

Background

- Neuromyelitis Optica Spectrum Disorder (NMOSD) is a rare autoimmune disease, in which the immune system attacks nervous system cells, mainly resulting in inflammation of the optic nerve.^{1,2,3} This may lead to severe vision and movement problems.
- The prevalence of NMOSD was notably elevated among different racial groups, with the highest rates observed in Blacks (12.99/100,000), constituting 27.7% of NMOSD patients.¹
- In the female population, the prevalence is 9.48/100,000, with Black and Asian females exhibiting 2.65- and 1.94-times higher prevalence rates, respectively, compared to White females.¹
- Total healthcare costs of managing NMOSD and relapses are estimated to be about \$60,500 annually, with a relapse episode lasting for 10-15 days. Due to the severe impact of the relapses, many relapses may require emergency department visits.⁴
- Limited research has evaluated the impact of sociodemographic factors on NMOSD hospitalizations.

Objectives

- To examine the hospitalization characteristics and outcomes [length of stay (LOS), hospitalization charges] of NMOSD patients across 2016-2020.
- To determine the impact of social determinants of health (age, gender, race, income) on NMOSD hospitalization outcomes.

Methods

- We used the Healthcare Cost and Utilization Project (HCUP) National Inpatient Sample (NIS) database (2016-2020).
- We used International Classification of Diseases-10 (ICD-10) codes to identify hospitalizations associated with NMOSD (ICD10: G36.0).
- Sociodemographic factors, hospital characteristics, and outcomes were pooled for analyses.
- We conducted multivariate analyses adjusted for income, region, procedures, and hospital characteristics.
- Total charges were subjected to regression analysis, with log transformation applied to the values for interpretation and statistical analysis.

Results

NMOSD Hospitalizations Compared to All Hospitalizations

NMOSD Hospitalizations Length of Stay (LOS)

- NMOSD LOS was longer (8 ± 7.3 days) compared to HCUP average (4.8 ± 6.5 days).
- Hospitalizations in Black patients had longer LOS (8.6 ± 7.6 days) compared to White (7.3 ± 7.3 days) and Hispanic (7.6 ± 6.1 days) patients (Figure 1).

NMOSD Hospitalizations Total Charges

- Total charges were higher among NMOSD hospitalizations ($\$84,171 \pm 74,294$) compared to HCUP average ($\$57,419 \pm 96,851$).
- NMOSD hospitalizations for Hispanic patients incurred the highest total charges ($\$98,501 \pm 85,871$), followed by Black ($\$81,404 \pm 72,857$) and White ($\$80,089 \pm 73,396$) patients (Figure 2).

Regression Analysis Model

The model used in the analysis is a multiple linear regression model, specified as follows:

$$\text{Length of Stay} / \log(\text{Total Charges}) = \beta_0 (\text{Intercept}) + \beta_1(\text{Age}) + \beta_2(\text{Female}) + \beta_3(\text{Black}) + \beta_4(\text{Hispanic}) + \beta_5(\text{Other Race}) + \beta_6(\text{Income Zip Quartile}) + \beta_7(\text{Large Metro}) + \beta_8(\text{Med Metro}) + \beta_9(\text{Mid West}) + \beta_{10}(\text{South}) + \beta_{11}(\text{West}) + \beta_{12}(\text{Medium Hospital}) + \beta_{13}(\text{Large Hospital}) + \beta_{14}(\text{Urban Non-Teaching}) + \beta_{15}(\text{Urban Teaching}) + \beta_{16}(\text{Number of Procedure Codes}) + \beta_{17}(\text{Number of Diseases}) + \beta_{18}(\text{Medicare}) + \beta_{19}(\text{Private including HMO}) + \beta_{20}(\text{Other Insurance}) + \epsilon$$

Where:
 β_0 is the intercept
 $\beta_1 + \beta_2 + \beta_3$ etc. are the coefficients for each independent variable
 ϵ is the error term, capturing the variability in Total charges or Length of stay

References

- Kim et al. Differential diagnosis of neuromyelitis optica spectrum disorders. *Ther Adv Neurol Disord*. 2017 Jul;10(7):265-289.
- Briggs et al. Prevalence of neuromyelitis optica spectrum disorder in the United States. *Mult Scler*. 2024 Jan 27:13524585231224683.
- Kim et al. Racial differences in neuromyelitis optica spectrum disorder. *Neurology*. 2018 Nov 27; 91(22): e2089–e2099.
- Royston et al. Neuromyelitis optica spectrum disorder: Clinical burden and cost of relapses and disease-related care in US clinical practice

- Over 5 years there were 1,686 NMOSD hospitalizations, with a mean age at hospitalizations of 45.9 ± 15.4 years (Table 1).
- NMOSD hospitalizations were predominantly for women patients (79.6%)
- Black patients accounted for 39.7% of the hospitalizations, White 37.3% and Hispanic patients for 11.9%
- There were minimal differences between Males and Females in terms of LOS and Total Charges for NMOSD hospitalizations (Table 2).

Table 1. NMOSD Overall Hospitalization Characteristics

	Age	Male	Female	Total
Average Age (SD)	45.9 (15.4)	44.35 (15.43)	45.12 (15.46)	
Race	Mean (SD)	N (%)	N (%)	N (%)
White	47.9 (16.4)	170 (49.4%)	459 (34.2%)	629 (37.3%)
Black	42.9 (14.0)	103 (30.0%)	566 (42.2%)	669 (39.7%)
Hispanic	42.7 (14.2)	45 (13.1%)	156 (11.6%)	201 (11.9%)
Other	45.0 (16.1)	19 (5.5%)	118 (8.8%)	137 (8.1%)
Missing		7 (2.0%)	43 (3.2%)	50 (3.0%)
Total		344 (20.4%)	1,342 (79.6%)	

Table 2. NMOSD Hospitalization Outcomes

	Length of Stay	Total Charges
	Mean (SD)	Mean (SD)
Overall	8.0 (7.3)	\$84,171 (74,294)
Gender		
Male	7.8 (7.6)	\$85,550 (74,899)
Female	8.0 (7.3)	\$83,818 (74,162)

Figure 1. Length of Stay by Race

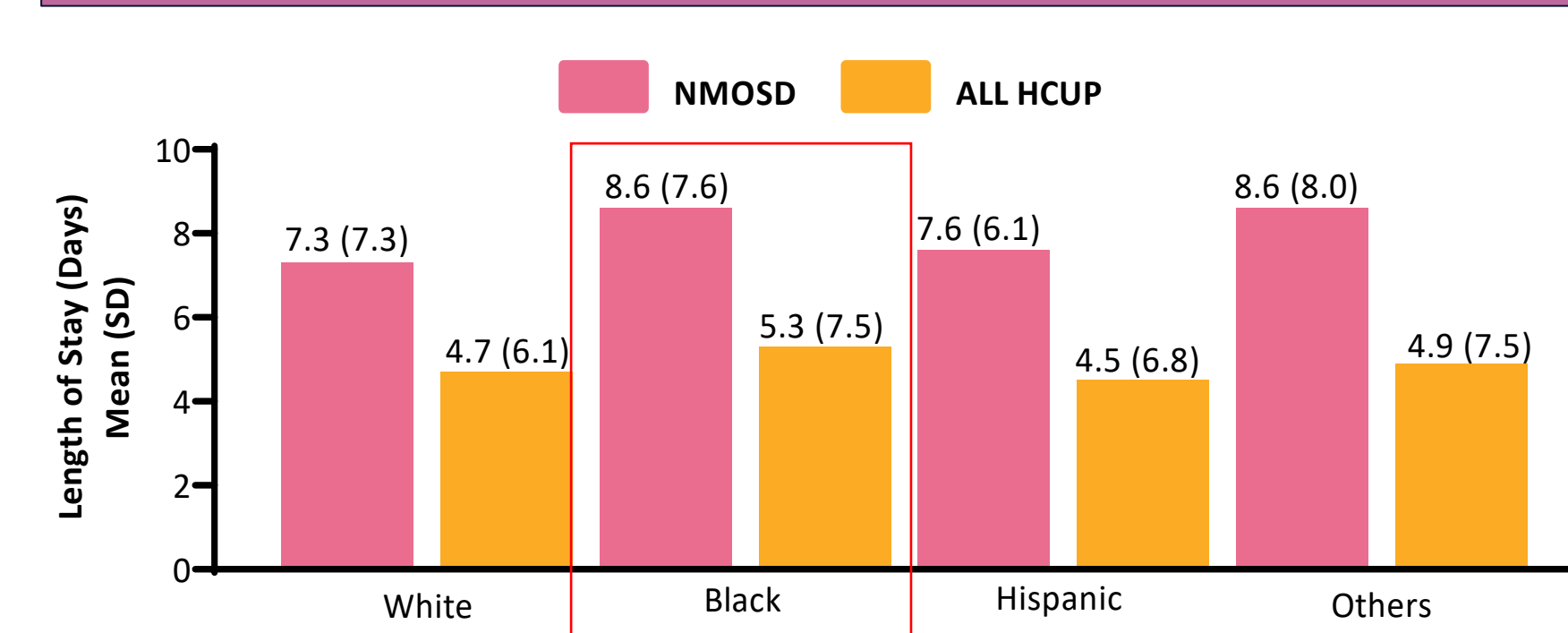


Figure 2. Hospitalization Charges by Race

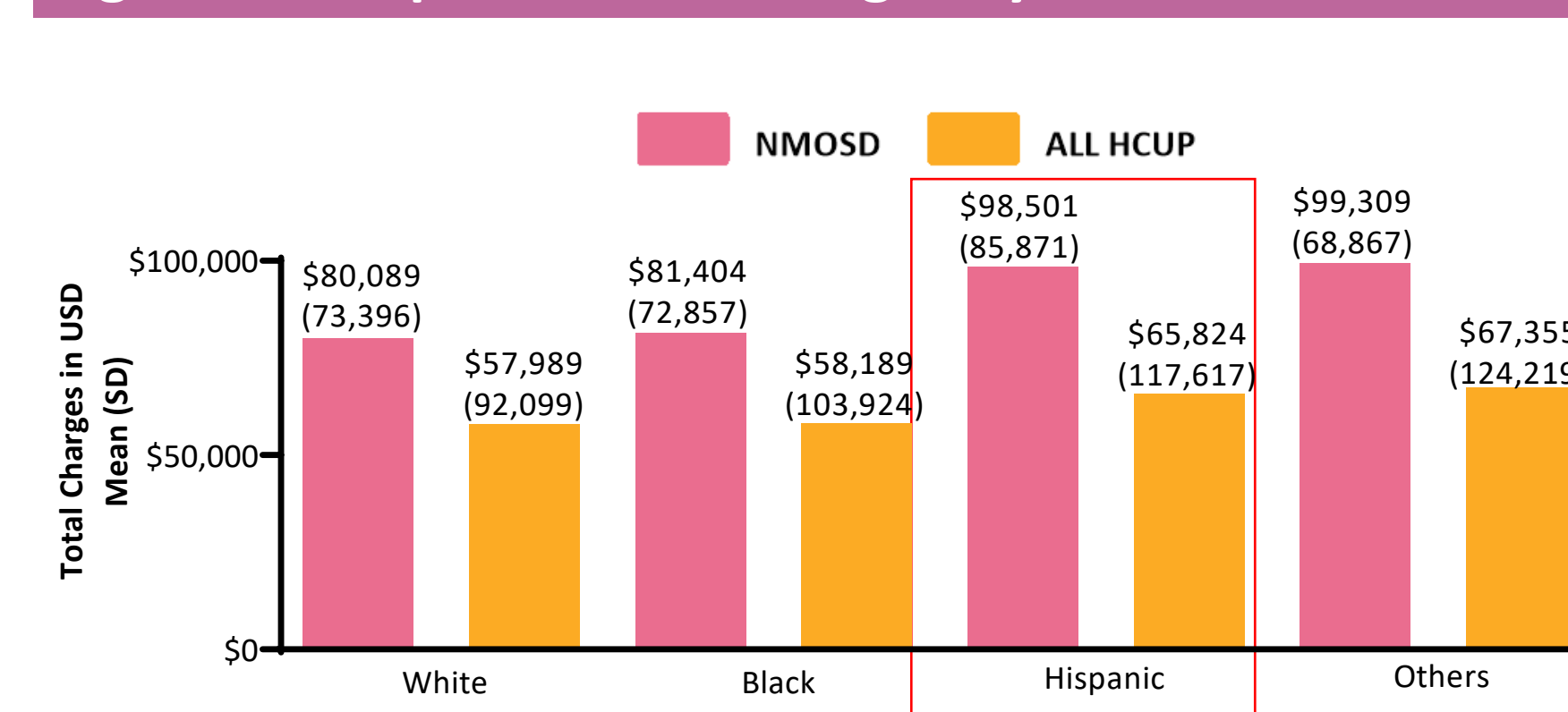


Table 1: Regression Analysis

Variables	Length of Stay (Model A) R ² =36.0%		Log Total Charges (Model B) R ² =37.4%	
	Coefficient	p value	Coefficient	p value
Patient Age (years)	0.023	0.046	0.003	0.029
Gender (Reference Male)				
Female	-0.268	0.464	-0.062	0.164
Race (Reference White)				
Black	1.415	<0.001	0.120	0.007
Hispanic	0.836	0.111	0.165	0.010
Other	1.816	0.002	0.184	0.010
Quartile Income	0.032	0.828	0.002	0.932
Patient's Location (Reference Small Metro)				
Large Metro	-0.245	0.670	-0.065	0.362
Medium Metro	0.252	0.663	-0.065	0.362
Hospital Region (Reference Northeast)				
Midwest	-0.686	0.148	-0.353	<0.001
South	-0.346	0.407	-0.432	<0.001
West	-0.707	0.170	0.023	0.718
Hospital Size (Reference Small)				
Medium	0.122	0.829	-0.008	0.910
Large	0.468	0.352	0.140	0.022
Hospital Location/Type (Reference Rural)				
Urban Non-Teaching	-0.469	0.729	0.700	<0.001
Urban Teaching	0.228	0.858	0.787	<0.001
Hospital Ownership (Reference Government Owned)				
Private, Non-Profit	-0.417	0.286	-0.026	0.590
Private, Investor own	-1.141	0.089	0.365	<0.001
Expected Payer Type (Reference Medicaid)				
Medicare	-1.059	0.020	-0.010	0.856
Private including HMO	-0.811	0.040	0.043	0.366
Other	0.653	0.246	0.028	0.687
Number of Procedures performed	1.313	<0.001	0.177	<0.001
Number of Diseases	0.392	<0.001	0.030	<0.001

Length of Stay (Model A; Table 3)

- Age:** Each additional year of age is associated with a longer stay of approximately 0.023 days ($p < 0.05$).
- Race:** Compared with the reference group (White), African American patients have, on average, a longer hospital stay by 1.4 days ($p < 0.001$).

Total Charges (Model B; Table 3)

- Age:** For every additional year of age, charges increase by 0.3% ($p < 0.05$).
- Race:** On average, hospitalizations for Black patients incurred charges 12% higher than those for White patients ($p < 0.05$), while hospitalizations for Hispanic patients incurred charges 16.5% higher ($p < 0.05$).

Conclusions

- This is the first US study of NMOSD hospitalizations over 5 years.
- Disproportionately more women (79%) and Blacks (40%) are hospitalized due to the higher prevalence of the disease in women and Black Americans.
- On average, the NMOSD hospitalizations were almost twice as long as average HCUP hospitalizations.
- Furthermore, NMOSD hospitalizations were ~50% more expensive than an average HCUP hospitalization.
- Black patients had significantly longer LOS (1 extra day) and Hispanic patients incurred significantly higher charges (~\$17,500 more).
- Effective treatment of NMOSD in the community is crucial to ensure that these vulnerable patients are not hospitalized, where they may bear disproportionately higher healthcare burden.

Limitations

- HCUP data which is based on total charges may not accurately reflect the actual cost structure related to hospital services.
- HCUP primarily focuses on inpatient care and hence no extrapolation can be made about NMOSD in non-hospital settings, which will require further study

Author Disclosures

JA served on scientific advisory boards for of EMD Serono, Genentech, Horizon Therapeutics/Amgen & TG Therapeutics; has received research support from Horizon Therapeutics/Amgen
 AA and MR are employees of APPERTURE LLC and are HEOR consultants to several Biopharmaceutical companies
 KP, HP, JP are employees of Amgen (Horizon Therapeutics) and are stock-holders of Amgen

