



## Introduction

### Background

- Bronchiolitis obliterans syndrome (BOS) is an obstructive airway disease of the lungs commonly associated with lung transplantation
- BOS is characterized by T-cell mediated inflammation and fibrosis of bronchiolar walls that reduce the diameter of the bronchioles and result in progressive and irreversible airflow obstruction, respiratory failure and death
- BOS is a well described complication of lung transplantation typically appears 1-2 years post transplantation and affects 50% of recipients in the 5 years following transplantation<sup>1,2</sup>
- There is currently no approved therapy for BOS
- BOS is initially suspected with an unexplained decline in lung function over 3 months
- Clinical guidelines recommend post-transplant lung function testing, with decreasing intensity over time, but the extent to which guidelines are followed has not been assessed

### Study Goal

- Use real world data to assess ongoing lung function testing and monitoring among lung transplant (LTx) recipients with Medicare or commercial insurance coverage in the US

## Methods

### Data Sources

- IQVIA PharMetrics Plus™ claims database, with enrollment, demographic and claims data for over 140 million individuals in the US with commercial insurance coverage
- Medicare Limited Data Set, 100% sample, with enrollment, demographic and medical claims data for Medicare beneficiaries in the US

### Study Patients

- Commercially insured patients were age <65y
- Patients with Medicare coverage were age-eligible [ $\geq 65+y$ ] or disability-eligible [ $< 65y$ ]
- All patients had at least one inpatient claim with a procedure or diagnosis code for lung transplantation
- Patients in both cohorts had a 6+ month period with no evidence of transplantation prior to lung transplant and were observable 12+ months following transplant

### Study Design

- Longitudinal retrospective analysis
- Study period was 1/1/2006 to 9/30/2018 (Figure 1)
- Outcome measures
  - Lung function testing in years 1 through 5 post transplant
  - ICD, CPT, and HCPCS codes used to identify claims for specific lung function tests
  - Encounters for lung function testing, measured as days with at least 1 test

Figure 1. Study window



## References

1. Hadjiiladis D, Davis RD, Palmer SM. Is transplant operation important in determining posttransplant risk of bronchiolitis obliterans syndrome in lung transplant recipients? *Chest*. 2002 Oct;122(4):1168-1175. DOI: 10.1378/chest.122.4.1168.
2. Christie JD, et al. The registry of the International Society for Heart and Lung Transplantation: 29th Adult lung and heart-lung transplant report—2012. *J Hear Lung Transplant*. 2012 Oct;31(10):1073-86.

## Acknowledgement and Funding

Dr. Henig is a former employee of Breath Therapeutics, a Zambon company; Dr. Sacks, Mr. Cyr and Ms. Healey are employees of Precision HEOR, a division of the Precision Medicine Group, which received funding from Breath Therapeutics for this research.

## Results

### Study Patients

- 367 commercially insured and 1,776 Medicare lung transplant patients were continuously enrolled in their health plans and observable for at least 6 months before and 12 months after transplant
- Commercially insured patients were 39% female; mean age was 50.7±13.3
- Medicare patients were 39% female; mean age was 60.6±12.2

### Lung function testing

#### Commercially insured patients

- Lung function testing rates were highest in the first post-transplant year, with a sharp reduction in subsequent years (Figure 1)
- Commercially insured patients had 39.4 encounters for lung function testing, on average, in the first year after transplant
- Spirometry was commonly used, with an average of 10.6 tests per patient in the first post-transplant year, but rates were much lower in subsequent years (Table 1)

#### Medicare patients

- Testing rates were highest in the first post-transplant year and decreased markedly in subsequent years (Figure 1)
- Medicare patients had encounters for lung function testing 14.0 times, on average, in the first year after transplant
- Bronchoscopy procedures occurred at a rate of 5.4 ± 3.3 per patient in the first year after transplant, but declined dramatically from year 2 onward (Table 2)

#### Commercial vs. Medicare Patients

- Patients with commercial coverage had significantly higher rates than Medicare patients of encounters for lung function testing in the first year after transplant, with higher rates of bronchoscopy, spirometry, CT scan, x-ray and other tests (Table 1 & 2)
- Testing rates were significantly lower in years 2-5 for both cohorts, but rates of most tests were higher for commercial patients throughout the study period (Table 1 & 2)
- With marked declines in lung function testing, differences between the two cohorts were diminished over time (Figure 1)

Table 1. Mean number of lung function tests per commercial patient per year following allograft

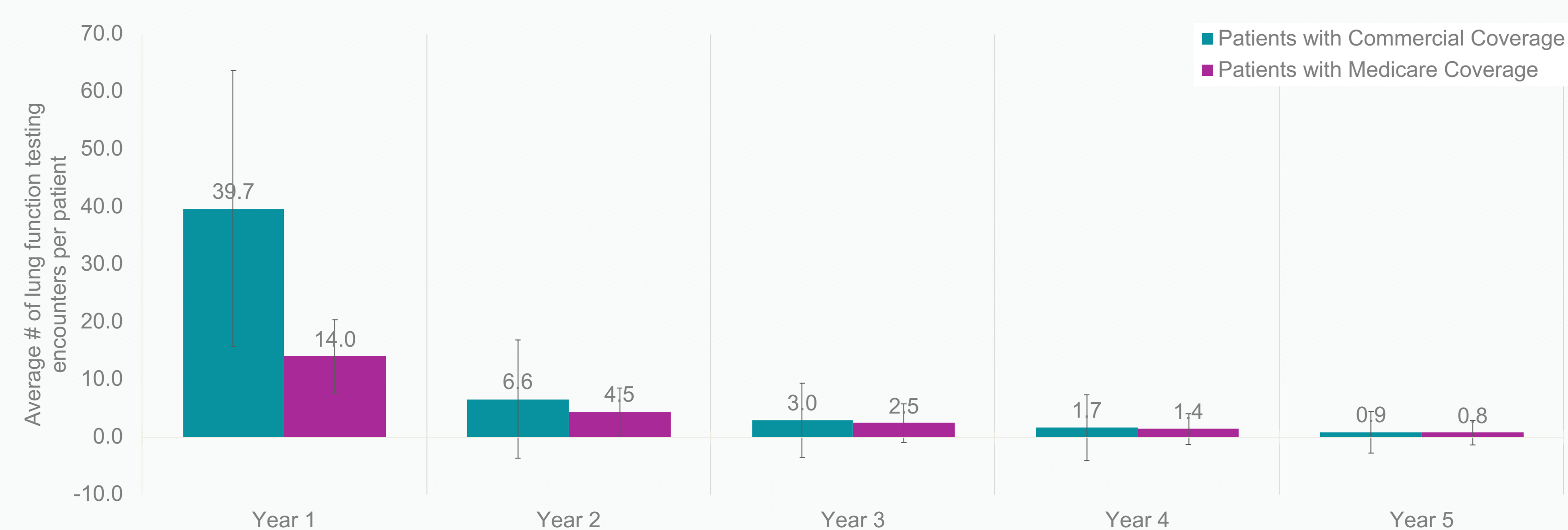
| Lung Function Testing     | Year(s) since transplant |        |        |        |        |
|---------------------------|--------------------------|--------|--------|--------|--------|
|                           | Year 1                   | Year 2 | Year 3 | Year 4 | Year 5 |
| # of test encounters*     | 39.4                     | 6.6    | 3.0    | 1.7    | 0.9    |
| Bronchoscopy              | 8.6                      | 1.3    | 0.3    | 0.2    | 0.1    |
| Chest X-ray               | 3.9                      | 5.7    | 2.3    | 1.4    | 0.7    |
| CT Scan, chest            | 2.7                      | 0.8    | 0.3    | 0.1    | 0.1    |
| Lung Biopsy               | 6.4                      | 1.5    | 0.6    | 0.4    | 0.2    |
| Lung diffusion capacity   | 0.7                      | 0.3    | 0.2    | 0.1    | 0      |
| Lung function volume test | 0.1                      | 0      | 0      | 0      | 0      |
| Peak flow test            | 0                        | 0      | 0      | 0      | 0      |
| Plethysmography           | 0.4                      | 0.2    | 0.1    | 0.1    | 0      |
| Pulse oximetry test       | 2.3                      | 0.8    | 0.3    | 0.2    | 0.1    |
| Spirometry                | 10.6                     | 3.2    | 1.6    | 0.9    | 0.4    |

\*Number of test encounters refers to the number of separate days observed in the claims data in which a patient received any number of relevant tests. Given that multiple tests can be administered in the same visit, the total number of tests may sum to less than the number of test encounters.

Table 2. Mean number of lung function tests per Medicare patient per year following allograft

| Lung Function Testing     | Year(s) since transplant |        |        |        |        |
|---------------------------|--------------------------|--------|--------|--------|--------|
|                           | Year 1                   | Year 2 | Year 3 | Year 4 | Year 5 |
| # of test encounters*     | 14.0                     | 4.5    | 2.5    | 1.4    | 0.8    |
| Bronchoscopy              | 5.4                      | 1.1    | 0.4    | 0.2    | 0.1    |
| Chest X-ray               | 11.9                     | 3.5    | 1.8    | 1.1    | 0.6    |
| CT Scan (chest)           | 1.1                      | 0.6    | 0.3    | 0.2    | 0.1    |
| Lung Biopsy               | 4.2                      | 1.1    | 0.5    | 0.2    | 0.1    |
| Lung diffusion capacity   | 0.3                      | 0.3    | 0.2    | 0.1    | 0.1    |
| Lung function volume test | 0.1                      | 0      | 0      | 0      | 0      |
| Peak flow test            | 0                        | 0      | 0      | 0      | 0      |
| Plethysmography           | 0.2                      | 0.2    | 0.1    | 0.1    | 0      |
| Pulse oximetry test       | 2.1                      | 0.6    | 0.3    | 0.1    | 0.1    |
| Spirometry                | 8.4                      | 3      | 1.7    | 1      | 0.5    |

Figure 2. Average number of encounters for lung function testing



## Conclusion

Lung function testing after lung transplant is intensive in both commercially insured and Medicare patients in the first year after transplant, with testing rates declining significantly over time. Testing is more intensive for commercially insured patients in the first post-transplant year, but decreases for both cohorts in subsequent years. These findings suggest that post-transplant lung function testing guidelines are being followed for patients with commercial and Medicare insurance coverage.