Economic Burden of Bronchiolitis Obliterans Syndrome (BOS) Following Allogeneic Hematopoietic Stem Cell Transplant (alloHSCT) in Patients with Commercial Insurance in the United States

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Introduction

Background

- Bronchiolitis obliterans syndrome (BOS), also known as pulmonary chronic Graft versus Host Disease (cGvHD), is an obstructive airway disease of the lungs associated with alloHSCT or 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
- BOS is a well described complication, affecting 48% of lung transplant recipients within 5 years of transplantation. It can also be a complication following alloHSCT, affecting an estimated 9% of patients with comparable histopathology and clinical symptoms[1,2]
- There is currently no approved therapy for the treatment of BOS
- Little is known about the impact of BOS on healthcare resource use (HRU) and costs in alloHSCT patients[3,4]

Study Goal

- Quantify the economic burden of BOS in alloHSCT patients

Methods

Data source

- IQVIA PharMetrics Plus™ commercial claims database, with enrollment, demographic and claims data for over 140 million individuals in the U.S.

Study Patients

- 322 patients between 0-64y of age treated with alloHSCT, from 1/1/2007 to 9/30/2017 (**Figure 1**)
  - Follow-up for 12 months before and 12-24 months after index alloHSCT (**Figure 2**)
  - AlloHSCT identified using International Classification of Disease (ICD) procedure codes
- ICD diagnosis codes used to identify patients with BOS (**Table 1**)
- Patients who developed BOS after alloHSCT were propensity score matched to patients who did not develop BOS (**Figure 2**)

Study Design

- Longitudinal retrospective analysis
- Outcome measures
  - Demographics and clinical characteristics in pre-alloHSCT year
  - All-cause HRU and costs for year 1 and year 2 after alloHSCT

Table 1. Clinical codes[a] for BOS diagnosis

ICD	Diagnosis codes for BOS
ICD-9	491.8, 491.9, 515, 516.34, 516.8, 996.84
ICD-10	J41.8, J42, J84.09, J84.115, J84.89, T86.818, T86.819

[a] International Classification of Disease (ICD) diagnosis codes

Methods (cont'd)

Figure 1. Patient Cohorts

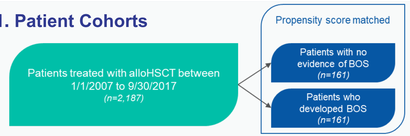
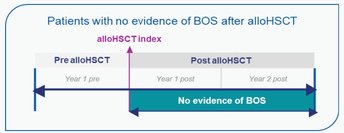
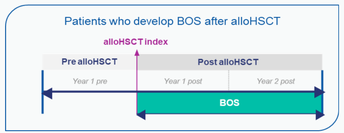


Figure 2. Study windows by patient cohort





Results

Study patients

- 161 alloHSCT patients who developed BOS were matched with 161 patients who did not develop BOS.
- Mean age was 51.0y [SD: ± 12.13]; age range was 6 to 64y; the majority of patients were male (60%)
- There were no significant differences between matched groups in demographic or clinical characteristics, with the exception of alloHSCT patients with leukemias/lymphomas (BOS: 94% vs. no BOS: 80%) and chronic pulmonary disease^ (BOS: 24% vs. no BOS: 16%)
- BOS and no BOS patient counts dropped to 77 and 74 in year 2 post alloHSCT respectively. High BOS mortality rates and switches to Medicare coverage are possible explanations for these decreases^^ **(Table 2)**

Healthcare Resource Use

- BOS patients had 1.5x higher rates of inpatient admissions, on average, in the year after alloHSCT, compared with controls (3.9 [SD: ± 3.3] vs. 2.6 [SD: ± 2.5]) (**Figure 3**)
- More BOS patients received lung function testing and treatments, compared with controls (**Table 2**)

^Asthma or COPD

^^ Cause for disenrollment, such as death, is not available in commercial claims data

Results (cont'd)

Figure 3. Annual inpatient admission rates per patient

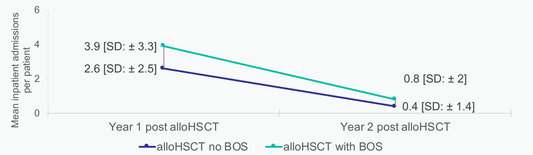


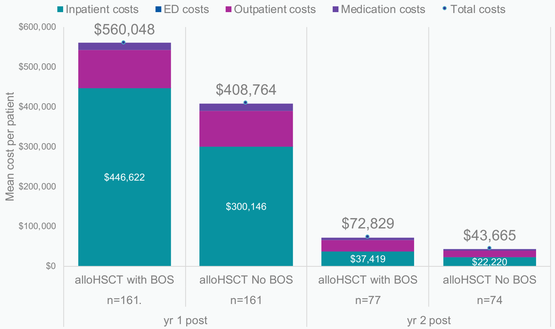
Table 2. Percent of patients with treatments, cost of treatments and diagnostic tests

	Year 1 post		Year 2 post	
	alloHSCT with BOS	alloHSCT no BOS	alloHSCT with BOS	alloHSCT no BOS
Total N Pts in Cohort	*161*	*161*	*77*	*74*
Percent of patients in year				
Patients with spirometry	*60%*	*42%*	*74%*	*35%*
Patients with treatments†	*61%*	*39%*	*61%*	*31%*
Annual mean cost per patient				
Treatments†	$31,761	$12,573	$7,994	$4,432
Diagnostic tests‡	$35,744	$10,192	$7,684	$4,910

† ventilation, oxygen therapy, pulmonary rehabilitation, extracorporeal photopheresis therapy (ECP)

‡Bronchoscopy, chest X-ray, CT scan (chest), lung biopsy, lung diffusion capacity, lung function volume test, peak flow test, plethysmography, pulse oximetry test, spirometry

Figure 4. Average annual cost per patient by healthcare setting



Abbreviations: ED: emergency department visit

Results (cont'd)

Costs

- Among patients who developed BOS, mean per patient costs were 37% higher in the first year after alloHSCT, compared with controls ($560,048 vs. $408,764) (**Figure 4**)
- Inpatient costs were responsible for most of this difference ($446,622 vs. $300,146), reflecting higher inpatient admission rates (**Figure 4**)
- Although costs for patients observable in the second post-alloHSCT year were lower for both patient groups, the cost of treating BOS patients was 67% higher than no BOS patients ($72,829 vs. $43,665) (**Figure 4**)
- Lung function test costs were over 3 times as high for BOS patients and lung function treatment costs 2.5 times as high in first year after transplant (**Table 2**)

Conclusions

AlloHSCT patients who develop BOS in the U.S. have higher rates of hospitalization and require more lung function tests and more treatments, compared with alloHSCT patients with no evidence of BOS

These higher rates of healthcare service use are accompanied by additional mean annual per patient costs accumulating to $151,000 in the first post-alloHSCT year

Increased awareness of patients at risk of developing BOS will have meaningful implications for healthcare resource utilization

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Conflict of Interest Disclosures

- Dr. Henig is an employee of Breath Therapeutics, a Zambon company
- Dr. Sacks, Mr. Cyr and Ms. Healey are employees of Precision Xtract, a division of the Precision Medicine Group, which received funding from Breath Therapeutics for this research
- Dr. Batt is a consultant to the Precision Medicine Group

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