same period. More targeted studies looking at factors associated with readmissions for COPD would shed additional light on the observed sex disparities.

**Author disclosures** are available with the text of this letter at [www.atsjournals.org](http://www.atsjournals.org)

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**Potential Delays in Diagnosis of Idiopathic Pulmonary Fibrosis in Medicare Beneficiaries**

To the Editor:

Idiopathic pulmonary fibrosis (IPF) is a chronic interstitial lung disease (ILD) of unknown cause, with median survival of 3 to 5 years (1). In 2014, two treatments that slow IPF progression gained U.S. Food and Drug Administration approval, highlighting the need for early, accurate diagnosis (2–4). Establishing a diagnosis of IPF can be challenging, with misdiagnoses and delays commonly reported (5–7). Despite evidence of diagnostic delays, developing a real-world estimate of this delay is difficult because of inclusion of data in IPF registries only after diagnosis, poor recall of symptom onset in surveys, and the disease’s relative rarity (annual prevalence, 4.6–11.3/100,000) (8), preventing identification of adequate sample populations. Using Medicare claims data, which capture health service utilization for Americans 65 years and older, we examined patterns of diagnostic respiratory testing and pulmonologist visits that precede IPF diagnosis to investigate potential diagnostic delays. This research was previously presented at the American Thoracic Society 2017 conference, the 2017 Aspen Lung Conference, and the CHEST 2017 meeting.

**Methods**

We analyzed claims data for all Medicare beneficiaries who were diagnosed with IPF in 2012. On the basis of a published algorithm for identifying beneficiaries with IPF in claims data (9, 10), beneficiaries were included if they: 1) had one or more inpatient or two outpatient claims with IPF as a listed diagnosis in 2012 (3), 2) had no claim with another ILD code (3) after the last observed IPF claim, 3) had no claims with IPF within 5 years before the first qualifying IPF claim in 2012 (index date), and 4) had one or more chest computerized tomography (CT) scans before index diagnosis. Among included beneficiaries, we counted the following tests in the 5 years before IPF diagnosis: pulmonary function tests (PFTs), chest radiographs, chest CT scans, fiberoptic bronchoscopy, autoimmune serologies, 6-minute-walk test, cardiopulmonary exercise test, precipitin panels, arterial blood gas, oxygen saturation, and surgical lung biopsies. Time from first recorded test to diagnosis of IPF was measured and illustrated as cumulative probability curves. We reviewed claims for evaluation and management services to identify provider specialty; pulmonologist visits were reported similar to testing above. The study was exempted from institutional review board review.

**Results**

Among 33,780 Medicare beneficiaries with a qualified claims-based diagnosis of IPF in 2012, 7,306 met all criteria and formed the final sample. Beneficiary characteristics are summarized in Table 1. All beneficiaries had at least one diagnostic test of interest during the 5-year prediagnosis period, with the most common tests being chest radiographs (99.2%) and PFTs (75.0%) (the full list is provided in Table 2). Tests were associated with many provider specialties, often other than pulmonology. The time between tests and initial IPF diagnosis varied, although testing and pulmonologist visit frequency increased immediately before diagnosis (Figure 1).

The majority of beneficiaries (n = 5,154, 70.5%) had a pulmonologist visit within 5 years before IPF diagnosis (Table 2).

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Genentech, Inc. provided financial support for this research.
Table 1. Patient demographics of patients newly diagnosed with idiopathic pulmonary fibrosis (N = 7,306)

| Characteristic | Patients Newly Diagnosed with IPF |
|---------------|----------------------------------|
| Age, yr       |                                 |
| Mean (standard deviation) | 80.8 (6.2) [81] |
| [median]      |                                  |
| Minimum–maximum | 70–105                            |
| Female        | 3,559 (48.7)                     |
| Race          |                                  |
| White         | 6,894 (94.4)                     |
| Black         | 212 (2.9)                        |
| Hispanic      | 56 (0.8)                         |
| Asian         | 40 (0.5)                         |
| Other/unknown | 104 (1.4)                        |
| Region        |                                  |
| Midwest       | 1,880 (25.7)                     |
| Northeast     | 1,412 (19.3)                     |
| South         | 2,962 (40.5)                     |
| West/other/unknown | 1,052 (14.4)            |

Definition of abbreviation: IPF = idiopathic pulmonary fibrosis.

Data presented as No. (%) unless otherwise noted.

Of these 5,154 beneficiaries, 34.7% had their initial pulmonologist visit more than 3 years before diagnosis.

The first chest CT scan was observed throughout the 5-year prediagnosis period, with 19.1% of beneficiaries having their first scan more than 4 years before IPF diagnosis, 32.5% more than 3 years before diagnosis, and 57.5% more than 1 year before diagnosis (Table 2). Repeated scans were common before index diagnosis.

Discussion

In a large, nationally representative sample of Medicare beneficiaries with IPF, chest imaging, PFTs, and pulmonologist visits were commonly performed in the 5 years before a diagnostic code for IPF appeared. Nearly one-third of beneficiaries had their first CT scan more than 3 years before diagnosis, with slightly more seeing a pulmonologist in this period. If these are proxies for development of IPF-related respiratory symptoms, our findings may mean that diagnosis of IPF is frequently delayed, even after evaluation by a pulmonologist.

Our results are consistent with previous studies (7). Lamas and colleagues (7) found a median delay of 2.2 years before an accurate diagnosis. Furthermore, diagnostic delay was associated with comorbidities such as coronary artery disease and gastroesophageal disease, to which symptoms of IPF may have been initially attributed. A survey study of patients with IPF reported more than half of patients were initially misdiagnosed, and 43% recalled a delay of 1 year or more from symptoms to diagnosis (6). Our study supports these findings by suggesting that diagnostic imaging and PFT are ordered often years before initial diagnosis, and that delayed diagnosis may potentially occur even after diagnostic tests and pulmonologist evaluation. This may point to a need to improve IPF diagnostic tests, testing algorithms, and/or test interpretation, even among pulmonologists. In addition, 30% of patients did not see a pulmonologist before diagnosis, possibly indicating the need for better access to subspecialty care. Improvement in chest CT scan capabilities and interpretation and early referral to an ILD center may reduce potential delays and expedite appropriate treatment.

Our study is limited, in that even with use of chest CT scans (not specific to high-resolution scans) and other respiratory testing, earlier diagnosis of IPF may not have been possible. The test results may have been unavailable, initially normal, or insufficient to diagnose IPF; beneficiaries may have initially lacked a radiographic usual interstitial pneumonia (UIP) pattern recommended for definite diagnosis or had testing that preceded the development of IPF diagnostic criteria on the basis of confidence of radiographic UIP pattern (11). In addition, surgical lung biopsy, itself a risk among elderly patients, is often not performed due to cost and invasiveness.

Table 2. Frequency distributions of first diagnostic test and first pulmonologist visit in 5 years before diagnosis of idiopathic pulmonary fibrosis among newly diagnosed Medicare beneficiaries (N = 7,306)

| Year before Diagnosis when First Test Occurred | Fifth Year | Fourth Year | Third Year | Second Year | First Year* |
|-----------------------------------------------|------------|-------------|------------|-------------|-------------|
| No.   | %     | No. | %     | No. | %     | No. | %     | No. | %     | Cumulative % |
| Any diagnostic test                           | 4,217      | 57.7 | 1,365 | 18.7 | 695 | 9.5 | 460 | 6.3 | 569 | 7.8 | 100.0 |
| Pulmonary function testing                     | 1,219      | 16.7 | 867 | 11.9 | 696 | 9.5 | 752 | 10.3 | 1,942 | 26.6 | 75.0 |
| Chest radiograph                               | 3,542      | 48.5 | 1,531 | 21.0 | 823 | 11.3 | 571 | 7.8 | 782 | 10.7 | 99.2 |
| CT scan of the chest                           | 1,399      | 19.1 | 978 | 13.4 | 864 | 11.8 | 962 | 13.2 | 3,103 | 42.5 | 100.0 |
| Fiberoptic bronchoscopy                        | 115        | 1.6 | 100 | 1.4 | 116 | 1.6 | 168 | 2.3 | 770 | 10.5 | 17.4 |
| Autoimmune serologies                          | 484        | 6.6 | 420 | 5.7 | 414 | 5.7 | 479 | 6.6 | 1,157 | 15.8 | 40.4 |
| 6-minute-walk test                             | 142        | 1.9 | 127 | 1.7 | 156 | 2.1 | 229 | 3.1 | 742 | 10.2 | 19.1 |
| Cardiopulmonary exercise testing†             | N/A        | N/A | N/A | N/A | 33 | 0.5 | N/A | N/A | N/A | N/A | N/A |
| Precipitin panel                               | 22         | 0.3 | 26 | 0.4 | 26 | 0.4 | 47 | 0.6 | 244 | 3.3 | 5.0 |
| Arterial blood gas                             | 186        | 2.5 | 156 | 2.1 | 181 | 2.5 | 214 | 2.9 | 525 | 7.2 | 17.3 |
| Oxygen saturation                              | 753        | 10.3 | 600 | 8.2 | 566 | 7.7 | 618 | 8.5 | 1,176 | 16.1 | 50.8 |
| Surgical lung biopsy                           | 60         | 0.8 | 73 | 1.0 | 65 | 0.9 | 104 | 1.4 | 474 | 6.5 | 10.6 |
| Pulmonologist visit                            | 1,245      | 17.0 | 543 | 7.4 | 520 | 7.1 | 625 | 8.6 | 2,221 | 30.4 | 70.5 |

Definition of abbreviations: CT = computed tomography; N/A = not applicable.

†Four cell counts suppressed because of three cell sizes with counts less than 11.
patients, who predominated our study, may have been deferred (11, 12). Second, the long observation period pre-index could have introduced early testing that was unrelated to IPF diagnosis; we minimized this (immortal time) bias by including specialized testing that was likely related to a later diagnosis. Third, beneficiaries identified as having IPF may not have IPF, because of misclassification and/or miscoding (10, 13); however, our method for identifying IPF beneficiaries was derived from a modified code-based algorithm (10), with improved positive predictive value over prior algorithms. Finally, as an artifact of our study’s 5-year look-back period, the final sample was older than typical beneficiaries with IPF.

Our study examined Medicare beneficiaries with IPF to show that diagnostic delays may occur, even after chest imaging, pulmonary function studies, and a pulmonologist’s evaluation. Further study among ILD specialty centers and within the era of antifibrotic therapy may help confirm whether patients could be diagnosed earlier and if earlier diagnosis leads to improved clinical outcomes.

**Author disclosures** are available with the text of this letter at www.atsjournals.org.

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2. Oldham JM, Noth I. Idiopathic pulmonary fibrosis: early detection and referral. *Respir Med* 2014;108:819–829.
Ethics of Health Research Supported by For-Profit Cannabis Companies: What Have We Learned from Big Tobacco?

To the Editor:

As clinician-investigators with an interest in the impact of legalized cannabis on pulmonary diseases, we read the results of a clinical trial of vaporized cannabis for advanced chronic obstructive pulmonary disease with enthusiasm (1). We commend the researchers for conducting a well-designed study focused on use of noncombusted cannabis for pulmonary conditions. However, publication of this study by AnnalsATS raises an important point. Together with acknowledging support of the study’s authors by numerous funding sources, including the Canadian Institutes of Health Research, the senior author also received an investigator-initiated study grant from Tilray. Per the company’s website, (www.tilray.com), “Tilray is a global leader in medical cannabis research, cultivation, processing and distribution [that aspires] to lead, legitimize and define the future of our industry by building the world’s most trusted cannabis company…[W]e are the first GMP-certified medical cannabis producer to supply cannabis flower and extract products to tens of thousands of patients, physicians, pharmacies, hospitals, governments and researchers….”

Tilray was listed on the Nasdaq Stock Market (NASDAQ:TLRY) in July 2018 with a market value reportedly worth $5 billion (2), making it relatively smaller than Philip Morris International or Coca-Cola, July 2018 with a market value reportedly worth $5 billion (2), making Tilray was listed on the Nasdaq Stock Market (NASDAQ:TLRY) in 2011;48:179–186.

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Research queried specifically in the authors’ instructions, despite the fact that consuming cannabis by combustion remains most common among regular users (3).

Accepting funding from commercial sources to conduct research has the potential to bias scientific investigations and may also undermine trust in research results. Tobacco industry research funding is the most obvious example in which strategies used by the industry to shape evidence on risk have been identified, including funding and publishing research that supports the interest group’s position (4). Earlier this year, alcohol industry support of federal research regarding alcohol use also came under similar scrutiny when the National Institutes of Health (NIH) stopped a $100 million study of the putative benefits of alcohol on human health that was revealed to be largely supported by the alcohol industry, which may have had input during the trial’s design in 2013 and 2014 (5).

Although conducting clinical trials related to cannabis in the United States remains challenging, options do exist for performing this type of work that do not require direct funding from industry. Methods that investigators have used include purchasing cannabis from a commercial supplier using investigator funding (including suppliers in Good Manufacturing Practice–certified facilities [6]) or using cannabis supplied for research purposes free of charge (less optimal). The National Institute on Drug Abuse also has a drug supply program that can provide both NIH-sponsored and non–NIH-sponsored investigators with cannabis products for research after an Investigational New Drug Application is filed and reviewed and a Drug Enforcement Administration registration for cannabis (a schedule I controlled substance) is obtained by the investigator. We hope that editors of ATS journals will urgently clarify instructions with respect to investigators accepting funding from for-profit cannabis companies with the same level of concern as tobacco industry–funded investigations until sufficient evidence can be provided regarding its safety for human health.

Author disclosures are available with the text of this letter at www.atsjournals.org.

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