figure 3. Adjusted Productivity Loss in Prevalent and Incident PAH Populations



Significant p-value (<0.05) across all variables
PAH cohort: patients with PAH; Control cohort: non-PAH patients
PAH: pulmonary arterial hypertension; PPPM: per patient per month; STD: short term disability

- Patients with PAH had higher STD cost PPPM ($1,226 vs $277) and productivity loss PPPM ($1,230 vs $321) as compared to controls for the prevalent PAH population.
- A similar trend was observed for the incident PAH and controls; productivity loss PPPM ($1,706 vs $263).
- However, a higher indirect costs was observed for incident PAH patients ($1,718 vs $1,230) compared to prevalent PAH patients (Figure 4).

Figure 4. Adjusted Indirect Costs in the Prevalent and Incident PAH Populations



Significant p-value (<0.05) across all variables
PAH cohort: patients with PAH; Control cohort: non-PAH patients
PAH: pulmonary arterial hypertension; PPPM: per patient per month; STD: short term disability

RESULTS - cont'd

- Sensitivity analysis examining outcomes during the 12-month follow-up period showed a similar trend, indicating higher productivity loss and indirect costs among case patients compared to controls (Table 3).

Table 3. Sensitivity Analysis for Productivity Loss and Indirect Costs

	Prevalent Population			Incident Population		
	PAH Cohort N=841	Control Cohort N=841	P-value	PAH Cohort N=271	Control Cohort N=271	P-value
Productivity Loss (days, PPPM)	2.02	0.85	0.1987	3.21	0.15	0.0120*
Indirect Costs (PPPM)	$515	$308	0.0002*	$736	$301	<.0001*

*Significant p-value
PAH: pulmonary arterial hypertension, PPPM: per patient per month

LIMITATIONS

- As with all retrospective studies, only associations and not causation can be inferred.
- The actual pay rate may have been different from the average hourly pay rate used for computing productivity loss costs, thus, incorporating a possibility of bias into productivity loss cost estimates.
- There may be residual confounding because of unmeasured/unadjusted predictors such as comorbidities, etc. in the multivariable regression models.
- The study results may not be generalizable to the entire US population as the data only included commercially-insured patients who were employed. The condition of patients with public insurance may be different.

CONCLUSION

- **This real-world study showed that patients with PAH had higher direct healthcare utilization resulting in higher direct healthcare cost for patients with PAH diagnosis compared to other patients without PAH diagnosis**
- **The study showed higher productivity loss days resulting in higher indirect cost for patients with PAH compared to the control patients. This incremental cost and higher productivity loss were attributable to the use of more STD benefit in the PAH population.**
- **In addition, this study observed higher productivity loss and indirect cost in the incident PAH patients compare to the prevalent PAH patients.**
- **These data suggest that the patients with the chronic conditions including PAH incur a substantial loss of productivity due to their illness as compared to those without these chronic conditions.**
- **PAH places a burden on employees and employer in terms of lost productivity and associated costs, and on individuals in terms of lost income related to absenteeism, activity limitation, and disability. Therefore, consideration of indirect and direct costs is necessary to gain a more complete view of the economic burden of PAH.**

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Disclosures

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