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Access disparities to Magnet hospitals for patients undergoing neurosurgical operations

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Abstract

Background—Centers of excellence focusing on quality improvement have demonstrated superior outcomes for a variety of surgical interventions. We investigated the presence of access disparities to hospitals recognized by the Magnet Recognition Program of the American Nurses Credentialing Center (ANCC) for patients undergoing neurosurgical operations.

Methods—We performed a cohort study of all neurosurgery patients who were registered in the New York Statewide Planning and Research Cooperative System (SPARCS) database from 2009–2013. We examined the association of African-American race and lack of insurance with Magnet status hospitalization for neurosurgical procedures. A mixed effects propensity adjusted multivariable regression analysis was used to control for confounding.

Results—During the study period, 190,535 neurosurgical patients met the inclusion criteria. Using a multivariable logistic regression, we demonstrate that African-Americans had lower admission rates to Magnet institutions (OR 0.62; 95% CI, 0.58–0.67). This persisted in a mixed effects logistic regression model (OR 0.77; 95% CI, 0.70–0.83) to adjust for clustering at the patient county level, and a propensity score adjusted logistic regression model (OR 0.75; 95% CI, 0.69–0.82). Additionally, lack of insurance was associated with lower admission rates to Magnet institutions (OR 0.71; 95% CI, 0.68–0.73), in a multivariable logistic regression model. This persisted in a mixed effects logistic regression model (OR 0.72; 95% CI, 0.69–0.74), and a propensity score adjusted logistic regression model (OR 0.72; 95% CI, 0.69–0.75).

Conclusions—Using a comprehensive all-payer cohort of neurosurgery patients in New York State we identified an association of African-American race and lack of insurance with lower rates of admission to Magnet hospitals.

Keywords

neurosurgery; Magnet recognition; center of excellence; access disparities; SPARCS

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INTRODUCTION

Regionalization of care to centers of excellence is at the core of recently enacted legislation.^{10–14,18} The Magnet Recognition Program of the American Nurses Credentialing Center (ANCC)² is one such initiative recognizing rigorous quality improvement, and superior nursing care delivery. It focuses on five core principles: “transformational leadership, a structure that empowers staff, an established professional nursing practice model, support for knowledge generation and application, and robust quality improvement mechanisms”.² This initiative is increasingly recognized by the public, after inclusion in US News and World Report rankings,³⁴ and quality initiatives such as the Leapfrog Group.¹ Prior investigations have demonstrated that hospitalization in these institutions is associated with improved outcomes for neurosurgical patients. In this setting, access disparities among these patients to Magnet hospital can have detrimental effects for population health.

Prior studies have investigated the impact on racial and socioeconomic factors on the care of neurosurgical patients. Some groups have demonstrated that African-Americans and uninsured have limited access to various neurosurgical operations.^{3–5,7,30} Others have shown that similar racial and socioeconomic disparities are associated with inferior outcomes after neurosurgical procedures.^{15–17,26,27,31,35} There has been no previous study investigating potential access disparities to centers of excellence, such as Magnet hospitals, for neurosurgical patients.

We used the New York Statewide Planning and Research Cooperative System (SPARCS)¹⁹ to study the association of African-American race and lack of insurance with being hospitalized in a Magnet hospital for a neurosurgical operation. We utilized a battery of approaches to control for confounding, including regression adjustment, and propensity score adjustment, whereas mixed effects methods were employed to control for clustering at the regional level.

METHODS

New York Statewide Planning and Research Cooperative System (SPARCS)

This study was approved by the Dartmouth Committee for Protection of Human Subjects. All patients who were hospitalized for neurosurgical operations, and were registered in the SPARCS (New York State Department of Health, Albany, NY)¹⁹ database between 2009 and 2013 were included in the analysis. For these years, SPARCS contains patient-level details for every hospital discharge, ambulatory surgery, and emergency department admission in New York State as coded from admission and billing records. More information about SPARCS is available at <https://www.health.ny.gov/statistics/sparcs/>.

Magnet Recognition Program

The Magnet Recognition program of the ANCC was established in 1994 by a subsidiary of the American Nurses Association.² Magnet recognition lasts for four years. As of 2015, 402 facilities in the United States were recognized by the program. This program involves rigorous documentation and site visits to evaluate institutions across five core principles.²

More information on this process can be found at <http://www.nursecredentialing.org/Magnet>.

Cohort Definition

In order to establish the cohort of patients, we used *International Classification of Disease-9-Clinical Modification* (ICD-9-CM) codes to identify patients in the database who were hospitalized for a neurosurgical operation (Table S1) between 2009 and 2013. Patients with incomplete information regarding insurance were excluded, when insurance status was the variable of interest, and patients with incomplete information regarding race were excluded, when race was the variable of interest. Finally, patients 65 years and older were excluded when insurance status was the variable of interest. This population is eligible for Medicare, which confounds the association of age and insurance with the decision to transfer.

Outcome variables

The primary outcome variable was hospitalization in a Magnet institution for a neurosurgical procedure. The program's website was used to identify hospitals in New York State that obtained Magnet recognition and the year this was achieved. Hospitals were classified as having Magnet recognition in the corresponding year of the analysis. Classifications were updated each year of the study period in case of mergers or closures.

Exposure variables

The primary exposure variables were African-American race and lack of insurance.

Covariates (Table S1) used for risk-adjustment were age, gender, total number of cases per surgeon, insurance (private, Medicare, Medicaid, uninsured, other, when race was the exposure variable of interest), and race (African-American, Hispanic, Asian, other, when insurance status was the exposure variable of interest).

The comorbidities used for risk adjustment were diabetes mellitus (DM), smoking, chronic lung disease, hypertension, hypercholesterolemia, peripheral vascular disease (PVD), congestive heart failure (CHF), coronary artery disease (CAD), history of transient ischemic attack (TIA), alcohol abuse, obesity, chronic renal failure (CRF), and coagulopathy. Only variables that were defined as "present on admission" were considered part of the patient's preadmission comorbidity profile.

Statistical analysis

The association of our exposure variables with Magnet hospitalization was examined in a multivariable setting.

A logistic regression was used for our categorical outcome (admission to a Magnet hospital). The covariates used for risk adjustment in these models were: age, gender, total number of cases per surgeon, race (in the analysis where insurance was the variable of interest), insurance (in the analysis where race was the variable of interest), and all the comorbidities and hospital characteristics mentioned previously. In order to control for regional clustering, we used mixed effects methods with patient county as a random effect variable. In an

alternative way to control for confounding, we used a propensity adjusted (with deciles of propensity score) logistic regression model. We calculated the propensity score with a separate logistic regression model, using all the covariates mentioned previously. Mixed effects methods were also used for the propensity-adjusted model.

In order to demonstrate the robustness of our data in a sensitivity analysis, we used all categories of race and insurance in the respective analyses, as indicated previously. Additionally, we repeated all the analyses in predefined subgroups of patients undergoing neurovascular procedures, tumor surgeries, or spine surgery. The magnitude and direction of the observed associations did not change and therefore these results are not reported further.

Regression diagnostics were used for all models. All results are based on two sided tests, and the level of statistical significance was set at 0.05. This study, based on 190,535 patients, has sufficient power (80%) at a 5% type I error rate to detect differences in Magnet hospital admission, as small as 0.6%. Statistical analyses were performed using Stata version 13 (StataCorp, College Station, TX).

RESULTS

Patient characteristics

In the selected study period there were 190,535 patients (Figure 1) hospitalized for neurosurgical procedures (mean age was 55.1 years, with 50.7% females) who were registered in SPARCS. Of these patients, 141,279 patients had information regarding insurance status, and of those 137,380 had insurance coverage, and 3,899 were uninsured. The respective distribution of exposure variables between the two groups can be found in Table 1a. Overall, there were 18,656 African-American patients in our cohort. The respective distribution of exposure variables between African-Americans and non-African-Americans can be found in Table 1b.

Association of Magnet hospitalization with insurance

Overall, 929 (23.8%) uninsured, and 48,045 (35.0%) insured patients undergoing neurosurgical procedures were admitted to Magnet hospitals. Uninsured patients had with lower rates of admission to a Magnet hospital for acute ischemic stroke in comparison to their insured counterparts (OR 0.58; 95% CI, 0.54–0.63) in unadjusted analysis. Likewise, using a multivariable logistic regression, we identified that uninsured had lower admission rates to Magnet institutions (OR 0.62; 95% CI, 0.58–0.67) (Table 2). This persisted in a mixed effects logistic regression model (OR 0.77; 95% CI, 0.70–0.83) to adjust for clustering at the county level, and a propensity score adjusted logistic regression model (OR 0.75; 95% CI, 0.69–0.82).

Association of Magnet hospitalization with race

Overall, 4,993 (26.8%) African-Americans, and 63,015 (36.7%) non African-Americans undergoing neurosurgical operations were admitted to Magnet hospitals. African-Americans had lower rates of admission to a Magnet hospital for acute ischemic stroke in comparison to non African-Americans (OR 0.63; 95% CI, 0.61–0.65) in unadjusted analysis. Likewise,

using a multivariable logistic regression, we identified that African-Americans had lower admission rates to Magnet institutions (OR 0.71; 95% CI, 0.68–0.73) (Table 2). This persisted in a mixed effects logistic regression model (OR 0.72; 95% CI, 0.69–0.74) to adjust for clustering at the county level, and a propensity score adjusted logistic regression model (OR 0.72; 95% CI, 0.69–0.75).

DISCUSSION

Using a comprehensive all-payer cohort of patients in New York State undergoing neurosurgical procedures we identified an association of lack of insurance and African-American race with lower rates of Magnet institution hospitalization. These results were consistent across techniques to control for confounders. Magnet recognition is heavily advertised by hospitals.² These facilities have been found to have lower rates of nursing burnout and improved overall financial performance, as well as superior outcomes for patients undergoing neurosurgical procedures.^{2,9,20–23}

Prior studies have investigated racial and socioeconomic disparities for patients undergoing neurosurgical operations. Bekelis et al, in a series of studies across four US States, demonstrated that African-American race and government insurance were associated with limited access to outpatient neurosurgical procedures.^{3,4,7,30} They identified inefficiencies in resource utilization by these patient groups,^{8,28} and lower rates of transfers of neuro-trauma patients of lower socioeconomic status to centers of excellence.^{6,29} The same group described lower rates of treatment of unruptured cerebral aneurysms among lower socioeconomic strata.⁵ Several other investigators have demonstrated that African-Americans and patients with inferior insurance are often treated by low-volume providers.¹⁵ These populations consistently demonstrated increased mortality and morbidity after neurosurgical operations.^{15–17,26,27,31,35} The interpretation of these studies is restricted in some cases by the lack of advanced observational techniques, and in others by analyses limited to a single institution. Although these investigations focus on disparities in outcomes, no previous study has demonstrated access disparities to centers of excellence, such as Magnet recognized hospitals, associated with neurosurgical patients.

Our study purposefully addresses many of the prior methodologic limitations. First, we created a cohort of all patients in a major state, giving a true picture of practice in the community. Second, we used advanced observational techniques to control for confounding. Propensity score stratification was used to adjust our analyses for known confounders. Regional factors have been identified consistently as major contributors to access disparities to centers of excellence. The possibility of clustering at the regional level, which can bias the results of multi-center national studies, was accounted for by using mixed effects methods. Results were consistent across techniques, supporting the validity of the observed associations.

Further research into the racial disparities associated with access to Magnet hospitals in neurosurgery is warranted. It is likely that minorities tend to live in communities with lower quality hospitals minimizing their access to Magnet recognized institutions. Neurosurgical interventions are often associated with life threatening pathologies, and the socioeconomic

disparities identified highlight a critical need for more universal access to these institutions. Our data should provide information to policy makers, regulators, payers, and administrators when designing the structure of hospital systems and optimizing healthcare delivery. Hospitals serving these populations should be incentivized to improve their nursing standards, and achieve Magnet recognition.^{2,9,20–25,33} Such institutional commitment to quality improvement empowers nurses and physicians to deliver evidence-based care, establish effective communication, and identify patient problems quicker.^{24,25,33}

Our study has several limitations. Residual confounding could explain some of the observed associations, despite the use of advanced observational techniques. Additionally, coding inaccuracies can potentially occur and affect our estimates. Although SPARCS includes all New York State hospitals, the generalization of our findings to the entire country is uncertain. SPARCS does not provide details on the functional status of the patients. However, this would be expected to bias our results towards the null, underscoring the importance of the observed associations.

Additionally, we were lacking post-hospitalization, and long-term outcomes on our patients. Quality metrics (i.e. modified Rankin score) are also not available through SPARCS. Although functional outcomes were not the target of our analysis, these can only be provided by prospective registries. In this direction, the NeuroPoint Alliance has created the Quality and Outcomes Database (QOD), the first national neurosurgery registry.³² Finally, causality cannot be established based only on observational data, despite the use of advanced techniques.

Conclusions

Access disparities in centers of excellence can have detrimental consequences for population health. We investigated the association of racial and socioeconomic disparities with the access of neurosurgical patients to hospitals recognized by Magnet Recognition Program of the American Nurses Credentialing Center. Using a comprehensive all-payer cohort of neurosurgical patients in New York State we identified an association of lack of insurance, and African-American race with lower rates of admission to Magnet recognized hospitals.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.
Cohort creation

Table 1a

Patient characteristics when insurance is the variable of interest

	All Patients N= 141279			Uninsured Patients N= 3899			Insured Patients N= 137380		
	Mean	SD		Mean	SD		Mean	SD	P-Value
	N	%		N	%		N	%	P-Value
Age	48.66	10.90		46.32	11.24		48.72	10.89	<0.0001
	48974	34.66		929	23.83		48045	34.97	<0.0001
Magnet hospital	71137	50.35		1789	45.88		69348	50.48	<0.0001
Female gender	96568	68.55	African-American	2307	59.50		94261	68.80	<0.0001
Race	15102	10.72	Caucasian	552	14.24		14550	10.62	<0.0001
	11861	8.42	Hispanic	489	12.61		11372	8.30	<0.0001
	2805	1.99	Asian	134	3.46		2671	1.95	<0.0001
	14544	10.32	Other	395	10.19		14149	10.33	0.733
Transient Ischemic Attack	179	0.13		9	0.23		170	0.12	0.064
Ischemic Stroke	177	0.13		6	0.15		171	0.12	0.609
Coronary Artery Disease	7826	5.54		157	4.03		7669	5.58	<0.0001
Chronic Obstructive Pulmonary Disease	20699	14.65		465	11.93		20234	14.73	<0.0001
Congestive Heart Failure	1698	1.20		34	0.87		1664	1.21	0.055
Diabetes Mellitus	17231	12.20		399	10.23		16832	12.25	0.0001
Coagulopathy	1439	1.02		36	0.92		1403	1.02	0.548
Chronic Renal Failure	1660	1.17		34	0.87		1626	1.18	0.075
Hypertension	51324	36.33		1188	30.47		50136	36.49	<0.0001
Smoking	25140	17.79		863	22.13		24277	17.67	<0.0001
Hypercholesterolemia	32004	22.65		581	14.90		31423	22.87	<0.0001
Obesity	15682	11.10		296	7.59		15386	11.20	<0.0001
Alcohol	2553	1.81		117	3.00		2436	1.77	<0.0001
Peripheral Vascular Disease	1756	1.24		28	0.72		1728	1.26	0.003

SD: Standard Deviation

Table 1b

Patient characteristics when race is the variable of interest

	All Patients			African American Patients			Non-African American Patients		
	N= 190535			N= 18656			N= 171879		
	Mean	SD		Mean	SD		Mean	SD	P-Value
Age	55.14	14.75		53.26	13.34		55.35	14.88	<0.0001
	N	%		N	%		N	%	P-Value
Magnet hospital	68008	35.69		4993	26.76		63015	36.66	<0.0001
Female gender	96738	50.77		10381	55.64		86357	50.24	<0.0001
Insurance	50653	26.63	Medicare	4072	21.87		46581	27.15	<0.0001
	8396	4.41	Medicaid	1641	8.81		6755	3.94	<0.0001
	100054	52.61	Private	9171	49.25		90883	52.97	<0.0001
	4503	2.37	Uninsured	588	3.16		3915	2.28	<0.0001
	26578	13.97	Other	3149	16.91		23429	13.66	<0.0001
Transient Ischemic Attack	226	0.12		31	0.17		195	0.11	0.046
Ischemic Stroke	283	0.15		57	0.31		226	0.13	<0.0001
Coronary Artery Disease	18547	9.73		1370	7.34		17177	9.99	<0.0001
Chronic Obstructive Pulmonary Disease	28676	15.05		3104	16.64		25572	14.88	<0.0001
Congestive Heart Failure	4094	2.15		573	3.07		3521	2.05	<0.0001
Diabetes Mellitus	29096	15.27		4054	21.73		25042	14.57	<0.0001
Coagulopathy	2294	1.20		232	1.24		2062	1.20	<0.0001
Chronic Renal Failure	4679	2.46		803	4.30		3876	2.26	<0.0001
Hypertension	85820	45.04		10359	55.53		75461	43.90	<0.0001
Smoking	28035	14.71		2930	15.71		25105	14.61	<0.0001
Hypercholesterolemia	55508	29.13		4150	22.24		51358	29.88	<0.0001
Obesity	20031	10.51		2521	13.51		17510	10.19	<0.0001
Alcohol	3194	1.68		442	2.37		2752	1.60	<0.0001
Peripheral Vascular Disease	4076	2.14		306	1.64		3770	2.19	<0.0001

SD: Standard Deviation

Table 2

Models demonstrating the association of lack of insurance and African-American race with the possibility of being evaluated at a Magnet designated hospital for a neurosurgical procedure

	OR (95% CI)	P-value
Uninsured patients		
Unadjusted	0.58 (0.54–0.63)	<0.0001
Logistic regression		
Standard	0.62 (0.58–0.67)	<0.0001
Mixed effects model (patient county as random variable)	0.77 (0.70–0.83)	<0.0001
Propensity score adjusted model (patient county as random variable)	0.75 (0.69–0.82)	<0.0001
African American patients		
Unadjusted	0.63 (0.61–0.65)	<0.0001
Logistic regression		
Standard	0.71 (0.68–0.73)	<0.0001
Mixed effects model (patient county as random variable)	0.72 (0.69–0.74)	<0.0001
Propensity score adjusted model (patient county as random variable)	0.72 (0.69–0.75)	<0.0001