Predictors of High-cost Patients With Noninfectious Inflammatory Eye Diseases

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ABSTRACT

Purpose: Noninfectious inflammatory eye diseases (NIIEDs), such as uveitis, is a general term used to describe a complex mix of acute, chronic, allergic, and inflammatory disorders. Prior literature has established that, in addition to severe clinical burden, NIIEDs is associated with significant economic burden for US payers; however, no literature provides a current estimate of the economic burden associated with patients with high-cost NIIEDs. This study aimed to better understand the cost and resource use distribution and predictors of patients with high-cost NIIEDs.

Methods: This retrospective cohort study selected adult patients with NIIEDs from a large US administrative claims database between 2006 and 2015. Among the included patients, total all-cause health care costs were calculated for a randomly selected 12-month period. Patients in the top 20% of total all-cause health care costs were identified as high-cost patients; the remaining patients were identified as lower-cost patients. Patient demographic characteristics, clinical characteristics, cost, and health care resource utilization (HRU) were compared. Logistic regression models were used to determine characteristics associated with high-cost patients.

Findings: Patients with NIIEDs (n = 14,879) were categorized into 2976 high-cost and 11,903 lower-cost patients. High-cost patients with NIIEDs were significantly more likely to experience blindness, cataract, cystoid macular degeneration, retinal detachment, and visual disturbances during the follow-up period than the lower-cost patients (all $P < 0.05$). The high-cost patients accounted for ~77% of the total all-cause health care spend. High-cost patients incurred an average annual total health care cost of $59,873, and the top 1 percentile incurred $349,967 during the follow-up period. Hospitalization was a key cost driver among the high-cost patients, accounting for 50% of the total cost among the top 1 percentile of patients. High-cost patients were more likely to have specific autoimmune diseases, inpatient admission, and use of biologic and immunosuppressant agents.

Implications: A small segment of patients with NIIEDs consumed most resources. This study identified several predictors based on patient characteristics and HRU that may help inform the profile of patients with NIIEDs with the highest health care needs. As such, patients with a given profile can be selected for targeted interventions by clinicians to potentially help improve quality of care and to reduce costs. (*Clin Ther.* 2019;41:2331–2342)

Keywords: health care resource utilization, high costs, noninfectious inflammatory eye diseases, predictors.

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INTRODUCTION

Noninfectious inflammatory eye diseases (NIIEDs), such as uveitis, is a general term used to describe a complex mix of acute and chronic disorders that affect the eye or surrounding tissue, including the iris, ciliary body, choroid, retina, vitreous, or optic nerve.[1] Patients with NIIEDs may present with pain and blurred vision that can progress quickly, leading to complications, including glaucoma, cataracts, optic nerve damage, retinal detachment, and blindness.[2] Although many cases are idiopathic, NIIEDs are commonly associated with many systemic diseases such as multiple sclerosis, sarcoidosis, ankylosing spondylitis, and psoriatic arthritis.[3] Although relatively uncommon, NIIEDs are estimated to be responsible for ~10%−20% of all blindness in the United States[4] and is the third-leading cause of preventable blindness worldwide.[5] In addition to the clinical burden, NIIEDs are associated with significant costs from the US payer perspective.[6–8] In a previous study, the direct costs of patients with NIIEDs were found to be 3.5 times higher than patients without NIIEDs ($12,940 vs $3730); the costs of patients with NIIEDs were primarily driven by outpatient visits and prescription drug use.[7]

It is well documented in medical literature that total health care costs for patients with a given condition are unevenly distributed among that population; as is the case for many disease populations, few patients within the same population use most resources, leading to extremely skewed health care costs toward high-cost patients.[9–11] Within a patient population, few patients use most resources, leading to extremely skewed health care costs toward high-cost patients. Although this trend was found in various diseases, no studies have investigated the distribution of health care costs among patients with NIIEDs.

This study aimed to provide a comprehensive assessment of the cost, health care resource utilization (HRU), and prescription drug use among high-cost patients with NIIEDs. In addition, this study identified demographic and clinical characteristics associated with the high-cost patient population that may lead to higher odds of being classified as a high-cost patient. By understanding the cost and resource use distribution and associated characteristics of patients with NIIEDs, this study may be able to provide additional information to physicians and payers during the decision-making process.

METHODS

Data Source

This study used de-identified administrative claims from OptumHealth Care Solutions, Inc, a large database that contains health care and prescription drug utilization records of >19.1 million beneficiaries (including employees, spouses, dependents, and retirees) with commercial insurance from 84 large self-insured Fortune 500 companies. These companies operate in a broad range of industries (including manufacturing, telecommunications, financial services, and food and beverage companies) with locations in all census areas of the United States and are covered by a range of health carriers. The database contains information on patient age, sex, enrollment history, medical diagnoses, procedures performed, dates and place of service, prescription drug use, and payment amounts. Administrative claims from January 1, 2006, through September 30, 2015 (study period) were included in this study.

Sample Selection

From the medical claims of the OptumHealth Care Solutions database, patients with at least 1 inpatient admission or outpatient/physician office visit with a diagnosis for an inflammatory eye disease of interest during the study period were selected. Each admission and visit with a diagnosis of interest was defined as a potential index date. The inflammatory eye diseases of interest included disorders of the globe (identified with International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM] diagnosis codes 360.1−360.12, 360.14), disorders of the retina (ICD-9 codes 362.1, 362.18), disorders of the choroid (ICD-9 codes 363.00−363.06, 363.1−363.13, 363.2x), disorders of the iris and ciliary body (ICD-9 codes 364.x−364.3), disorders of the optic nerve and visual pathways (ICD-9 codes 377.3−377.41), and other disorders of the eye (ICD-9 codes 379.0x, 379.8). To ensure the inflammatory eye disease diagnosis was noninfectious, potential index dates were excluded if a patient had eye surgery on or in the 90 days preceding or a prescription for an ophthalmic anti-infective agent or systemic antibiotic on or in the 90 days afterward.

Consistent with prior research,[12] the sample was limited to patients who had at least 1 potential index date with a relevant ICD-CM code in an inpatient setting or ≥2 potential index dates in an outpatient/physician office setting separated by ≥ 30 days. Each patient's index date for the study was chosen at random from among their potential index dates, which allowed for patients at various disease stages (eg, as opposed to only those in early-stage) to be included. In addition, patients were required to have continuous insurance coverage for the 6 months before and the 12 months after the randomly selected index date and be at least 18 years of age on the index date. To ensure completeness of insurance claims and cost information, patients with insurance coverage through a health maintenance organization were excluded.

Total all-cause health care costs were calculated for each patient in the 12-month period after the index date (follow-up period). Patients were then categorized into 2 distinct cohorts as follows: (1) high-cost patients, defined as those patients in the top 20% of total all-cause health care costs during the follow-up period, and (2) lower-cost patients, defined as the remaining 80% of patients.[10,11]

Study Measures

Patient age, sex, US census region, and the specific type of inflammatory eye disease diagnosis were evaluated on the index date. Patient comorbidity profiles, including Charlson Comorbidity Index[13] and the presence of select autoimmune diseases were reported in the 6-month period preceding the index date (baseline period). These demographic and clinical characteristics were reported separately for the lower-cost and high-cost cohorts.

During the follow-up period, the presence of ocular complications and direct HRU were reported for the lower-cost and high-cost cohorts. Ocular complications included blindness, cataract, cystoid macular degeneration, glaucoma, retinal detachment, and visual disturbances. Direct HRU included the proportion of patients with at least 1 inpatient admission, emergency department visit, and specialist (ophthalmologist and optometrist) visit; at least 1 surgically placed corticosteroid implant; and at least 1 prescription fill for antidepressants, antineoplastic agents, biologic therapies, bisphosphonates, corticotropin, glucocorticosteroids, immunosuppressive agents, and NSAIDs. These factors of HRU were identified based on prior research and input of the authors.

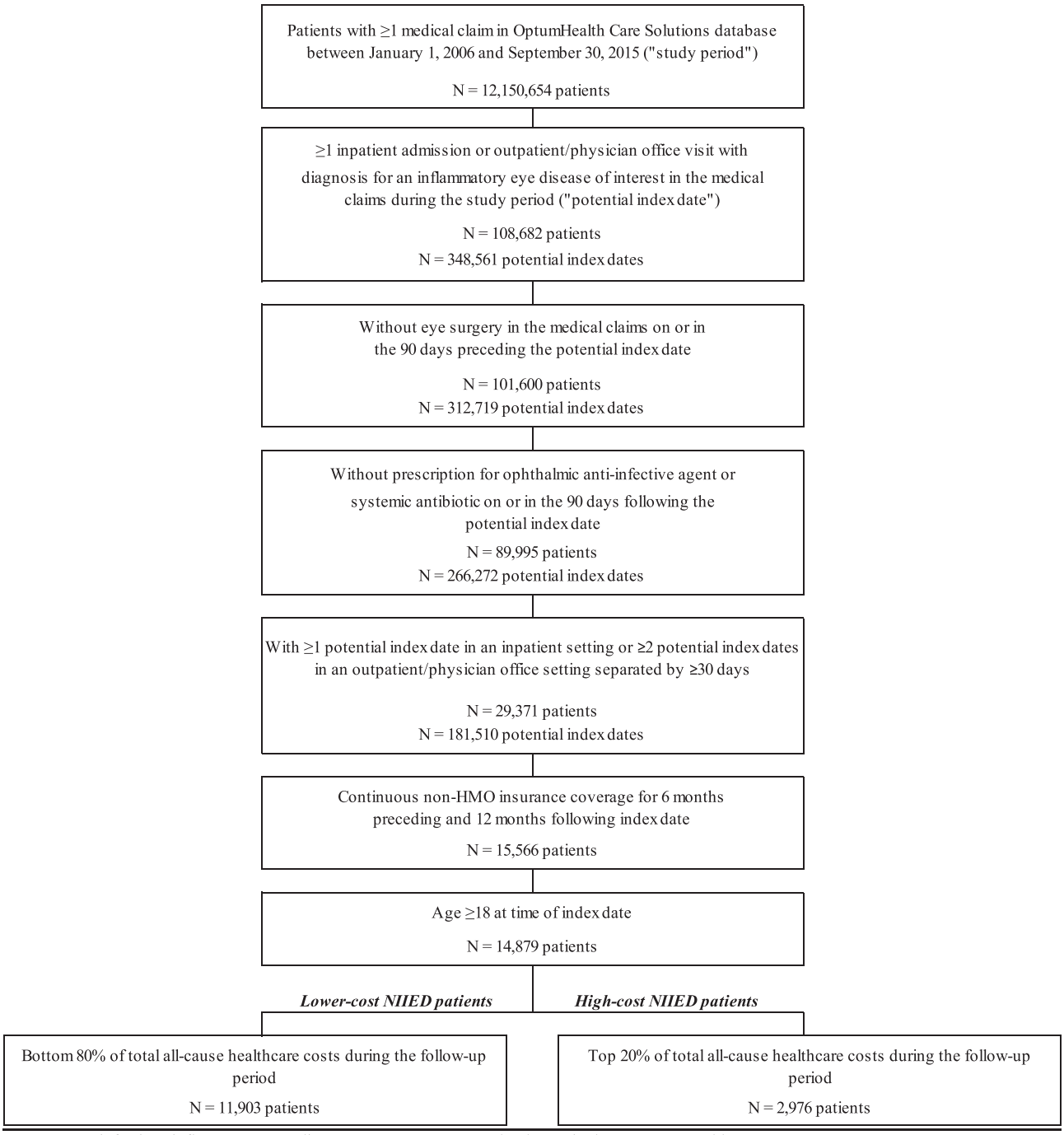
Per-patient total all-cause health care costs, defined as the sum of medical costs and prescription drug costs, were calculated during the follow-up period. Per-patient costs were reported for each quintile of patients and were further stratified for the high-cost patients with NIIEDs into the 80th to 90th percentile, the 90th to 95th percentile, the 95th to 99th percentile, and the 99th to 100th percentile for additional granularity of cost distribution. These costs were also reported by place of service, including inpatient, outpatient/physician office visits, emergency department, other medical visits (eg, home health, laboratories), and prescription drugs. All direct costs were inflated to 2015 US dollar (the latest year available in the data), using the medical care component of the Consumer Price Index. The cost of medical claims for patients ≥65 years of age were inflated by a factor of 5, to account for the fact that Medicare typically covers 80% of Part B services; prescription drug costs were not inflated.

Predictors of being a high-cost patient were determined with the use of logistic regression analyses. Associations of high-cost patients and NIIED patient demographic characteristics, clinical characteristics, and follow-up period characteristics were evaluated.

Statistical Analyses

Patient demographic characteristics, clinical characteristics, and follow-up period characteristics were compared between the lower-cost and high-cost patient cohorts with the use of statistical tests. Odds ratios (OR) and 95% CIs were calculated with the use of univariate and multivariate logistic regression models to determine characteristics associated with being a patient with NIIEDs in the top 20% of total health care costs. Statistically significant baseline demographic and clinical characteristics with an OR ≥1.5 or ≤0.75 from the univariate logistic regression models and all follow-up period characteristics variables were included in the multivariate logistic regression model.

To assess statistical significance of descriptive comparisons, P values were calculated with Wilcoxon rank sum tests for continuous variables and χ^2 tests for categorical variables. P values < 0.05 were considered statistically significant. All analyses were



NIIED: non-infectious inflammatory eye disease; CPT: Current Procedural Terminology; HMO: Health Maintenance Organization; ICD-9-CM: International Classification of Diseases, Ninth Revision, Clinical Modification

Notes:

1. Patients with a diagnosis of keratitis (ICD-9-CM 370) at any time or with a diagnosis of another inflammatory eye disease outside the study period or during the study period but outside of an inpatient or outpatient setting were excluded from both the potential NIIED and control cohorts (N = 297,877 patients).
2. Eye surgery was identified in the medical claims data using ICD-9-CM procedure codes 08-16 and CPT codes 65091-68899.

conducted with SAS version 9.4 (SAS Institute Inc, Cary, North Carolina).

RESULTS

Sample Selection

Of the 12,150,654 patients with at least 1 medical claim in OptumHealth Care Solutions database during the study period, 108,682 patients had at least 1 inpatient admission or outpatient/physician office visit with a diagnosis for an inflammatory eye disease of interest. In total, 14,879 patients with NIIEDs met all study inclusion criteria. After stratifying into quintiles of total all-cause health care costs during the follow-up period, there were 2976 high-cost patients and 11,903 lower-cost patients (Figure 1).

Baseline Characteristics

High-cost patients were similar in age to lower-cost patients (56.9 years vs 56.4 years; $P = 0.069$), but were they significantly less likely to be men (38.4% vs 44.2%; $P < 0.001$). Compared with the lower-cost patients, high-cost patients had significantly higher rates of disorders of the retina (1.2% vs 0.8%; $P = 0.048$) and disorders of the optic nerve and visual pathways (39.9% vs 20.9%; $P < 0.001$), but they had significantly lower rates of disorders of the iris and ciliary body (39.5% vs 52.5%; $P < 0.001$) and other disorders of the eye (11.8% vs 18.5%; $P < 0.001$) on the index date (Table I).

High-cost patients had a significantly higher Charlson Comorbidity Index (1.3 vs 0.5; $P < 0.001$) and were more likely to have at least 1 comorbid autoimmune disease (36.5% vs 8.8%; $P < 0.001$) compared with the lower-cost patients. Moreover, the rate of comorbidities, including ankylosing spondylitis, Behcet's syndrome, inflammatory bowel disease, multiple sclerosis, psoriatic arthropathy, relapsing polychondritis, rheumatoid arthritis, Sjögren's syndrome, systemic lupus erythematosus, and systemic vasculitis, were significantly higher in the high-cost patients than in the lower-cost patients (all $P < 0.001$) (Table I).

Clinical Outcomes and HRU During the Follow-up Period

The most common ocular complications in the follow-up period for all patients were glaucoma, cataract, and visual disturbances. High-cost patients had higher rates of all ocular complications during the follow-up period than the lower-cost patients, with significantly higher rates of blindness (5.1% vs 2.0%; $P < 0.001$), cataract (21.6% vs 18.3%; $P < 0.001$), cystoid macular degeneration (4.2 vs 3.4%; $P = 0.037$), and visual disturbances (16.2% vs 8.7%; $P < 0.001$) (Table II).

A higher proportion of high-cost patients had at least 1 inpatient admission (45.3% vs 8.5%; $P < 0.001$) and 1 emergency department visit (51.2% vs 22.8%; $P < 0.001$) than the lower-cost patients. Lower-cost patients were more likely to have at least 1 optometrist visit than the high-cost patients (24.4% vs 27.9%; $P < 0.001$) (Table II). Compared with lower-cost patients, a higher proportion of high-cost patients had at least 1 surgically placed corticosteroid implant (2.4% vs 1.2%; $P < 0.001$) and at least 1 prescription filled (93.0% vs 86.3%; $P < 0.001$). In addition, high-cost patients with NIIEDs were more likely to have fills for every prescription drug class evaluated (all $P < 0.001$) (Table II).

Health Care Costs During the Follow-up Period

High-cost patients, who represent 20% of the NIIED patient population, accounted for ~77% of the total all-cause health care costs in the follow-up period. The mean (SD) per-patient total all-cause health care costs during the follow-up period for patients with NIIEDs was $15,651 ($54,537). High-cost patients incurred an average total health care cost nearly 5.5 times that of patients in the fourth

Figure 1. Selection of lower-cost and high-cost patients with noninfectious inflammatory eye diseases (NIIEDs). Patients with a diagnosis of keratitis (International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM] 370) at any time or with a diagnosis of another inflammatory eye disease outside the study period or during the study period but outside of an inpatient or outpatient setting were excluded from both the potential NIIED and control cohorts (N = 297,877 patients). Eye surgery was identified in the medical claims data with the use of ICD-9-CM procedure codes 08−16 and Current Procedural Terminology codes 65091−68899. HMO = Health Maintenance Organization.

Table I. Baseline characteristics, stratified by health care cost cohort.

Characteristic*	Lower-Cost Patients With NIIEDs (N = 11,903)	High-Cost Patients With NIIEDs (N = 2976)	*P*
Patient demographic characteristics			
Age, y	56.4 (16.1)	56.9 (16.0)	0.069
Male	44.2% (5256)	38.4% (1142)	<0.001†
US census region			
New England	9.5% (1136)	10.6% (315)	0.087
Middle Atlantic	13.4% (1596)	16.9% (502)	<0.001†
East North Central	16.3% (1937)	15.2% (453)	0.162
West North Central	8.7% (1040)	7.6% (227)	0.052
South Atlantic	18.0% (2139)	16.3% (486)	0.036†
East South Central	4.2% (505)	3.1% (92)	0.004†
West South Central	10.0% (1192)	8.9% (266)	0.077
Mountain	5.7% (675)	4.7% (141)	0.046†
Pacific	7.3% (873)	6.6% (197)	0.177
Unknown	6.8% (810)	10.0% (297)	<0.001†
Patient clinical characteristics			
NIIED index study condition			
Disorders of the globe	1.2% (137)	1.6% (47)	0.059
Disorders of the retina	0.8% (95)	1.2% (35)	0.048†
Disorders of the choroid	7.0% (834)	6.9% (206)	0.871
Disorders of the iris and ciliary body	52.5% (6246)	39.5% (1176)	<0.001†
Disorders of the optic nerve and visual pathways	20.9% (2492)	39.9% (1186)	<0.001†
Other disorders of the eye	18.5% (2198)	11.8% (352)	<0.001†
Charlson Comorbidity Index	0.5 (1.0)	1.3 (1.8)	<0.001†
Number of autoimmune comorbidities	0.1 (0.3)	0.4 (0.6)	<0.001†
Number of autoimmune comorbidities			
0	91.2% (10,852)	63.5% (1891)	<0.001†
1	8.3% (987)	33.8% (1005)	<0.001†
≥2	0.5% (64)	2.7% (80)	<0.001†
Autoimmune comorbidities			
Ankylosing spondylitis	0.9% (103)	2.8% (82)	<0.001†
Behçet's syndrome	0.1% (14)	0.4% (11)	0.003†
Inflammatory bowel disease	1.1% (125)	3.2% (96)	<0.001†
Multiple sclerosis	1.7% (208)	18.1% (538)	<0.001†
Psoriatic arthropathy	0.3% (33)	1.6% (48)	<0.001†
Relapsing polychondritis	0.2% (20)	0.6% (17)	<0.001†
Rheumatoid arthritis	1.6% (196)	6.6% (197)	<0.001†
Sarcoidosis	1.6% (189)	2.2% (64)	0.034†
Sjögren's syndrome	0.2% (26)	0.5% (15)	0.008†

Table I. (*Continued*)

Characteristic*	Lower-Cost Patients With NIIEDs (N = 11,903)	High-Cost Patients With NIIEDs (N = 2976)	*P*
Systemic lupus erythematosus	0.6% (73)	1.3% (39)	<0.001†
Systemic vasculitis	1.1% (125)	2.2% (64)	<0.001†
Vitiligo	0.1% (8)	0.1% (2)	1.000

NIIED = noninfectious inflammatory eye disease.
* Data are expressed as mean (SD) or % (n).
† Statistically significant, $P < 0.05$.

quintile (60th−80th percentile) and 120 times that of patients in the first quintile (0th−20th percentile); the total health care costs of the quintiles of patients with NIIEDs were $505, $2051, $4702, $11,122, and $59,873, respectively. Further stratifying the health care costs of the high-cost patients with NIIEDs, the top 1% of patients (99th−100th percentile) had mean per-patient total health care costs of $349,967, which is 31 times that of the patients in the fourth quintile; high-cost patients in the 80th to 90th percentile, 90th to 95th percentile, and 95th to 99th percentile had mean per-patient total health care costs of $26,303, $47,892, and $86,602, respectively.

For the first to fourth quintiles, outpatient/physician office visits comprised most per-patient health care costs, followed by prescription drug costs. The proportion of costs attributed to inpatient admissions increases across the patient cost quintiles from 0.20% for the first quintile to 9.1% for the fourth quintile and up to 49.9% for patients in the top 1% of patients with NIIEDs. Patients in the 90th to 95th percentile incurred the highest prescription drug costs and the highest proportion of prescription drug costs relative to total costs (Figure 2).

Baseline Period Predictors of NIIED High-cost Patients

Certain baseline characteristics significantly influenced a patient's odds of being a high-cost patient with NIIEDs. Patients with disorders of the optic nerve and visual pathways had higher odds of being a high-cost patient; however, the difference was not significant in the adjusted, multivariate model (unadjusted OR = 2.50, $P < 0.001$; adjusted OR = 1.11, $P = 0.305$). Patients with disorders of the iris and ciliary body (unadjusted OR = 2.50, $P < 0.001$; adjusted OR = 0.728, $P < 0.001$) and other disorders of the eye (unadjusted OR = 0.592, $P < 0.001$; adjusted OR = 0.65, $P < 0.001$) had significantly lower odds of being a high-cost patient in both the unadjusted and adjusted models.

A baseline diagnosis of ankylosing spondylitis, inflammatory bowel disease, multiple sclerosis, psoriatic arthropathy, relapsing polychondritis, or rheumatoid arthritis significantly increased the odds of being a high-cost patient in both the adjusted and unadjusted models (Table III).

Follow-up Period Predictors of NIIED High-cost Patients

The odds of being a high-cost patient was significantly higher for patients with cataract (unadjusted OR = 1.23 [95% CI, 1.12−1.36], $P < 0.001$; adjusted OR = 1.29, $P < 0.001$) or visual disturbances (unadjusted OR = 2.03, $P < 0.001$; adjusted OR = 1.28, $P = 0.002$) in the follow-up period in both the adjusted and unadjusted models. In addition, a follow-up period inpatient admission; surgically placed corticosteroid implant; or prescription for antidepressants, antineoplastic agents, biologic therapies, glucocorticosteroids, immunosuppressive agents, or NSAIDs increased the odds of being a high-cost patient in both the adjusted and unadjusted models (Table III). The likelihood ratio test for whether the explained variance in the adjusted multivariate model exceeded the unexplained variance was statistically significant at $P < 0.001$.

Table II. Clinical outcomes and health care resource utilization in the follow-up period, stratified by health care cost cohort.

Variable*	Lower-Cost Patients With NIIEDs (N = 11,903)	High-Cost Patients With NIIEDs (N = 2976)	P
Ocular complications			
Blindness	2.0% (240)	5.1% (153)	<0.001†
Cataract	18.3% (2181)	21.6% (644)	<0.001†
Cystoid macular degeneration	3.4% (402)	4.2% (124)	0.037†
Glaucoma	20.8% (2480)	21.6% (643)	0.356
Retinal detachment	2.4% (282)	2.8% (84)	0.153
Visual disturbances	8.7% (1039)	16.2% (483)	<0.001†
Health care resource utilization‡			
≥1 medical visit			
Inpatient admission	8.5% (1008)	45.3% (1349)	<0.001†
Emergency department	22.8% (2714)	51.2% (1524)	<0.001†
Specialists			
Ophthalmologist	78.8% (9382)	78.2% (2328)	0.479
Optometrist	27.9% (3324)	24.4% (725)	<0.001†
≥1 surgically placed corticosteroid implant§	1.2% (139)	2.4% (70)	<0.001†
≥1 prescription filled, % (n)	86.3% (10,272)	93.0% (2769)	<0.001†
Antidepressants	16.9% (2015)	33.0% (982)	<0.001†
Antineoplastic agents	3.3% (394)	11.1% (330)	<0.001†
Biologic therapies	0.6% (70)	8.7% (258)	<0.001†
Bisphosphonates	4.3% (506)	6.4% (191)	<0.001†
Corticotropin	0.0% (0)	0.3% (9)	<0.001†
Glucocorticosteroids	16.1% (1911)	33.1% (985)	<0.001†
Immunosuppressive agents	1.3% (149)	4.2% (124)	<0.001†
NSAIDs	16.9% (2017)	24.7% (735)	<0.001†

NIIED = noninfectious inflammatory eye disease.
* Data are expressed as % (n).
† Statistically significant, $P < 0.05$.
‡ Follow-up period characteristics were evaluated during the 12-month period after the index date.
§ Surgically placed corticosteroid implant was identified in the medical claims data with the use of Current Procedural Terminology codes 67027 and 67028 and Healthcare Common Procedure Coding System codes J7311 and J7312.

DISCUSSION

Few patients with NIIEDs are associated with most HRU and costs, imposing a significant economic and clinical burden. From the univariate model, high-cost patients with NIIEDs are more likely to be women, to be diagnosed with disorders of the retina and disorders of the optic nerve and visual pathways, and to have comorbid autoimmune conditions. In the follow-up period, high-cost patients with NIIEDs had higher rates of ocular complications and higher all-

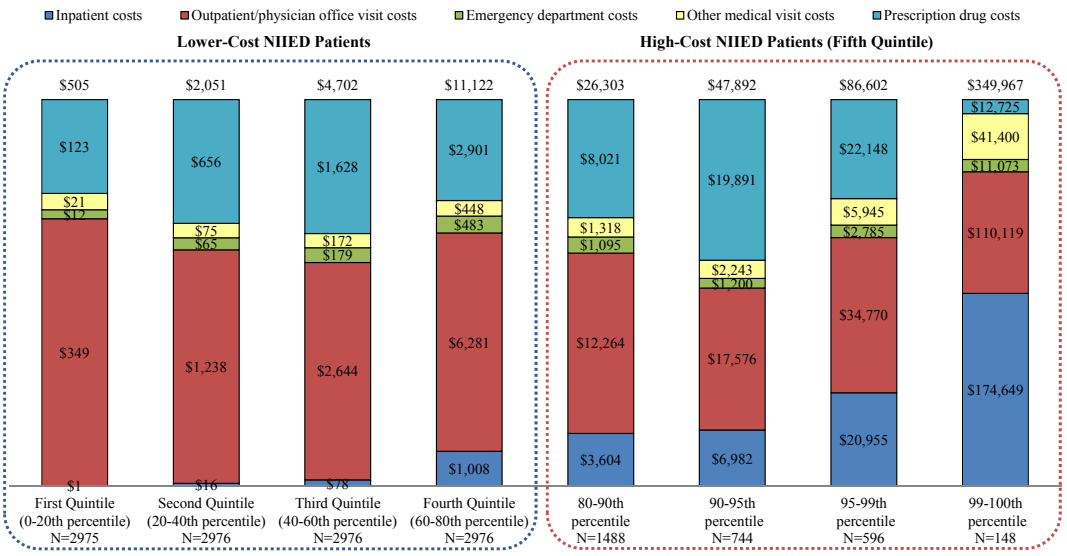


Figure 2. Mean per-patient annual health care costs, stratified by place of service, during the follow-up period among patients with noninfectious inflammatory eye diseases (NIIEDs).

cause HRU, including inpatient admissions and emergency department visits. Prescription fills for all drug classes were more common for high-cost patients than for lower-cost patients. The mean per-patient total all-cause costs for patients with NIIEDs was $15,651; however, patients with NIIEDs with the top 20% of total health care costs incur a per-patient mean cost of $59,873 and account for 77% of total costs. The increasing proportion of inpatient costs drives the increase in costs across the quintiles of patients with NIIEDs.

A diagnosis of a disorder of the iris and ciliary body or other disorders of the eye lower the odds of a patient with NIIEDs being in the top 20% of total all-cause health care costs, whereas the presence of autoimmune diseases greatly increase the odds of a patient with NIIEDs being in the top 20% of total all-cause health care costs. Patients with cataract or visual disturbances, as well as patients with at least 1 inpatient admission, surgically placed corticosteroid implant, or prescription for biologic therapies or immunosuppressive agents, also had higher odds of being a high-cost patient with NIIEDs.

The cost of patients with NIIEDs is consistent with health care costs reported in prior literature. In Thorne et al,[7] patients with noninfectious intermediate, posterior or panuveitis had total annual direct and indirect costs, inflated to 2012 US dollars, of $14,468 per patient. When accounting for inflation and the exclusion of indirect costs (ie, work loss outcomes) between this study and that of Thorne et al,[7] the total health care costs of patients with eye disease are comparable. Furthermore, although no previous literature assesses the cost distribution and predictors of high-cost patients with NIIEDs, the findings in this study are consistent with findings in other patient populations. For example, Engel et al[10] reported that the top 21% of patients with back pain with high total health care costs accounted for 67.7% of total costs; Chiang and Kao[9] reported that in elderly patients with liver cancer, patients in the top 10% of total health care costs in the last month of life amounted to 39.0% of total health care costs; Rice et al[11] found that among patients with sarcoidosis the 20% of patients classified as high-cost patients accounted for ~72% of the total health care costs. All of these studies, along with the present study, support the finding that health care resources and costs are not equally distributed among patients with a given condition.

Table III. Model for the association of high total all-cause health care costs in the follow-up period and NIIED patient characteristics.

Variable	Univariate Logistic Regression Model		Multivariate Logistic Regression Model	
	Odds Ratio (95% CI)	*P*	Odds Ratio (95% CI)	*P*
Baseline period characteristics*				
NIIED index study condition				
Disorders of the iris and ciliary body	0.59 (0.55–0.64)	<0.001†	0.73 (0.61–0.87)	<0.001†
Disorders of the optic nerve and visual pathways	2.50 (2.30–2.73)	<0.001†	1.11 (0.91–1.35)	0.305
Other disorders of the eye	0.59 (0.53–0.67)	<0.001†	0.65 (0.53–0.81)	<0.001†
Autoimmune comorbidities				
Ankylosing spondylitis	3.25 (2.42–4.35)	<0.001†	2.12 (1.44–3.13)	<0.001†
Behçet's syndrome	3.15 (1.43–6.95)	0.004†	1.62 (0.60–4.36)	0.341
Inflammatory bowel disease	3.14 (2.40–4.12)	<0.001†	2.96 (2.11–4.15)	<0.001†
Multiple sclerosis	12.41 (10.51–14.65)	<0.001†	16.57 (13.58–20.21)	<0.001†
Psoriatic arthropathy	5.89 (3.78–9.20)	<0.001†	2.27 (1.27–4.05)	0.005†
Relapsing polychondritis	3.41 (1.79–6.52)	<0.001†	2.27 (1.00–5.12)	0.049†
Rheumatoid arthritis	4.23 (3.46–5.18)	<0.001†	1.84 (1.39–2.43)	<0.001†
Sjögren's syndrome	2.31 (1.22–4.38)	0.010†	0.85 (0.33–2.17)	0.735
Systemic lupus erythematosus	2.15 (1.46–3.18)	<0.001†	1.25 (0.76–2.06)	0.374
Systemic vasculitis	2.07 (1.53–2.81)	<0.001†	0.85 (0.58–1.25)	0.410
Follow-up period characteristics				
Ocular complications				
Blindness	2.63 (2.14–3.24)	<0.001†	1.16 (0.89–1.52)	0.266
Cataract	1.23 (1.12–1.36)	<0.001†	1.29 (1.14–1.45)	<0.001†
Cystoid macular degeneration	1.24 (1.01–1.53)	0.037†	1.26 (0.97–1.63)	0.087
Glaucoma	1.05 (0.95–1.15)	0.356	1.22 (1.08–1.38)	0.001†
Retinal detachment	1.20 (0.94–1.53)	0.154	1.27 (0.94–1.73)	0.127
Visual disturbances	2.03 (1.80–2.28)	<0.001†	1.28 (1.10–1.50)	0.002†
Health care resource utilization				
Medical visits (≥1 vs 0)				
Inpatient admission	8.96 (8.14–9.87)	<0.001†	7.94 (7.04–8.95)	<0.001†
Emergency department	3.55 (3.27–3.86)	<0.001†	1.78 (1.59–1.99)	<0.001†
Surgically placed corticosteroid implant (≥1 vs 0)	2.04 (1.53–2.73)	<0.001†	1.71 (1.18–2.48)	0.005†
Prescription filled (≥1 vs 0)				
Antidepressants	2.42 (2.21–2.65)	<0.001†	1.63 (1.46–1.83)	<0.001†
Antineoplastic agents	3.64 (3.13–4.24)	<0.001†	1.99 (1.62–2.45)	<0.001†
Biologic therapies	16.04 (12.28–20.95)	<0.001†	18.33 (13.40–25.08)	<0.001†
Bisphosphonates	1.55 (1.30–1.84)	<0.001†	1.10 (0.88–1.37)	0.398
Glucocorticosteroids	2.59 (2.36–2.83)	<0.001†	1.65 (1.46–1.85)	<0.001†

Table III. (*Continued*)

Variable	Univariate Logistic Regression Model		Multivariate Logistic Regression Model	
	Odds Ratio (95% CI)	*P*	Odds Ratio (95% CI)	*P*
Immunosuppressive agents	3.43 (2.69−4.37)	<0.001†	2.24 (1.65−3.04)	<0.001†
NSAIDs	1.61 (1.46−1.77)	<0.001†	1.26 (1.12−1.43)	<0.001†

NIIED = noninfectious inflammatory eye disease.
* Baseline demographic and clinical characteristics with an odds ratio ≥1.5 or ≤0.75 from the univariate analysis and all follow-up period clinical complications variables were included in the multiple logistic regression model.
† Statistically significant, $P < 0.05$.

This study provides a comprehensive, current estimate of the characteristics, costs, health care resource use, and prescription drug use of patients with NIIEDs, stratified by patients in the top 20% of total all-cause health care costs and the remaining 80% of patients. This study helps contribute to the understanding of the imbalanced distribution of costs among patients with the same clinical diagnoses and further helps identify patients with NIIEDs with increased odds of being a high-cost patient. Because the distribution of costs is so skewed toward these high-cost patients, understanding the impact of specific NIIED diagnoses, comorbid conditions, and clinical outcomes on the odds of being a high-cost patient can help clinicians make decisions on providing care. Ideally, this awareness allows clinicians to provide more cost-effective care, reducing the economic burden borne by commercial payers for treating these high-cost patients in the United States.

Given the range of diseases included in the analysis, future research should explore the impact of specific NIIEDs on cost distribution and predictors of high-cost patients. Additional research should quantify the medical costs attributed to NIIEDs, specifically versus medical costs attributed to comorbid conditions in the lower-cost and high-cost cohorts.

This study has several limitations, inherent to the data used in the present analysis. First, this study aimed to investigate noninfectious eye diseases with the use of claims data. As such, the sample selection aimed to exclude infections as best as possible. Administrative claims databases may not contain all detailed clinical information relating to a patient's care or health status, given that such databases are primarily used for reimbursement purposes. There may be key clinical information, such as disease severity, that affects total all-cause health care costs and affects a patient's odds of being a high-cost patient with NIIEDs that is not evident with the use of claims data. Second, the multivariate logistic regression model used in this study may not capture all covariates that influence the likelihood of a patient with NIIEDs being in the top 20% of total all-cause health care costs. Finally, the study population consisted of commercially insured. Although the data reflect the predominant form of health insurance in the United States, with the use of data from multiple health carriers, it is unknown the extent to which these results are generalizable to other insured populations (eg, Medicare or Medicaid). Indeed, the analysis covers a number of infectious eye diseases, and the cost distribution for any given insured population may differ from the analysis presented here.

CONCLUSION

Consistent with previous findings in various other disease areas, this study found that a small segment of patients with NIIEDs consumed most resources. This study identified several predictors based on patient characteristics and HRU that may help inform the profile of patients with NIIEDs with the highest health care needs. As such, patients with a given profile can be selected for targeted interventions by clinicians to potentially help improve quality of care and to reduce costs.

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DISCLOSURES

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