

Pulmonary Nontuberculous Mycobacterial Infections: Healthcare Resource Utilization and Costs in Medicare Patients at a US Health Plan

Keli Abraham, PharmD¹; Robert Dufour, PhD²; Kevin J. McDermott, BS³; Amanda Tarr, PhD³

¹Humana, Inc., Louisville, KY, USA; ²Comprehensive Health Insights, Inc., Louisville, KY, USA; ³Insmmed Incorporated, Bridgewater, NJ, USA

INTRODUCTION

- Approximately 70% of US cases of pulmonary nontuberculous mycobacterial (PNTM) infection are estimated to be in patients >65 years old,¹ and its prevalence is increasing among this patient segment.²
- PNTM infections are difficult to diagnose because symptoms, such as coughing, sputum production, dyspnea, weight loss, and fatigue, are common of other respiratory comorbidities, such as bronchiectasis, chronic obstructive pulmonary disease associated with smoking, and cystic fibrosis.²⁻⁴ For these reasons, patients with PNTM often experience a long lag time between the onset of symptoms and a diagnosis. Additionally, PNTM infections can exacerbate the deterioration of lung function, compounding respiratory problems for patients with serious comorbid conditions.⁵
- For a relatively rare disease (an estimated 86,244 US national cases in 2010), the financial cost of PNTM disease is substantial, particularly among older adults, with an estimated annual cost of between \$815 million and \$1.2 billion, depending on the number of outpatient visits.¹
- The prolonged time to PNTM diagnosis leads to ongoing healthcare resource utilization (HCRU).⁵
- Due to prolonged diagnostic time in patients with PNTM infection, understanding prediagnosis HCRU may be a useful tool for healthcare plans to identify and appropriately manage this population in a timely, cost-effective fashion.
- Understanding HCRU postdiagnosis in patients with PNTM infection can identify areas of high use and help to design strategies for optimizing healthcare (eg, education, resource allocation).

OBJECTIVE

- To examine the HCRU and healthcare costs during the 18 months preceding and following the diagnosis of PNTM infection in the Medicare population vs. a matched control group at a large US health plan

METHODS

Study Design

- Medical and pharmacy claims between January 1, 2007, and May 31, 2014, were used to identify Medicare patients with PNTM infection (n = 738) and matched controls (n = 5166).
 - The Medicare population was defined as Medicare Advantage and Prescription Drug (MAPD) Plan members within the Humana database.
- Medicare members with PNTM infection were identified between July 1, 2008, and November 30, 2012, and defined by
 - Identifying ≥2 separate medical claims for PNTM infection (ICD-9-CM 031.0) with claim for first diagnosis serving as the index date; *and*
 - ≥18 months of continuous enrollment prediagnosis
 - ≥18 months of continuous enrollment postdiagnosis or until death
 - Between the ages of 18 and 89 years with medical and pharmacy coverage
- Matched control members were identified by the following criteria:
 - Between the ages of 18 and 89 years with medical and pharmacy coverage; *and*
 - ≥18 months of continuous enrollment pre- and postdiagnosis
- Medicare members with PNTM infection and control patients were matched based on gender, age, and line of business.
- Patients with PNTM infection were further subdivided in 2 groups: Guideline Optimal Treatment (n=214) and Suboptimal Treatment.
 - Patients with PNTM infection were categorized in the Guideline Optimal Treatment group if they had fills for ≥3 of American Thoracic Society / Infectious Diseases Society of America (ATS/IDSA) guideline antibiotics within the first 9 months after the diagnosis of PNTM.
 - Patients with PNTM infection were categorized in the Suboptimal Treatment group if they only had 0 to 2 fills for ATS/IDSA guideline antibiotics during the first 9 months after the diagnosis of PNTM.

Outcome Measures

- HCRU pre- and postdiagnosis:
 - The mean (standard deviation) was calculated as a monthly average for the PNTM group vs. the control group for each of the 8 utilization categories, which included:
 - Inpatient stays** – count of distinct admit dates (excluded facility transfers that are contiguous to a stay)
 - Length of stay** – measured in days per month
 - Emergency room (ER) visits** – count of distinct service dates at an Emergency Department
 - Outpatient visits** – count of distinct service dates and distinct providers for claims where place of treatment is listed as outpatients (includes office visits)
 - Specialist visits** – subset of Outpatient visits where the provider is a specialist as specified on the claim line
 - Laboratory tests** – count of distinct service dates for claims where place of service is Laboratory
 - Other** (eg, ambulance)
 - Pharmacy utilization (fills)** – count of distinct service dates (fill date) and National Drug Code (NDC) code
- Healthcare costs pre- and postdiagnosis
 - Healthcare costs were computed using the allowed amount and are all reported in 2013 dollars. All results show the average cost per month for patients in the PNTM group and patients in the control group.
 - Medical and pharmacy claims were used to calculate costs for 3 categories:
 - Total costs** (medical + pharmacy)
 - Medical costs**
 - Pharmacy costs**

RESULTS

Healthcare Resource Utilization and Healthcare Costs

Healthcare Resource Utilization

- Prior to being diagnosed with PNTM infection, those patients had higher HCRU for each of the 8 service categories vs. matched controls ($P<.0001$ for each category; first 8 rows and first 2 columns of **Table 1**).
- HCRU was also significantly higher in all 8 categories for patients with PNTM infection following diagnosis vs. matched controls ($P<.001$ for each category; first 8 rows and last 2 columns of **Table 1**).

Healthcare Costs

- Healthcare costs were significantly higher in all 3 categories (pharmacy, medical, and total costs) for patients diagnosed with PNTM infection vs. matched controls ($P<.0001$ for each category; last 3 rows of **Table 1**) pre- and postdiagnosis.

Table 1. Monthly Pre- and Postdiagnosis Healthcare Resource Utilization and Healthcare Costs for Patients With PNTM Infection and Matched Controls

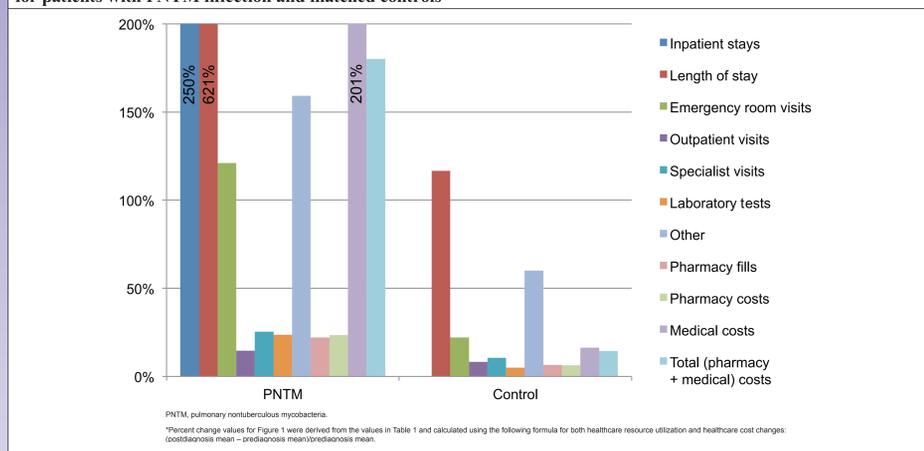
Utilization Category	Medicare Population			
	Prediagnosis		Postdiagnosis	
	PNTM	Control	PNTM	Control
Sample Size	738	5166	738	5166
Utilization Category	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Inpatient stays (count of admission dates/month)	0.06 (0.08)	0.02 (0.04)	0.21 (0.41)	0.02 (0.05)
Length of stay (sum of days in a hospital/month)	0.24 (0.36)	0.06 (0.17)	1.73 (5.10)	0.13 (0.93)
Emergency room visits (count of services dates at an emergency room/month)	0.19 (0.29)	0.09 (0.34)	0.42 (0.83)	0.11 (0.25)
Outpatient visits (count of service dates at an outpatient setting/month)	2.60 (1.75)	1.34 (1.19)	2.98 (2.49)	1.45 (1.34)
Specialists visits (count of service dates with a specialist/month)	1.10 (0.96)	0.57 (0.70)	1.38 (1.45)	0.63 (0.78)
Laboratory tests (count of service dates for laboratory claims/month)	0.38 (0.45)	0.20 (0.29)	0.47 (0.66)	0.21 (0.32)
Other (count of all other POT not captured in other categories, eg, ambulance/month)	0.71 (1.64)	0.25 (0.86)	1.84 (3.17)	0.40 (1.28)
Pharmacy fills (count of fill dates and NDC codes/month)	3.69 (2.73)	2.60 (2.34)	4.51 (3.51)	2.77 (2.45)
Cost Category	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Pharmacy costs (mean/month)	\$283.12 (\$479)	\$147.46 (\$253)	\$349.38 (\$638)	\$156.75 (\$294)
Medical costs (mean/month)	\$1,920.88 (\$3,280)	\$654.94 (\$1,305)	\$5,779.33 (\$13,086)	\$761.90 (\$1,367)
Total costs (mean/month)	\$2,204.00 (\$3,456)	\$802.40 (\$1,359)	\$6,173.71 (\$13,123)	\$918.64 (\$1,449)

NDC, National Drug Code; NTM, pulmonary nontuberculous mycobacteria; POT, points of treatment; SD, standard deviation.

Changes in Healthcare Resource Utilization and Healthcare Costs

- When examining pre- and postdiagnosis HCRU, greater utilization was seen following the diagnosis of PNTM infection than prior to the diagnosis, as shown by the percent change in **Figure 1**.
- As with HCRU, healthcare costs were higher in the postdiagnosis period for patients with PNTM infection than prior to the diagnosis of PNTM infection based on the percent change seen in **Figure 1**.

Figure 1. Percent change from pre- to postdiagnosis period for healthcare resource utilization and healthcare costs for patients with PNTM infection and matched controls*



Guideline Optimal Treatment and Suboptimal Treatment Groups

- Patients with PNTM infection in the Guideline Optimal Treatment group generated fewer inpatient stays ($P<.005$), shorter inpatient stays ($P<.001$), fewer emergency room trips ($P<.05$), but significantly more pharmacy fills ($P<.001$) than patients with PNTM infection in the Suboptimal Treatment group (**Table 2**).
- The same patients with PNTM infection in the Guideline Optimal Treatment group had significantly lower medical costs ($P<.01$) and total costs ($P<.01$) than patients with PNTM infection in the Suboptimal Treatment group. No difference was seen in pharmacy costs between these 2 subgroups (**Table 3**).

Table 2. Monthly Postdiagnosis Healthcare Resource Utilization for Patients With PNTM Infection in Guideline Optimal Treatment and Suboptimal Treatment Groups Based on ATS/IDSA Guidelines

Category	Medicare Population	
	Postdiagnosis	
	Guideline Optimal Treatment	Suboptimal Treatment
Sample Size	214	524
Category	Mean (SD)	Mean (SD)
Inpatient stays	0.14 (0.28)	0.23 (0.44)
Length of stay (sum of days in a hospital/month)	0.96 (3.04)	2.04 (5.71)
Emergency room visits (count of services dates at an emergency room/month)	0.39 (0.85)	0.44 (0.83)
Outpatient visits (count of service dates at an outpatient setting/month)	3.18 (2.34)	2.90 (2.55)
Specialists visits (count of service dates with a specialist/month)	1.49 (1.22)	1.34 (1.53)
Laboratory tests (count of service dates for laboratory claims/month)	0.57 (0.63)	0.43 (0.67)
Other (count of all other POT not captured in other categories, eg, ambulance/month)	1.94 (3.21)	1.81 (3.17)
Pharmacy fills (count of fill dates and NDC codes/month)	5.34 (3.21)	4.17 (3.58)

ATS/IDSA, American Thoracic Society/Infectious Diseases Society of America; NDC, National Drug Code; PNTM, pulmonary nontuberculous mycobacteria; POT, points of treatment; SD, standard deviation.

Table 3. Monthly Postdiagnosis Healthcare Costs for Patients With PNTM Infection in Guideline Optimal Treatment and Suboptimal Treatment Groups Based on ATS/IDSA Guidelines

Category	Medicare Population	
	Postdiagnosis	
	Guideline Optimal Treatment	Suboptimal Treatment
Sample Size	214	524
Category	Mean (SD)	Mean (SD)
Pharmacy costs	\$508.06 (\$701)	\$347.98 (\$607)
Medical costs	\$4,275.21 (\$12,735)	\$6,401.58 (\$13,200)
Total costs	\$4,783.27 (\$12,828)	\$6,749.56 (\$13,222)

ATS/IDSA, American Thoracic Society/Infectious Diseases Society of America; PNTM, pulmonary nontuberculous mycobacteria; SD, standard deviation.

CONCLUSIONS

- HCRU and healthcare cost patterns for patients with PNTM infection were significantly higher than those for their matched controls both pre- and postdiagnosis.
- After being diagnosed with PNTM, these patients appear to have a period of intensive HCRU and healthcare costs (that may be driven by treating the diagnosis according to established guideline standards).
 - Patients with PNTM infection in the Guideline Optimal Treatment group showed lower HCRU and healthcare costs than patients with PNTM infection in the Suboptimal Treatment group.
- The patterns of results found in this study are comparable to those described by Strollo et al.¹ However, these results offer the first comprehensive look at HCRU and healthcare costs in patients with PNTM infection using the administrative inpatient and outpatient claims and their allowed amounts for a Medicare Advantage population as opposed to population estimates.
- Based on these findings, healthcare plans serving the Medicare population should consider mechanisms to identify and appropriately treat patients with PNTM infection according to ATS/IDSA guideline standards, including quality improvement programs containing provider and patient education.

REFERENCES

- Strollo SE, Adjemian J, Adjemian MK, Prevots DR. *Ann Am Thorac Soc*. 2015;12(10):1458-1464.
- Adjemian J, Olivier KN, Seitz AE, et al. *Am J Respir Crit Care Med*. 2012;185(8):881-886.
- Lee MR, Yang CY, Chang KP, et al. *PLoS One*. 2013;8(3):e58214.
- Young JD, Balagopal A, Reddy NS, Schlesinger LS. *J Respir Dis*. 2007;28(1):7-18.
- Holt W, Abraham K, Dufour R, et al. Pulmonary nontuberculous mycobacteria infections: pre-index comorbidity and utilization patterns at a large US health plan. Presented at: IDWeek 2015 International Conference, October 7-11, San Diego, CA.
- Tarr A, Dufour R. *The Incidence and Burden of Nontuberculous Mycobacteria in a US Health Plan*. Internal Report presented to Insmmed Incorporated; 10 June 2015;1-31.

ACKNOWLEDGMENTS

The authors acknowledge Connexion Healthcare (Newtown, PA) for providing editorial, layout, and design support. Insmmed Incorporated (Bridgewater, NJ) provided funding to Connexion Healthcare for these services.

DISCLOSURES

Funding for this project was provided by Insmmed Incorporated. Keli Abraham is an employee of Humana Inc. and served as a consultant for the project. Kevin J. McDermott is an employee of Insmmed Incorporated. Robert Dufour and Amanda Tarr also served as consultants on the project and are employees of Comprehensive Health Insights, Inc.