Clarifying the diagnosis of post-inflammatory pulmonary fibrosis: a population-based study

To the Editor:

Epidemiological studies are important in defining the distribution and burden of diseases in a population. A common method of studying interstitial lung disease (ILD) epidemiology has been the analysis of insurance and billing claims databases, such as the Commercial Claims and Encounters Database and the Medicare Supplemental and Coordination of Benefits Database. These studies rely on the accuracy of International Statistical Classification of Diseases (ICD) codes to identify a patient population of interest. Several studies have described the incidence and prevalence of ILD by methodically searching ICD codes related to ILD or by using code-based algorithms [1–6].

Post-inflammatory pulmonary fibrosis (PPF) (ICD-9-CM 515) has been categorised as a general diagnostic code used by providers for IPF, an ILD characterised by progressive parenchymal fibrosis [1, 7]. Cases of PPF have been variably included in studies of IPF epidemiology. The prevalence of PPF may be comparable or higher to that of IPF. For example, COULTAS *et al.* [2] reported PPF to represent 16.7% of prevalent cases of ILDs while IPF comprised 22.5% in a population-based registry. RAGHU *et al.* [8] analysed a large healthcare claims database spanning the period 1996–2000 and found the prevalence of PFF to be nearly 11-fold higher than that of IPF identified by "broad case definition". To our knowledge, however, cases designated as PPF have never been fully characterised. In particular, it is unknown to what extent PPF (ICD-9-CM 515) overlaps with the diagnosis of IPF.

With approval from the Mayo Foundation Institutional Review Board (Mayo Clinic, Rochester, MN, USA), we conducted a population-based, retrospective cohort study of residents of Olmsted County, Minnesota, USA. The objectives of this study were to diagnostically characterise patients who have received the diagnosis code ICD-9 515 (PPF) and determine what portion were IPF. This study utilised the Rochester Epidemiology Project (REP), which is a medical records linkage system established in 1966 to capture healthcare data for the population of Olmsted County [9]. Persons were classified as Olmsted County residents if they had had a residential or nursing home address for >1 year [9].

All patients ≥18 years of age who received the diagnosis code of PPF (ICD-9 515) and received care in Olmsted County from 1997 to 2017 were identified. A total of 4813 unique patients were retrieved. From this cohort, we analysed those who had undergone chest computed tomography (CT) imaging (1789 patients) to enable characterisation of their lung disease.

Medical records and associated chest CT studies were reviewed and the pulmonary disease was categorised based on clinical context and predominant CT chest abnormality. These categories included airway abnormalities, atelectasis, bilateral interstitial infiltrates, cysts or cavities, oedema, emphysema, focal fibrotic abnormalities, focal or multifocal infiltrates, lymphadenopathy, nodules or masses, and pleural abnormalities (table 1). We assigned a specific diagnosis whenever possible if appropriate diagnostic evaluation was performed; in other cases, only a descriptive radiological finding was assigned. IPF was diagnosed based on 2018 Fleischner criteria [10]. A diagnosis of definite or probable IPF was assigned to patients with the appropriate clinical context and CT findings (based on review of both radiology reports and actual images) suggestive of a typical or probable usual interstitial pneumonia pattern. Clinical context criteria for IPF included age ≥60 years, absence of potentially relevant environmental or medication

TABLE 1 Diagnostic categories for patients assigned International Classification of Diseases-9 code 515 (post-inflammatory pulmonary fibrosis) (n=1789)

Diagnostic category	Patients
Airway abnormalities	83 (4.6%)
Atelectasis	214 (12.0%)
Bilateral interstitial infiltrates	177 (9.9%)
Asbestosis	2 (0.1%)
Combined pulmonary fibrosis and emphysema	3 (0.2%)
Connective tissue disease-related ILD	33 (1.8%)
Respiratory bronchiolitis-associated ILD/DIP	5 (0.3%)
Hypersensitivity pneumonitis	6 (0.3%)
Idiopathic pulmonary fibrosis	71 (4.0%)
Idiopathic nonspecific interstitial pneumonia	29 (1.6%)
Sarcoidosis	3 (0.2%)
Cysts or cavities	6 (0.3%)
Oedema	22 (1.2%)
Emphysema	49 (2.7%)
Focal fibrotic abnormalities	362 (20.2%)
Focal or multifocal (nonfibrotic) infiltrates	191 (10.7%)
Lymphadenopathy	23 (1.1%)
Nodules or masses	552 (30.9%)
Normal parenchyma	44 (2.5%)
Pleural abnormalities	66 (3.7%)

ILD: interstitial lung disease; DIP: desquamative interstitial pneumonia.

exposure and no evidence of connective tissue disease [10]. Surgical biopsy was not required for IPF diagnosis. A second study panel member also reviewed any cases of IPF or ILD, and the final diagnosis was given based on consensus.

Among the 1789 patients assigned the ICD-9 code 515 (PPF) with CT chest imaging, 177 (9.9%) had bilateral interstitial infiltrates consistent with ILD; only 71 (4.0%) patients had definite or probable IPF by the 2018 Fleischner criteria. The remaining 1612 (90.1%) patients were non-ILD cases. The largest proportion of non-ILD cases (n=552, 30.9%) manifested nodules or masses followed by focal fibrotic abnormalities (n=362, 20.2%) and atelectasis (n=214, 12.0%) (table 1). Over the study interval, there was a temporal trend to increased use of the ICD-9 code 515. For example, the number of cases designated with this code ranged 58–75 per year during the first 3 years compared to 99–178 per year during the last 3 years. The Olmsted County population increased ∼1.3-fold during this interval.

Of those with ILD other than IPF, the most common findings were connective tissue disease-related ILD (n=33, 1.8%) followed by idiopathic nonspecific interstitial pneumonia (n=29, 1.6%). Other diagnoses included combined pulmonary fibrosis and emphysema, hypersensitivity pneumonitis, sarcoidosis and respiratory bronchiolitis-associated ILD/desquamative interstitial pneumonia.

Our study shows that the PPF diagnosis represents a heterogeneous population, only a small portion of which had IPF or any ILD. To our knowledge, this is the first study to characterise patients assigned the diagnostic code ICD-9 code 515 (PPF) in clinical practice. The majority of our PPF patients manifested focal parenchymal abnormalities such as nodules/masses or focal fibrotic change on chest CT study. Of the 552 patients with nodules or masses, most patients (75%) did not have a specific pulmonary diagnosis. Similarly, the vast majority (90%) of those with focal fibrotic abnormalities did not have a specific pulmonary diagnosis other than descriptive CT findings. The diagnostic code of PPF appears to have been assigned by the clinicians or billing coders based on interpretation of radiological findings.

Our findings have implications for the use of ICD-9 code 515 (PPF) in epidemiological studies of ILD and specifically, IPF. The vast majority of patients designated as PPF did not have IPF or any form of ILD as assessed in this population-based study with 20 years of data. Olmsted County represents a unique region where medical care is provided by two health systems and longitudinal, comprehensive data can be captured. The use of the REP ensured that diagnoses were not routinely assigned from outside sources. Strict case criteria for IPF were used per Fleischner guidelines and real-world data were validated by manual chart review.

There are limitations of this study. Our data are based on a patient population residing in the southeastern portion of Minnesota. Though the demographics of IPF patients in Olmsted County are similar to those diagnosed internationally, study findings may not be generalisable to all populations across the USA or the world [11–13]. In addition, most IPF patients did not undergo surgical biopsy, with the diagnosis assigned based on review of the clinical context and chest CT findings.

Based on our results, we conclude that only a small minority of patients assigned the ICD-9 code 515 (PPF) have IPF. In clinical practice, PPF diagnosis comprises a heterogeneous population manifesting a wide array of chest CT findings, mostly nondiffuse. Future studies assessing the features of patients designated as PPF may provide additional insights to better defining the epidemiology of IPF.

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