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Incidence of right heart catheterization in patients initiated on pulmonary arterial hypertension therapies: A population-based study

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BACKGROUND: Pulmonary hypertension represents a heterogeneous collection of conditions classified into 5 groups according to pathology, pathophysiology and response to treatment. Right heart catheterization is required to classify patients and before initiation of specific therapy for treatment of pulmonary arterial hypertension. The aim of this study was to determine performance of right heart catheterization in patients prescribed pulmonary arterial hypertension (PAH)-specific medications.

METHODS: A retrospective review of administrative claims was performed using the Clinformatics Data Mart database. Individuals with an encounter diagnosis of pulmonary hypertension were identified by ICD-9 codes. An initial encounter diagnosis was defined as continuous enrollment for 12 months without a previous ICD-9 diagnosis of pulmonary hypertension. These individuals were followed for 15 months after initial encounter diagnosis. Individuals prescribed PAH-specific medications were assessed for characteristics, comorbidities and performance of echocardiography and right heart catheterization.

RESULTS: From 2002 to 2011, 15,772 patients had an outpatient visit with a diagnosis of pulmonary hypertension. From the initial group, 969 (6.1%) patients were prescribed PAH-specific medications within 1 year of encounter diagnosis. Oral PAH-specific medications were prescribed to 94.2% of patients. In patients prescribed PAH-specific medications, 91% had an echocardiogram within 1 year of encounter diagnosis. Cardiac catheterization was performed in 407 patients (42%) within 3 months of initial prescription and in 583 patients (60.2%) during the entire study period.

CONCLUSION: Performance of right heart catheterization was low in this population-based study of patients with an ICD-9 diagnosis code of pulmonary hypertension and taking PAH-specific medications.
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Pulmonary hypertension represents a pathologic condition caused by different cardiopulmonary diseases defined as a mean pulmonary artery pressure $\geq$25 mm Hg, as determined by right heart catheterization. The World Health Organization (WHO) classification scheme was developed to categorize patients with pulmonary hypertension into 5 distinct categories according to the pathology, pathophysiology and response to treatment.[1] This classification scheme has been accepted by pulmonary hypertension specialists and formed the basis for diagnostic and treatment guidelines.[2,3] Moreover, the United States Food and Drug Administration (FDA) and the European Agency for Drug Evaluation use this classification scheme for labeling of approved medications in the treatment of pulmonary hypertension.

Since 1996, 12 medical therapies have been approved by the FDA for treatment of rare causes of pulmonary

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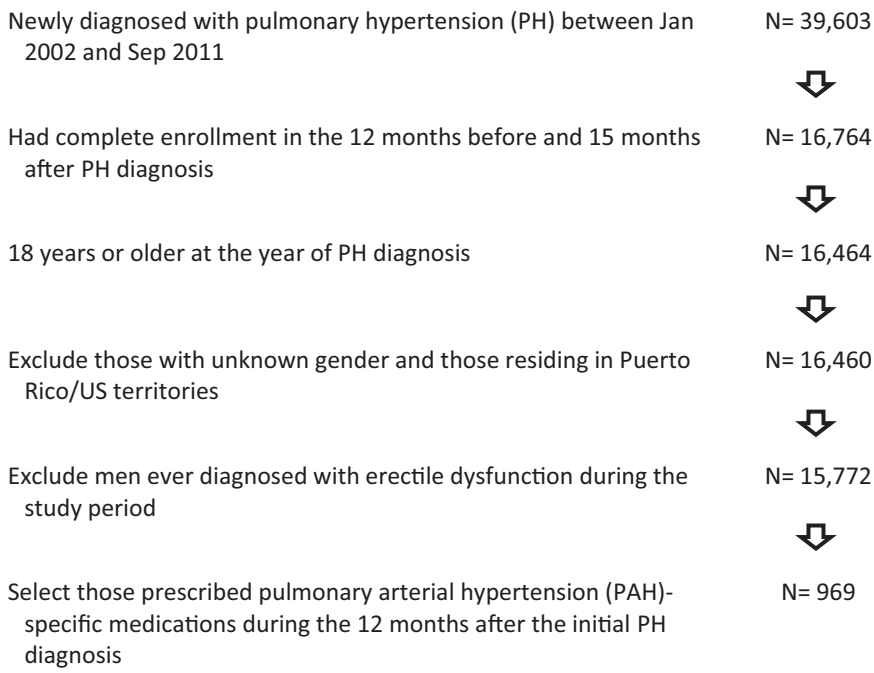

Figure 1 Cohort selection.

hypertension, namely pulmonary arterial hypertension (PAH) and chronic thromboembolic pulmonary hypertension. Although these medical therapies are reported to improve exercise tolerance and delay clinical worsening, they are costly and involve complex delivery methods with significant side effects.[4,5] Moreover, the majority of patients have pulmonary hypertension due to left ventricular pathology or chronic respiratory failure, yet data are lacking to support the use of PAH-specific medications in these groups of patients.[6] Thus, consensus guidelines state that right heart catheterization is necessary to diagnose and classify pulmonary hypertension.[1–3] In addition, performance of a right heart catheter study is recommended before prescribing PAH-specific medications. However, there are few data, outside of clinical trials, regarding the use of right heart catheterization in clinical practice. Consequently, we designed a study to determine the frequency of right heart catheterization in patients with newly diagnosed pulmonary hypertension prescribed PAH-specific medications. In addition, we examined the factors associated with performance of a right heart catheterization during the study period.

Methods

We used enrollment and claims data from the Clinformatics Data Mart (OptumInsight, Eden Prairie, MN) database (CDM) that contained member eligibility, medical services and prescription claims data. Patient characteristics were determined from member files and medical services data files. The study was approved by the institutional review board of the University of Texas Medical Branch, and written consent was not considered necessary due to the nature of the study.

We selected patients with pulmonary hypertension between January 2002 and September 2011. An individual was considered to have pulmonary hypertension if they had one outpatient visit or consultation with an encounter diagnosis of pulmonary hypertension, identified by Code 416.0 or 416.8 of the *International Classification of Diseases, 9th Revision, Clinical Modification* (ICD-9-CM). A newly diagnosed patient with pulmonary hypertension was defined as the absence of a clinic encounter with an ICD Code 416.0 or 416.8 in the preceding consecutive 12 months of continuous enrollment from the time of an initial clinic visit. Individuals were required to have continuous enrollment 12 months before and 15 months after the initial encounter diagnosis of pulmonary hypertension ($N = 16{,}764$) (Figure 1). Outpatient visits were identified by Current Procedural Terminology (CPT) Codes 99201 to 99205 and 99211 to 99215, and outpatient consultations were identified by CPT Codes 99241 to 99245. Individuals ≥ 18 years of age at time of diagnosis ($N = 16{,}464$) were included in this analysis. Individuals with a diagnosis of erectile dysfunction (ICD-9-CM Codes 302.72 or 607.84) during the 27-month study period ($N = 688$) and those residing in Puerto Rico/US territories ($N = 4$) were excluded.

Individuals were categorized by age, gender, region (midwest, northeast, south, and west) and year of diagnosis. We identified the care provider, disease state associated with PAH (congenital heart disease, connective tissue disorder, liver disease and human immunodeficiency virus/acquired immunodeficiency syndrome [HIV/AIDS]), comorbidities and performance of echocardiography within 1 year of encounter diagnosis of pulmonary hypertension. A patient seen by a provider (cardiologist, pulmonary specialist or primary care physician) at least once in the outpatient setting was considered to have received care by that provider. The provider's specialty was identified using medical services data. Congenital heart disease was identified by any claim with ICD-9-CM Code 745.4 or 746.9 in the year before or after the initial encounter diagnosis of pulmonary hypertension. Connective tissue disorder, liver disease, HIV/AIDS, obesity, hypertension, congestive heart failure, valvular disease and chronic pulmonary disease were identified in the same time frame using the enhanced ICD-9-CM coding algorithm for the Elixhauser comorbidities.[7] Performance of an echocardiogram was identified using CPT Codes 93306 to 93308, 93312 to 93314, 93318, 93320, 93321 and 93325, and ICD-9-CM Code 88.72. We identified performance of a heart catheterization procedure within ($\pm$) 3 months of medication, as