BACKGROUND

- Idiopathic pulmonary fibrosis (IPF) is a chronic, progressive, interstitial pulmonary disease of unknown cause and poor prognosis, occurring predominantly in older adults.
- Hospitalizations in patients with IPF are often associated with acute respiratory failure.
- During hospitalization, invasive mechanical ventilation (IMV) remains a treatment option despite being associated with poor outcomes.

OBJECTIVES

- To investigate costs and predictors of use of IMV in patients with IPF hospitalized with a principal diagnosis of respiratory disease.
- To investigate associations between IMV and length of stay (LOS), inpatient costs, and in-hospital mortality.

METHODS

Design and Data Source

- Cross-sectional cohort study using the National Inpatient Sample (NIS), the largest publicly available all-payer US inpatient database.
- Derived from discharge abstracts for > 7 million hospital stays per year from a nationally representative sample of acute care hospitals from states covering > 95% of the US population.
- Variables included demographics, comorbid conditions, severity of illness measured with All Patients Refined Diagnosis Related Groups (APR-DRGs), costs, LOS.

Inclusion Criteria:

- Principal diagnosis of respiratory disease (ICD-9-CM 460-519).

Exclusion Criteria:

- Admission for lung transplant.
- Statistical Analysis

- Variables weighted to represent national estimates.
- Costs inflated to 2011 U.S. dollars.
- Logistic regression to determine predictors of IMV use and mortality.
- Linear regression to determine predictors of hospital costs and LOS.
- Domain analysis used to account for the use of subpopulations.

Statistical Analysis performed using SAS® version 9.4.

RESULTS

Demographic and Clinical Characteristics

- Study included 22,350 IPF patients admitted with a principal diagnosis of respiratory disease, excluding patients with a non-IPF discharge diagnosis.
- IMV use decreased, although not statistically significant, from 2009 to 2011: 12.1% in 2009, 11.5% in 2010, and 10.7% in 2011.

Table 1: Patient Demographics

<table>
<thead>
<tr>
<th>Variable</th>
<th>N=2,546</th>
<th>N=19,805</th>
<th>All N=22,350</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD)</td>
<td>70.5 (7)</td>
<td>67.9 (7)</td>
<td>70.3 (8)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Female, no. (%)</td>
<td>55.4 (6)</td>
<td>53.7 (6)</td>
<td>54.3 (6)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Race, no. (%)</td>
<td>73.6 (3)</td>
<td>72.4 (3)</td>
<td>72.9 (3)</td>
<td>0.071</td>
</tr>
<tr>
<td>White</td>
<td>108 (4)</td>
<td>104 (4)</td>
<td>106 (4)</td>
<td>0.506</td>
</tr>
<tr>
<td>Black</td>
<td>2 (3)</td>
<td>1 (3)</td>
<td>1 (3)</td>
<td>0.829</td>
</tr>
<tr>
<td>Hispanic</td>
<td>200 (8)</td>
<td>199 (8)</td>
<td>199 (8)</td>
<td>0.934</td>
</tr>
<tr>
<td>Other</td>
<td>129 (5)</td>
<td>99 (4)</td>
<td>118 (5)</td>
<td>0.030</td>
</tr>
<tr>
<td>Missing</td>
<td>83 (3)</td>
<td>64 (3)</td>
<td>77 (3)</td>
<td>0.339</td>
</tr>
</tbody>
</table>

Univariate Comparisons

- Length of stay was 10.3 days longer and costs were $38,182 higher in patients treated with IMV (Table 2).

Table 2: Patient Comorbidities, LOS, and Total Costs

<table>
<thead>
<tr>
<th>Variable</th>
<th>N=2,546</th>
<th>N=19,805</th>
<th>All N=22,350</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (per year)</td>
<td>0.78</td>
<td>0.78</td>
<td>0.78</td>
<td>0.989</td>
</tr>
<tr>
<td>Female</td>
<td>0.62</td>
<td>0.62</td>
<td>0.62</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Race</td>
<td>0.98</td>
<td>0.98</td>
<td>0.98</td>
<td>0.719</td>
</tr>
<tr>
<td>White</td>
<td>1.03</td>
<td>1.03</td>
<td>1.03</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Black</td>
<td>1.15</td>
<td>1.15</td>
<td>1.15</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1.33</td>
<td>1.33</td>
<td>1.33</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Other</td>
<td>0.63</td>
<td>0.63</td>
<td>0.63</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Missing</td>
<td>0.45</td>
<td>0.45</td>
<td>0.45</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Univariate Comparisons

- Patients who used IMV were more likely to die in hospital and less likely to be routinely discharged (Figure 1).

Figure 1: Discharge Status with and without IMV

With IMV use (N=2,546)

Without IMV use (N=19,805)

- 6.9% Transfer to short-term hospital

- 5.1% Death

- 61.2% Routine

Limitations

- Several variables included in the clinical decision to initiate IMV were unavailable in NIS.
- Adherence to standard care protocols that are not coded in NIS (e.g., GERD, sleep apnea, obesity) are likely underestimated in this analysis.

CONCLUSIONS

- Invasive mechanical ventilation was used more in younger patients and those in a non-IPF primary diagnosis particularly those with pneumonia or myocardial infarction.
- IMV was associated with a nearly 10-day increase in hospital stay, an increased cost of approximately $37,911, and in 15-fold higher risk of death.
- This study confirms that mechanical ventilation is associated with poor outcomes in patients with IPF.

Risk of In-Hospital Death

- The in-hospital death rate was 56.1% (95% CI 50.7 - 61.5) for patients with IMV versus 7.5% (95% CI 6.7 - 8.4) without IMV (P<0.001), after adjusting for covariates (Figure 5).

Figure 5: Logistic Regression Model for Risk of In-Hospital Death

- Odds ratio (95% CI) 1.33 (1.07 - 1.66) * P<0.001

- Other limitations include the following:
  - Transport-related admissions were excluded, likely leading to underestimation of the complete cost of IPF.
  - Some variables involved in the clinical decision to initiate IMV were unavailable in NIS.
  - Adherence to standard care protocols that are not coded in NIS (e.g., GERD, sleep apnea, obesity) are likely underestimated in this analysis.

References:

- American Thoracic Society May 13-16, 2016 San Francisco, CA, USA
- Healthcares were conducted by Partnership for Health Analytic Research, LLC.

This study was sponsored by Genentech, Inc. and Hoffman-La Roche Ltd.