

# Costs and Length of Stay in Hospitalized Patients with Idiopathic Pulmonary Fibrosis: Analysis of the National Inpatient Sample

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## BACKGROUND

- Idiopathic pulmonary fibrosis (IPF) is a chronic, progressive, interstitial pneumonia of unknown cause and poor prognosis, occurring predominantly in older adults.<sup>1</sup>
- Overall US prevalence is estimated to be between 13 and 63 per 100,000 persons.<sup>2</sup>
- IPF patients are often hospitalized for disease progression and respiratory failure and such hospitalizations may be a major driver of healthcare cost.<sup>3</sup>

## OBJECTIVE

- To estimate the economic impact of hospital care in IPF, and to identify factors associated with cost and length of stay (LOS) in a cohort of IPF patients admitted for respiratory illnesses to short-stay hospitals in the US.

## METHODS

### Design and data source

- Cross-sectional retrospective cohort study using the National Inpatient Sample (NIS), the largest publicly available all-payer US inpatient database
  - NIS contains claims data from > 7 million hospital stays/year from a nationally representative sample of acute care hospitals.
- Study included all hospitalizations in the NIS from 2009 to 2011 with
  - a claim for IPF (ICD-9-CM code 516.3, 516.31) and
  - a principal diagnosis of respiratory disease (ICD-9-CM 460-519),
- Admissions for lung transplant were excluded.

### Statistical Analysis

- All variables weighted to represent national estimates.
- Costs calculated using cost-to-charge ratios and adjusted to 2011 US\$.
- Linear regression to identify factors associated with cost and LOS.
- Domain analysis to account for the use of subpopulations rather than the entire sample.
- Statistical analyses performed using SAS® version 9.4.

## RESULTS

- From 2009 to 2011 22,350 patients with IPF were admitted to US hospitals with a principal diagnosis of respiratory disease and did not undergo lung transplant.
- Mean (SE) age was 70.0 (0.32), and 50.9% were male.
- 43.1% of admissions had a principal diagnosis of IPF

**Table 1. Patient Demographics, Hospital Characteristics, and Admission Type**

	N = 22,350 Mean(+/-SE) / no.(%)
<b>Age</b>	70.0 (+/-0.32)
<b>Female</b>	11,374 (50.9)
<b>Race</b>	
White	14,404 (64.4)
Black	1,707 (7.6)
Hispanic	2,110 (9.4)
Other or missing	4,130 (18.5)
<b>Primary payer type</b>	
Medicare	15,297 (68.4)
Medicaid	1,531 (6.9)
Private (including HMO)	4,590 (20.5)
Other	932 (4.2)
<b>Hospital region</b>	
Northeast	3,897 (17.4)
Midwest	5,644 (25.3)
South	9,169 (41.0)
West	3,641 (16.3)
<b>Teaching hospital</b>	9,687 (43.3)

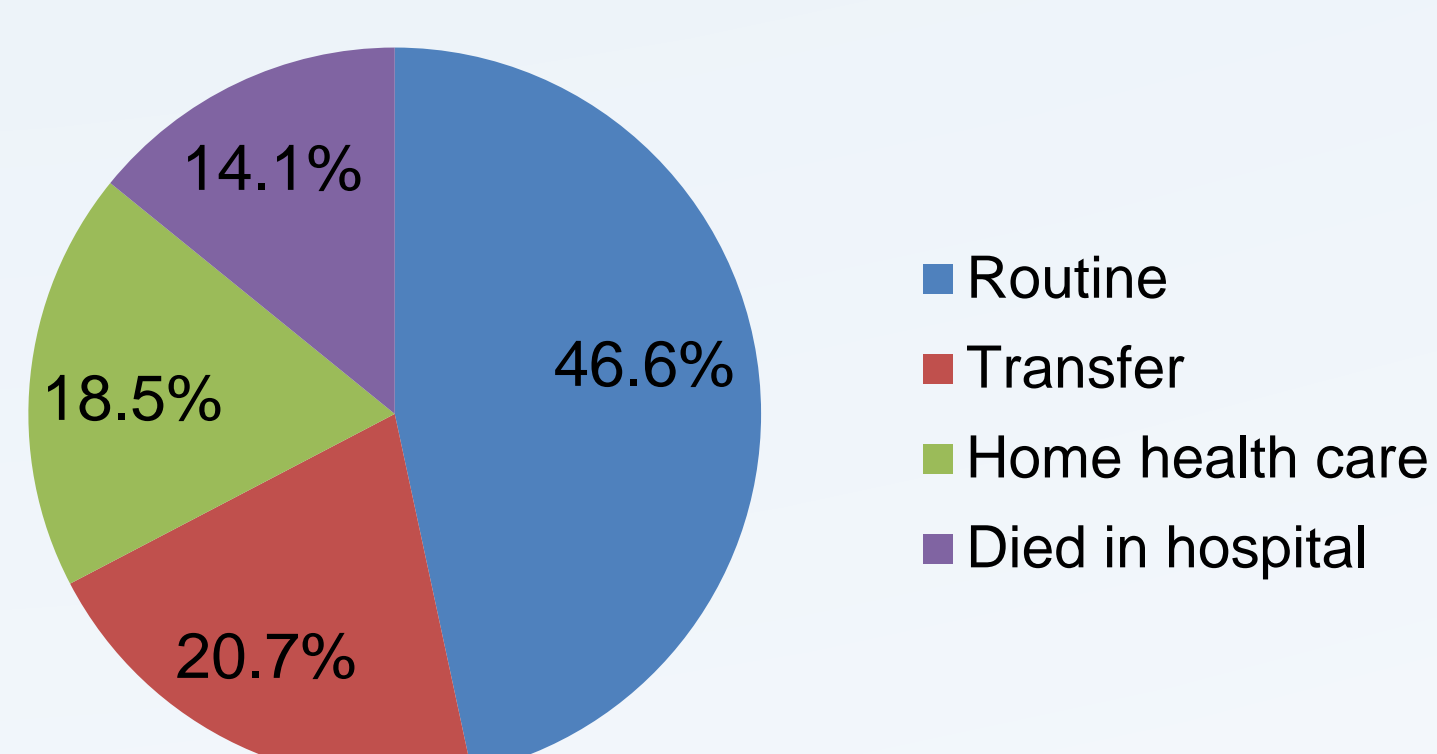
- Respiratory and cardiovascular comorbidities were common, including bacterial pneumonia (38.5%), COPD (38.2%), congestive heart failure (27.8%), and ischemic heart disease (28.4%).
- Invasive mechanical ventilation used in 11.4% of patients and non-invasive ventilation in 8.9%.

**Table 2: Patient Clinical Characteristics and Treatment**

	N = 22,350 Mean(+/-SE) / no.(%)
<b>No. of chronic conditions</b>	4.3 (+/-0.03)
<b>Chronic obstructive pulmonary disease<sup>a</sup></b>	8,535 (38.2)
<b>Bacterial pneumonia</b>	8,604 (38.5)
<b>Cardiovascular conditions</b>	10,063 (45.0)
Congestive heart failure	6,219 (27.8)
Ischemic heart disease	6,339 (28.4)
Myocardial Infarction	1,345 (6.0)
Pulmonary hypertension	84 (0.4)
<b>Invasive Mechanical Ventilation</b>	2,546 (11.4)
<b>Non-invasive Ventilation</b>	1,995 (8.9)

<sup>a</sup> including emphysema

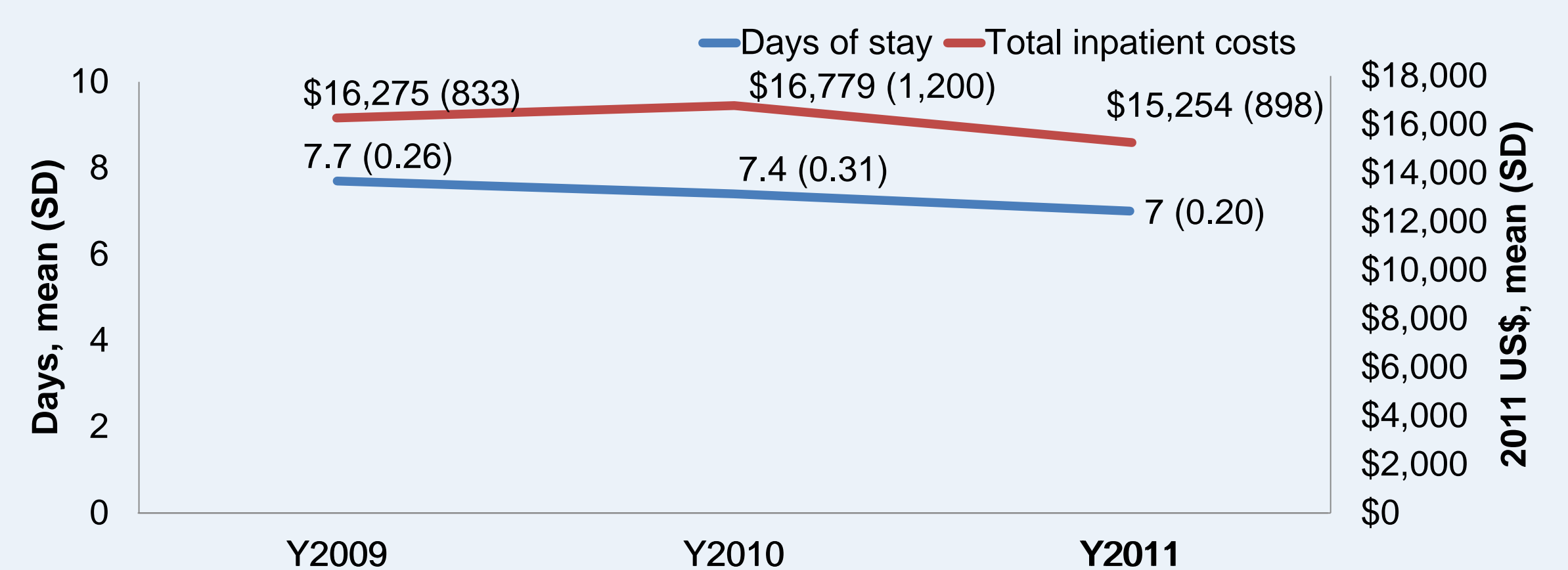
**Figure 1. Discharge Status**



## RESULTS (CONT.)

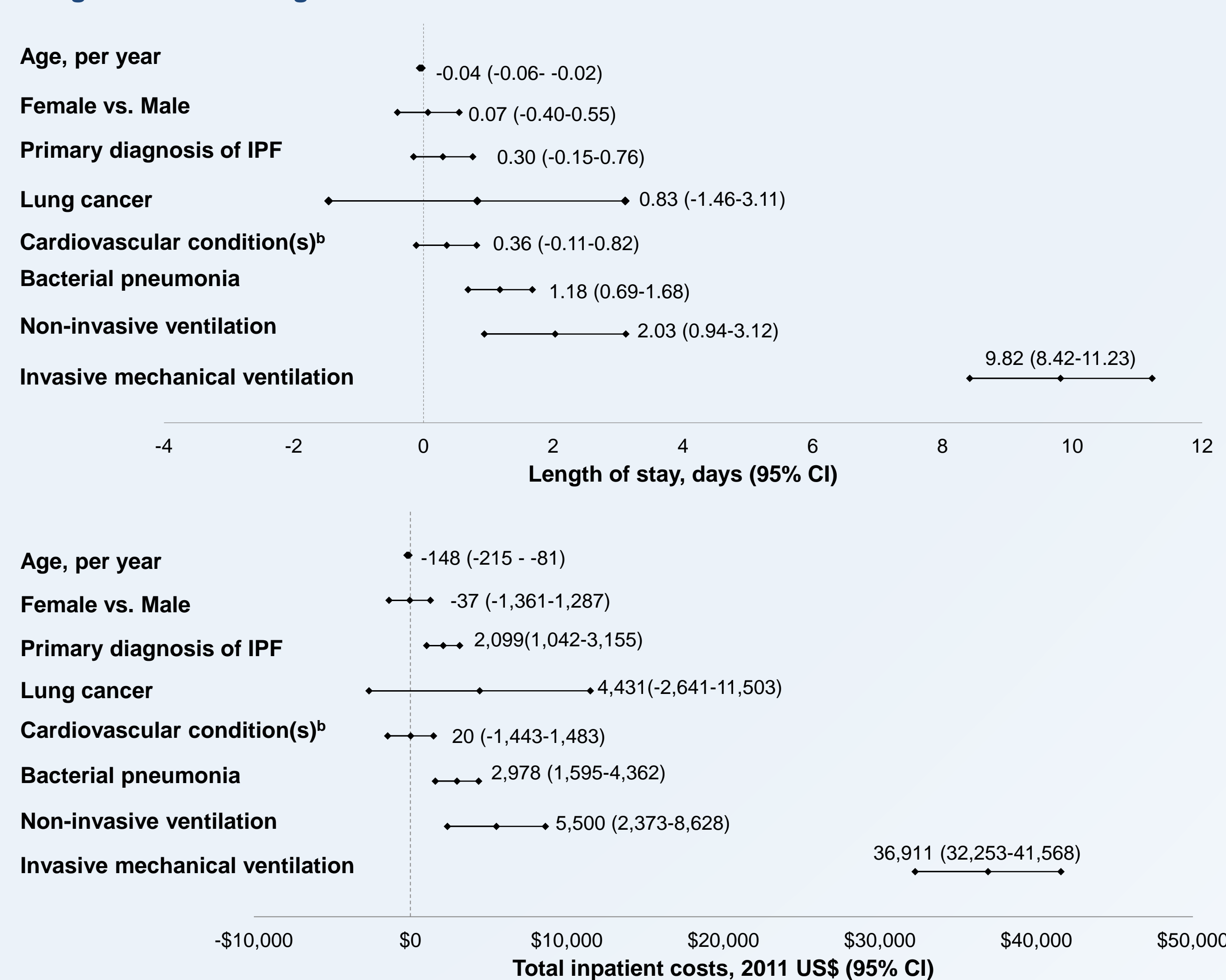
- Mean (SE) LOS for these respiratory-related hospitalizations was 7.4 (0.15) days overall: 7.7 (0.26) in 2009, 7.4 (0.31) in 2010, and 7.0 (0.20) in 2011. (Figure 2)
- Total hospitalization costs were mean (SE) \$16,042 (631) over the entire study period per event; \$16,275 (833) in 2009, \$16,779 (1,200) in 2010, and \$15,254 (898) in 2011.

**Figure 2. Length of Stay and Total Costs**



- Age, bacterial pneumonia, and use of non-invasive or invasive mechanical ventilation were statistically significantly ( $p < .001$ ) associated with cost and LOS.
- Admission with a primary diagnosis of IPF was significantly associated with cost but not LOS.
- Use of invasive mechanical ventilation had the largest effect on LOS and cost, with an increase of 9.82 days [95%CI 8.42 - 11.23] and \$36,911 [32,253 - 41,568] respectively.
- Non-invasive ventilation was associated with an increase of 2.03 days [0.94 - 3.12] in LOS and \$5,500 [2,373 - 8,628] in cost.

**Figure 3. Linear Regression Models for LOS and Costs<sup>a</sup>**



CI: confidence interval; <sup>a</sup> Point estimates and 95% CI for LOS and cost are adjusted for all listed variables. <sup>b</sup> Ischemic heart disease, myocardial infarction, and congestive heart failure.

## LIMITATIONS

- Only costs and comorbidity claims data from hospitalization captured which likely underestimates both overall patient cost and comorbidities.
- Patients transferred to other facilities may have died before discharge from those facilities, possibly leading to underreporting of deaths.
- Common chronic IPF comorbidities that do not lead to hospitalization (e.g. GERD, sleep apnea and obesity) are likely underreported in this database of inpatient services.

## CONCLUSIONS

- There are about 7,000 respiratory-related IPF admissions every year.
- Hospital charges average more than \$55,000 per admission and costs (calculated using cost-charge ratios) are more than \$16,000, suggesting an overall annual IPF hospitalization cost of more than \$110 million per year.
- Although there is some evidence of decrease in LOS over the last several years, means costs are not decreasing.
- The in-hospital death rate was 14%, and an additional 35% of patients were transferred to other facilities or required home health care after discharge.
- These findings highlight the need for further investigation into treatments and care processes that reduce the rate and cost burden of IPF hospitalizations.

## REFERENCES

- Ryu JH. Mayo Clin Proc. 2014;89:1130-42.
- Ley B. J Clin Epidemiol. 2013;5:483-92.
- Raimundo K. BMC Pulm Med. 2016;16:2.

