National Study of Ocular Hospitalizations in Medicare Beneficiaries

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• PURPOSE: To study the characteristics of Medicare beneficiaries hospitalized for ophthalmic conditions.
• DESIGN: Cross-sectional study.
• METHODS: The 2015 National Medicare 100% Inpatient Limited Dataset was analyzed to identify all patients with either an admitting or primary diagnosis for an ophthalmic condition using ICD-9-CM codes. All other hospitalized Medicare patients served for comparison. Comorbidities were calculated using the Elixhauser Comorbidity Index. Multivariable logistic regression was used to determine odds of primary ophthalmic hospitalization after controlling for patient characteristics and medical comorbidities.
• RESULTS: For 2015, there were a total of 13 152 Medicare patients with ocular hospitalizations compared to 6 621 005 patients with nonophthalmic events. Most ophthalmic patients were emergent admissions (73.19%) with routine discharges (75.50%) and low rates of inpatient mortality (0.62%). The top admitting diagnoses for nontraumatic and traumatic eye conditions were diplopia (11.69%) and closed fracture of the orbital floor (3.76%), respectively. Patients admitted for eye conditions were more likely to be younger, to be African American, and to have hypertension, valvular heart disease, diabetes, hypothyroidism, AIDS, lymphoma, solid tumor without metastasis, rheumatologic diseases, alcohol and drug abuse, psychoses, and depression compared to the general Medicare inpatient population.
• CONCLUSIONS: Most inpatient admissions for US Medicare beneficiaries with primary ophthalmic diagnoses were for nontraumatic disorders of the eye and adnexa. Ophthalmic admissions were on average shorter in duration and had lower rates of inpatient mortality compared to nonophthalmic admissions. Patients admitted for eye conditions were more likely to have comorbidities such as hypertension, diabetes, and depression compared to the general Medicare inpatient population.

OPHTHALMOLOGY HAS TRADITIONALLY BEEN AN outpatient service and less attention has been given to its role in inpatient medicine. Ocular conditions managed as an inpatient tend to be complex vision-threatening disorders, potentially life-threatening conditions, or neurologic emergencies.[1,2] Previous analyses of ophthalmic hospitalizations have used either state-level data[1] or sampling frameworks.[3] Prior research suggest the need for better understanding of risk factors that may lead to ophthalmic hospitalizations.[1] To our knowledge, there has been no study using national, population-based Medicare data that describe ophthalmic hospitalizations and the associated risk factors.

The purpose of this study is to describe ophthalmic hospitalizations with the 100% national Medicare inpatient dataset. We also examine the potential associations of underlying medical comorbidities and patient characteristics on the risk of ophthalmic hospitalization relative to the national Medicare inpatient population.

METHODS

WE CONDUCTED A CROSS-SECTIONAL STUDY USING DATA from the national Medicare 100% Inpatient Limited Dataset (LDS) for the year 2015. The Medicare Inpatient LDS is a dataset sponsored by the Centers for Medicare & Medicaid Services (CMS). It contains claims data submitted by inpatient hospital providers for all hospitalized Medicare patients in the calendar year. This study abides by the Dataset Use Agreement (DUA) and the Northwestern University Institutional Review Board granted a study exemption. (More details on the dataset and DUA can be found in the section on data availability at the end of this article.)

We employed the national Medicare Inpatient LDS to identify patients who had either an admitting diagnosis or a principal diagnosis of an ophthalmic condition through ICD-9-CM codes (Supplemental Table; Supplemental Material available at AJO.com) based on previously published research.[3] The admission diagnosis is the beneficiary's initial diagnosis at admission, while the principal diagnosis is the reason for admission shown in

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TABLE 1. Patient Demographics for National Medicare Hospitalizations, Year 2015

Total Number of Patients	Patients With Ocular Hospitalizations, N (%) (N = 13 152)	Patients With Other Hospitalizations, N (%) (N = 6 621 005)
Age[a]		
<65	2731 (20.77%)	1 258 914 (19.01%)
65-69	2321 (17.65%)	1 143 292 (17.27%)
70-74	2069 (15.73%)	1 042 896 (15.75%)
75-79	1914 (14.55%)	959 866 (14.50%)
80-84	1710 (13.00%)	875 475 (13.22%)
>84	2407 (18.30%)	1 340 562 (20.25%)
Sex		
Male	6078 (46.21%)	2 987 073 (45.12%)
Female	7074 (53.79%)	3 633 932 (54.88%)
Race[a]		
White	10 487 (79.74%)	5 464 410 (82.53%)
Black	1826 (13.88%)	749 317 (11.32%)
Hispanic	276 (2.10%)	135 210 (2.04%)
Other and unknown	563 (4.29%)	272 068 (4.11%)
Total Number of Admissions	**Ocular Admissions, N (%) (N = 13 463)**	**All Other Admissions, N (%) (N = 11 263 628[b])**
Location of hospital[a]		
Urban	12 370 (91.88%)	9 761 755 (86.67%)
Large rural town	794 (5.90%)	1 007 498 (8.94%)
Small rural town	203 (1.51%)	357 926 (3.18%)
Isolated small rural town	96 (0.71%)	136 449 (1.21%)
Regional area[a]		
Northeast	2887 (21.44%)	2 129 126 (18.9%)
West	1693 (12.58%)	1 555 440 (13.81%)
South	5460 (40.56%)	4 827 756 (42.84%)
Midwest	3390 (25.18%)	2 713 641 (24.1%)
Other	33 (0.25%)	37 665 (0.32%)
Length of stay in days (mean ± standard deviation)[a]	3.67 ± 4.63	5.57 ± 6.62
Admission type[a]		
Emergency	9 854 (73.19%)	7 009 201 (62.23%)
Urgent	1972 (14.65%)	1 716 222 (15.24%)
Elective	1226 (9.11%)	2 445 864 (21.71%)
Trauma center	392 (2.91)	74 468 (0.66%)
Other	19 (0.14%)	17 873 (0.16%)
Admission source[a]		
Physician referral	10 655 (79.14%)	8 432 930 (74.87%)
Clinic referral	1262 (9.37%)	1 198 236 (10.64%)
Hospital transfer	1103 (8.19%)	965 933 (8.58%)
Transfer from SNF, ICF, or another facility	443 (3.29%)	666 529 (5.91%)
Discharge status[a]	N (%)	N (%)
Routine (home, home care of organized home health association)	10,165 (75.50%)	7 123 172 (63.24%)
Skilled nursing facility	1748 (12.98%)	2 202 375 (19.55%)
Rehabilitation	494 (3.67%)	400 914 (3.56%)
Death	83 (0.62%)	357 696 (3.18%)
Other	973 (7.23%)	1 179 471 (10.47%)

[a]$P < .01$ of comparison group to case group. *P* values for continuous variables are by the Kruskal-Wallis test; *P* values for categorical variables are by the \rchi^2 test.

[b]Excludes all hospitalizations for the 13 152 patients with primary ophthalmic conditions.

TABLE 2. Top Admitting Diagnoses for Nontraumatic and Traumatic Ophthalmic Disorders

ICD-9 Code	Diagnosis	Frequency	%[a]
Top 15 nontraumatic			
368.2	Diplopia	1,574	11.69%
368.8	Other specified visual disturbance	1,491	11.07%
368.16	Psychophysical visual disturbance	1,016	7.55%
368.9	Unspecified visual disturbance	880	6.54%
369.9	Unspecified visual loss	446	3.31%
376.01	Orbital cellulitis	382	2.84%
369.8	Unqualified visual loss, one eye	369	2.74%
369	Profound visual impairment, both eyes	354	2.63%
379.91	Pain in or around eye	232	1.72%
362.34	Transient retinal artery occlusion	205	1.52%
784	Headache	178	1.32%
368.46	Homonymous bilateral field defects	170	1.26%
369.6	Profound impairment, 1 eye, impairment level not further specified	157	1.17%
434.91	Cerebral artery occlusion, unspecified with cerebral infarction	152	1.13%
360	Purulent endophthalmitis	141	1.05%
Top 10 traumatic			
802.6	Closed fracture of orbital floor (blow-out)	506	3.76%
871	Ocular laceration without prolapse, open wound of the eyeball	127	0.94%
921.2	Contusion of eye and adnexa	81	0.6%
871.1	Open wound of eyeball	78	0.58%
959.01	Head injury	70	0.52%
802.8	Closed fracture of other facial bones	69	0.51%
921.9	Unspecific contusion of eye	68	0.51%
870.8	Other specified open wounds of ocular adnexa	48	0.36%
921.1	Contusion of eyelids and periocular area	42	0.31%
921	Black eye, not otherwise specified	24	0.18%

[a]Percentage is calculated out of total number of ocular patients (N = 13 152).

the medical record to be chiefly responsible for the services provided and is used for diagnosis-related group assignment and hospital payment. Therefore we used both fields to capture the total number of patients admitted chiefly for an ocular problem. The ICD-9-CM codes are linkable across datasets through a scrambled patient identifier, with online documentation.[4] The comparison group consisted of nonophthalmic Medicare hospitalized patients. For patients with multiple admissions, the first admission was used. Patients over 65 qualified for Medicare through the age criteria, while patients under 65 qualified by having social security disability insurance or end-stage renal disease (ESRD) requiring dialysis or kidney transplant.

The Agency for Healthcare Research and Quality's publicly available Elixhauser comorbidity software, Version 3.7, was used for the comorbidity adjuster.[5] This software accounts for inpatient morbidity and mortality using 29 binary comorbidity measures. The Elixhauser algorithm was applied to the national Medicare Inpatient LDS using all diagnoses to create a comorbidity profile for each patient. In turn, the comorbidity profile for each patient was combined with categorical information on age, sex, and race.

The location and characteristics of hospitals were determined in 2 parts. First, we merged the national Medicare Inpatient LDS with the freely downloadable Medicare National Provider Identifiers (NPI) data.[6] With the NPI merge, the location of hospital was determined by analyzing specific details, including mailing address and zip codes. Second, the hospitals' zip codes and Rural Urban Commuting Area (RUCA) codes (version 2.0) were used to identify the type of town in which the hospitals were located.[7] There are 33 RUCA

TABLE 3. Major Medical Comorbidities (Elixhauser Comorbidity Index)

	Ocular Patients (N = 13 152)		All Other Patients (N = 6 621 005)	
Comorbidities	Frequency	%	Frequency	%
Congestive heart failure[a]	1627	12.37%	595 730	9.00%
Hypertension[a]	10 037	76.32%	3 123 542	47.18%
Valvular disease[a]	1095	8.33%	266 189	4.02%
Peripheral vascular disease[a]	1096	8.33%	408 104	6.16%
Pulmonary circulation disease	342	2.60%	177 041	2.67%
Chronic pulmonary disease[a]	2504	19.04%	1 055 589	15.94%
Paralysis	333	2.53%	158 479	2.39%
Other neurologic disorders[a]	1347	10.24%	570 537	8.62%
Diabetes without chronic complications[a]	3279	24.93%	1 088 909	16.45%
Diabetes with chronic complications[a]	1195	9.09%	268 422	4.05%
Hypothyroidism[a]	2438	18.54%	819 982	12.38%
Renal failure[a]	2251	17.12%	800 742	12.09%
Liver disease	257	1.95%	121 379	1.83%
Ulcer	<11[b]	—[b]	1634	0.02%
AIDS[a]	43	0.33%	5800	0.09%
Lymphoma[a]	166	1.26%	47 277	0.71%
Metastatic cancer	223	1.70%	120 912	1.83%
Solid tumor without metastasis[a]	432	3.28%	165 267	2.50%
Rheumatoid arthritis/collagen vascular disease[a]	540	4.11%	179 565	2.71%
Coagulopathy	505	3.84%	263 767	3.98%
Obesity[a]	1445	10.99%	590 856	8.92%
Weight loss[a]	392	2.98%	316 384	4.78%
Fluid and electrolyte disorders[a]	2486	18.90%	1 407 793	21.26%
Chronic blood loss anemia[a]	37	0.28%	47 345	0.72%
Iron deficiency anemia[a]	1950	14.83%	900 269	13.6%
Alcohol abuse[a]	496	3.77%	141 829	2.14%
Drug abuse[a]	358	2.72%	110 147	1.66%
Psychoses[a]	802	6.10%	228 903	3.46%
Depression[a]	1824	13.87%	616 950	9.32%

[a]$P < .01$ of comparison group to case group; P values for categorical variables are by the \rchi^2 test.
[b]Under Data Use Agreement (CMS-R-0235L) Section 8a no cell less than 11 or percentages may be displayed.

codes that classify towns and there are a number of ways RUCA codes can be aggregated. To facilitate analysis we used the University of Washington Categorization-A, which collapses the 33 RUCA codes into 4 groups (urban, large rural city/town, small rural town, isolated small rural town) for descriptive analysis.

• **STATISTICAL ANALYSIS:** The χ^2 test was used to determine differences in observed proportions of certain characteristics between the ophthalmic and comparison groups ($\alpha = 0.01$). The t test was used to assess differences for continuous variables. Adjusted odds ratio (OR) estimates for the associated risk of select patient characteristics (gender, age, and race) and all 29 individual medical comorbidities on ophthalmic hospitalization were obtained with logistic regression. Use of other variables such as location of hospital (urban) and admission type produced multicollinearity (highly correlated variables) with black race and were not included in the final analysis. Odds ratios and corresponding 95% confidence intervals (CI) were subsequently obtained. Analyses used SAS, version 9.4 (SAS Institute, Cary, North Carolina, USA).

RESULTS

• **DEMOGRAPHICS AND ADMISSION CHARACTERISTICS:** For 2015, there were a total of 13 463 ophthalmic inpatient admissions for 13 152 Medicare patients, compared to 11 263 628 nonophthalmic admissions for 6 621 005 Medicare patients (Table 1). For the ophthalmic patients, 20.77% of patients were younger than 65 years old, 17.65% were

TABLE 4. Logistic Regression Results of Ocular Hospitalization Associations

Variables	OR	95% CI
Age, y (reference >84 y)		
<65[a]	1.29	1.21, 1.37
65-69[a]	1.13	1.07, 1.20
70-74[a]	1.09	1.02, 1.16
75-79	1.08	1.02, 1.15
80-84	1.06	1.00, 1.13
Sex (reference: male)		
Female	0.96	0.93, 1.00
Race (reference: white)		
Black[a]	1.22	1.16, 1.28
Hispanic	1.04	0.92, 1.17
Other	1.07	0.98, 1.17
Comorbidities		
Congestive heart failure	1.07	1.02, 1.14
Hypertension[a]	3.52	3.37, 3.68
Valvular disease[a]	1.83	1.72, 1.95
Peripheral vascular disease	0.95	0.90, 1.02
Pulmonary circulation disease[a]	0.71	0.63, 0.79
Chronic pulmonary disease[a]	0.91	0.87, 0.96
Paralysis[a]	0.83	0.75, 0.93
Other neurologic disorders	1.00	0.94, 1.06
Diabetes without chronic complications[a]	1.25	1.19, 1.30
Diabetes with chronic complications[a]	1.97	1.84, 2.10
Hypothyroidism[a]	1.26	1.20, 1.32
Renal failure	0.99	0.95, 1.05
Liver disease[a]	0.81	0.72, 0.92
Ulcer[b]	1.11	0.42, 2.93
AIDS[a]	2.97	2.20, 4.03
Lymphoma[a]	1.66	1.42, 1.94
Metastatic cancer	0.96	0.84, 1.09
Solid tumor without metastasis[a]	1.18	1.07, 1.30
Rheumatoid arthritis/collagen vascular disease[a]	1.23	1.13, 1.35
Coagulopathy[a]	0.86	0.79, 0.94
Obesity[a]	0.78	0.74, 0.83
Weight loss[a]	0.60	0.54, 0.66
Fluid and electrolyte disorders[a]	0.64	0.61, 0.67
Chronic blood loss anemia[a]	0.31	0.23, 0.43
Iron deficiency anemia[a]	0.83	0.79, 0.88
Alcohol abuse[a]	1.52	1.38, 1.67
Drug abuse[a]	1.25	1.12, 1.40
Psychoses[a]	1.49	1.38, 1.60
Depression[a]	1.20	1.14, 1.26

CI = confidence interval; OR = odds ratio.

[a]$P < .001$ of comparison group (n = 6 621 005) to case group (n = 13 152).

[b]For adherence to Data Use Agreement (CMS-R-0235L) Section 8a assumes a cell size of 11.

between 65 and 69 years old, and 18.30% of patients were older than 84 years old. Patients under 65 mainly qualified for Medicare through disability, either with (7.98%) or without (87.55%) ESRD, while others qualified by having ESRD (4.47%). Most patients were female (53.79%). In terms of race, 79.74% were white, 13.88% were African American, and 2.10% were Hispanic. There were significantly more patients who were younger and African American in the ocular group compared to the general Medicare inpatient population (Table 1).

The majority of hospitalizations for eye conditions were in urban hospitals (91.88%) in the southern United States (40.56%), followed by the Midwest (25.18%) and the Northeast (21.44%). A large proportion of ocular admissions were emergent (73.19%) and referred by physicians (79.14%). The average length of stay for ophthalmic conditions was 3.67 days, which was significantly shorter than nonophthalmic hospitalizations, which was on average 5.57 days. A significantly larger proportion of patients with eye conditions were routinely discharged compared to the general Medicare inpatient population (75.50% vs 63.24%). The inpatient mortality rates were 0.62% for ocular and 3.18% for nonocular patients.

• **ADMITTING DIAGNOSES:** Nontraumatic disorders of the eye and adnexa comprised the majority of ocular admissions (84.91%). The most common admitting diagnoses for nontraumatic eye conditions were diplopia (11.69%), various types of visual disturbances (11.07%, 7.55, and 6.54%), unspecified visual loss (3.31%), and orbital cellulitis (2.84%). The most common diagnoses for traumatic eye conditions were closed fracture of the orbital floor (3.76%), ocular laceration (0.94%), contusion of the eye and adnexa (0.6%), and open wound of the eyeball (0.58%) (Table 2).

• **MEDICAL COMORBIDITIES:** Patients admitted for a primary ophthalmic condition had significantly ($P < .01$) higher percentage of congestive heart failure (12.37% vs 9.00%), hypertension (76.32% vs 47.18%), valvular heart disease (8.33% vs 4.02%), peripheral vascular disease (8.33% vs. 6.16%), chronic pulmonary disease (19.04% vs 15.94%), nonparalytic neurologic disorders (10.24% vs 8.62%), diabetes (with chronic complications 9.09% vs 4.05%; without chronic complications 24.93% vs 16.45%), hypothyroidism (18.54% vs 12.38%), renal failure (17.12% vs 12.09%), AIDS (0.33% vs 0.09%), lymphoma (1.26% vs 0.71%), solid tumor without metastasis (3.28% vs 2.50%), rheumatologic diseases (4.11% vs 2.71%), obesity (10.99% vs 8.92%), iron deficiency anemia (14.83% vs 13.6%), alcohol abuse (3.77% vs 2.14%), drug abuse (2.72% vs 1.66%), psychoses (6.10% vs 3.46%), and depression (13.87% vs 9.32%) compared to the general Medicare inpatient population (Table 3).

After controlling for age, sex, and race, the odds of primary ophthalmic hospitalizations were higher for those with hypertension (OR 3.52; CI 3.37, 3.68; $P < .001$), valvular heart disease (OR 1.83; CI 1.72, 1.95; $P < .001$), diabetes with (OR 1.97; CI 1.84, 2.10; $P < .001$) and without complications (OR 1.25; CI 1.19, 1.30;

$P < .001$), hypothyroidism (OR 1.26; CI 1.20, 1.32; $P < .001$), AIDS (OR 2.97; CI 2.20, 4.03; $P < .001$), lymphoma (OR 1.66, CI 1.42, 1.94; $P < .001$), solid tumor without metastasis (OR 1.18; CI 1.07, 1.30; $P = .0007$), rheumatologic diseases (OR 1.23; CI 1.13, 1.35; $P < .001$), alcohol (OR 1.52; CI 1.38, 1.67; $P < .001$) and drug abuse (OR 1.25; CI 1.12, 1.40; $P < .001$), psychoses (OR 1.49; CI 1.38, 1.60; $P < .001$), and depression (OR 1.20; CI 1.14, 1.26; $P < .001$) compared to the general Medicare inpatient population (Table 4).

On the other hand, the adjusted odds of primary ophthalmic hospitalizations were lower for those with pulmonary circulation disease (OR 0.71, CI 0.63, 0.79; $P < .0001$), chronic pulmonary disease (OR 0.91, CI 0.87, 0.96; $P < .0001$), paralysis (OR 0.83, CI 0.75, 0.93; $P = .001$), liver disease (OR 0.81, CI 0.72, 0.92; $P = .0012$), coagulopathy (OR 0.86, CI 0.79, 0.94; $P = .0012$), obesity (OR 0.78, CI 0.74, 0.83; $P < .0001$), weight loss (OR 0.60, CI 0.54, 0.66; $P < .0001$), fluid and electrolyte disorders (OR 0.64, CI 0.61, 0.67; $P < .0001$), chronic blood loss anemia (OR 0.31, CI 0.23, 0.43; $P < .0001$), and iron deficiency anemia (OR 0.83, CI 0.79, 0.88, $P < .0001$) compared to nonophthalmic hospitalizations.

DISCUSSION

THIS STUDY USED THE 100% NATIONAL POPULATION–BASED inpatient Medicare dataset to describe ophthalmic hospitalizations and its associated risk factors. We found that eye-related hospitalizations comprised 0.12% of all admissions among Medicare beneficiaries in 2015. Most hospitalizations were emergent, with routine discharges and low rates of inpatient mortality. We found that most ocular admissions were most commonly attributable to nontraumatic eye conditions, such as diplopia and cellulitis. In terms of trauma, orbital floor fractures and ocular lacerations were the most common. Orbital floor fractures in the inpatient setting are most commonly owing to falls, followed by assault,[3] with admission rates rising over the past decade because of increase in life expectancy.[8] Thus, introducing interventions aimed to reduce the incidence and severity of falls may help prevent ocular injuries in the future.[9]

Other studies using inpatient datasets (not exclusive to Medicare patients) have also found orbital cellulitis, orbital floor fractures, and diplopia to be highly prevalent among the elderly population (>65 years old).[1,3] Whereas our study looked at the Medicare population, which included a small proportion (20.77%) of young patients (<65 years of age) who qualified for Medicare through disability, Iftikhar and associates analyzed the epidemiology of inpatient admissions among younger age groups with a variety of payment plans (including private and government insurance plans) using the National Inpatient Sample and similarly found orbital floor fractures and cellulitis to be highly prevalent.[3] Furthermore, they found optic neuritis and diplopia to be the third most common diagnoses, following cellulitis and floor fractures, among the adult (19-44 years) and middle-aged (45-64 years) populations, respectively.

Our study found that likelihood of ophthalmic hospitalization was higher for those with various comorbidities such as hypertension, diabetes, valvular heart disease, and hypothyroidism and lower for those with comorbidities such as lung disease, liver disease, anemia, coagulopathy, and fluid and electrolyte disorders, compared to nonophthalmic hospitalizations. While this is not a causal relationship, this suggests that patients managed in the inpatient setting have complex ocular and systemic medical issues, which should be taken into consideration when taking care of their acute eye conditions.[1] For example, diabetes not only affects vision by causing diabetic retinopathy but also affects wound healing and infection risk, and increases complications to other organ systems. A large study showed that among patients admitted for surgical management of facial fractures (including orbital fractures), those with diabetes had higher costs, had longer lengths of stays, and were more likely to have more comorbidities and postoperative cardiac complications than those without diabetes.[10]

The most common cause of inpatient admission was diplopia. Diplopia can be attributable to traumatic causes (such as facial fractures) or nontraumatic causes (such as cranial nerve palsies, strabismus, stroke, and malignancy). Not much is known about the epidemiology of diplopia, especially in the inpatient setting.[11] Population-based studies in the outpatient setting have found sixth nerve palsies to be associated with hypertension (19%), coexisting diabetes and hypertension (12%), and trauma (12%).[12] A similar study found a 6-fold increase in the odds of diabetes and an 8-fold increase in odds of coexistent diabetes and hypertension in cases of sixth nerve palsy compared to controls.[13] Similarly, third nerve palsies were associated with microvascular ischemia (42%), trauma (12%), and compression from neoplasm (11%).[14] This is not surprising, as it is well known that hypertension and diabetes can cause cranial nerve palsies secondary to microvascular ischemia. Although it is not possible to establish a causal relationship with cross-sectional studies, these publications support our finding that there are associations between ocular conditions and comorbidities that can be seen at the population level.

We also found a relationship between ocular admissions and systemic diseases that cause immunosuppression, such as AIDS, lymphoma, solid tumors, and rheumatologic diseases. One study found that among inpatients with hematogenous infections, the odds of endogenous endophthalmitis was higher in patients with endocarditis, systemic abscesses, and immunocompromised status such as HIV/AIDS, lymphoma/leukemia, and diabetes with ophthalmic manifestations.[15] Again, these patients with endogenous

endophthalmitis were overall sicker and required intensive care unit admissions and longer hospitalizations. Our study suggests that patients with systemic immunosuppression may be at a higher risk of having serious ocular conditions requiring hospitalization. A better understanding of patients' medical comorbidities may help inform ophthalmology consulting services in the management of their patients' acute eye issues.

Another surprising finding was that psychiatric comorbidities such as depression, psychoses, and alcohol and drug abuse were associated with higher odds of admission for the primary ocular condition. Although we cannot determine a causal relationship between ophthalmic conditions and psychiatric illnesses, many studies have shown that there is a higher prevalence of depression among patients with visual impairments compared to those without.[16–18] In terms of drug and alcohol abuse, studies have shown that these conditions are highly prevalent in patients that present to the emergency department with ocular injuries.[19,20] In particular, orbital floor fractures were shown to be highly associated with alcohol consumption.[19]

There are several limitations to this study. First, this is an observational study using a large administrative dataset, which is susceptible to many biases. Selection bias poses a particular problem, as our results rely on accurate ICD-9 coding. It is possible that a patient with a primary ocular issue did not have his or her ophthalmic diagnosis listed as either the principal or admitting diagnosis. Furthermore, it is possible that a patient with multiple medical issues including a serious ocular condition requiring admission does not have an ophthalmic condition listed as his or her principal diagnosis. However, we limited our analyses to patients with a primary ocular diagnosis to avoid including individuals with a minor ophthalmic condition that did not warrant an inpatient hospitalization by itself. We used both admitting and principal diagnoses to capture the entire cohort of patients admitted for a primary ophthalmic reason, and reported the top traumatic and nontraumatic admitting diagnoses. This methodology of identifying ophthalmic hospitalizations has been validated in prior studies.[3] A large percentage of the admitting diagnoses were nonspecific visual disturbances, indicating that the cause of visual symptoms may not have been specified at the time of admission. One limitation with this approach is the potential inclusion of patients with nonophthalmic causes for their visual disturbance, which may result in false-positives. Second, we used the inpatient carrier file and thus our results are only generalizable to the Medicare inpatient population. We also used the inpatient carrier file to focus on secondary reasons for hospitalizations and not on reasons for outpatient utilization or management. In particular, Medicare patients under 65 who qualify for Medicare typically have poorer health or disability that put them at a higher risk of admission; thus their results may not be generalizable to a younger population who do not qualify for Medicare. Information on ocular admission among younger age groups can be ascertained from other studies,[3] as described above.

In addition, large datasets are susceptible to potential missing data and variation in coding practices. Last, we compared the ocular population to the general Medicare inpatient population, which may conflate measures of association. It should be emphasized that while we found several associations between ocular admissions and patient characteristics, these relationships are not causative. Also, it should be noted that we did not study associations for specific ocular diseases. More research is necessary to assess whether certain comorbidities or characteristics put patients with specific ocular disorders at a higher risk for admission. Furthermore, additional research is necessary to analyze the impact of socioeconomic factors, and in particular the potential impact of the social determinants of health[21] on ocular admissions has yet to be explored.

Most inpatient admissions for US Medicare beneficiaries with ophthalmic diagnoses were for nontraumatic disorders of the eye and adnexa. Ophthalmic admissions were on average shorter in duration and had lower rates of in-hospital mortality compared to nonophthalmic admissions. Patients admitted for eye conditions were more likely to be younger, to be African American, and to have cardiovascular comorbidities (owing to hypertension, diabetes, and valvular heart disease), compromised immunity (from AIDS, lymphoma, tumors, and rheumatologic diseases), and psychiatric conditions (such as depression, psychoses, and drug and alcohol abuse) compared to the general Medicare inpatient population. This suggests that there are often important systemic conditions that are present in the setting in which patients develop ophthalmic diseases, and managing these conditions both in and outside the hospital may reduce the burden of ocular diseases.

• **DATA AVAILABILITY:** Medicare Limited Data Set (LDS) files contain beneficiary-level protected health information and are under federal regulation through the Health Insurance Portability and Accountability Act; by law, LDS requests require a Data Use Agreement (DUA), available at https://www.resdac.org/cms-data/request/limited-data-sets, and require an Institutional Board waiver. Our study abides by the CMS's current cell size suppression policy in Data Use Agreement section 8 (DUA), which states that no cell less than 11 may be displayed unless permission is obtained. As such, our study did not require permission from CMS for data use. LDS requests do not require a ResDAC review and can be submitted directly to CMS by the researcher. For further information visit https://www.resdac.org/.

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