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Race differences in gastrostomy tube placement after stroke in majority-white, minority-serving, and racially integrated US hospitals

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Abstract

Background—We sought to determine individual and system contributions to race disparities in percutaneous endoscopic gastrostomy (PEG) tube placement after stroke.

Methods—Ischemic stroke admissions were identified from the Nationwide Inpatient Sample between 2007 and 2011. Hospitals were categorized based on the percentage of ethnic/racial minority stroke patients (<25% ethnic/racial minorities [“majority-white hospitals”], 25–50% ethnic/racial minorities [“racially integrated hospitals”], or >50% ethnic/racial minorities [“minority-serving hospitals”]). Logistic regression was used to evaluate the association between ethnicity/race and PEG utilization within and between the different hospital strata.

Results—Among 246,825 stroke admissions, patients receiving care in minority-serving hospitals had higher odds of PEG compared to patients in majority-white hospitals, regardless of individual patient race (adjusted odds ratio [OR] 1.24, 95% CI 1.12–1.38). Ethnic/racial minorities had higher odds of PEG than whites in any hospital strata; however, this discrepancy was largest in majority-white hospitals (OR 1.62, 95% CI 1.48–1.76), and smallest in minority-serving hospitals (OR 1.22, 95% CI 1.11–1.33; *p* for interaction <0.001). Ethnic/racial minority patients had similar odds of PEG in any hospital strata, while white patients had increasing odds of PEG in racially integrated and minority-serving compared to majority-white hospitals (OR 1.28, 95% CI 1.15–1.43 in racially integrated, and OR 1.39, 95% CI 1.23–1.57 in minority-serving, compared to majority-white hospitals, *p* for trend <0.001).

Conclusion—The likelihood of PEG after ischemic stroke was increased in minority-serving compared to majority-white hospitals. White patients had higher odds of PEG in minority-serving compared to majority-white hospitals, indicating a systemic difference in PEG placement across hospitals.

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Compliance with Ethical Standards

Dr. Gottesman is an Associate Editor for *Neurology*. The authors report no other conflicts of interest. Because NIS data are publicly available and contains no personal identifying information, this study was exempt from institutional review board approval.

Keywords

Health Care Disparities; Minority Health; Gastrostomy; Enteral Nutrition

Introduction

Ischemic stroke is a leading cause of disability in the United States[1]. Dysphagia is a common complication in the acute and subacute phase after stroke, affecting up to 50% of patients. While most patients recover swallowing function in a timely manner, some patients undergo placement of percutaneous endoscopic gastrostomy (PEG) tube.

Although in common use, the utility of PEG tubes after stroke is uncertain[2], and decision-making regarding PEG placement lacks objective and standardized criteria[3]. PEG tubes do not increase quality of life[4], and PEG placement is associated with procedure-related complications in up to 17% of cases. Major life-threatening complications occur in up to 3%[5,6]. In addition, PEG placement after stroke may be associated with increased early readmission rates, poor long-term outcomes, and mortality[7–10].

There is a growing body of evidence suggesting that ethnic/racial minorities have an increased likelihood of receiving a PEG tube after stroke compared to their white counterparts, independent of stroke severity and end-of-life preferences[11–15]. The underlying reasons for these disparities remain unclear, but may include individual (patient and provider) factors, as well as system (hospital) factors. Some hospitals, especially those located in urban neighborhoods, serve a substantially higher proportion of ethnic/racial minority patients, and may differ from hospitals serving predominantly white populations in their organizational structure, availability of equipment and specialists, and funding[16,17], which in turn may contribute to worse health outcomes among patients admitted to minority-serving hospitals[17–20].

There is substantial between hospital variability in the timing and placement rates of PEG tubes after stroke indicating system-level determinants of PEG placement[21,15]; however, it is presently unclear if ethnic/racial differences in PEG utilization are driven by individual characteristics or systemic differences between hospitals serving predominantly white vs. predominantly ethnic/racial minority patients. In order to disentangle the contributions of individual patient ethnicity/race versus hospital ethnic/racial composition as determinants of race disparities in PEG placement after stroke, we sought to determine whether PEG use differs among hospitals serving varying proportions of ethnic/racial minority patients. Similarly, we aimed to explore whether patient-level ethnicity/race disparities in PEG utilization differ depending whether patients are cared for in a hospital that cares for predominantly ethnic/racial minority versus predominantly white stroke patients.

Methods

Data source

Data were obtained from the Nationwide Inpatient Sample (NIS), part of the Healthcare Cost and Utilization Project (HCUP), sponsored by the Agency for Healthcare Research and

Quality[22]. The NIS is the largest all-payer inpatient database in the US, representing a 20% stratified sample of all admissions to non-federal US hospitals. All diagnoses and procedures are recorded using *International Classification of Diseases* version 9 Clinical Modification (ICD9-CM) codes. Because NIS data are publicly available and **contain** no personal identifying information, this study was exempt from institutional review board approval.

Case selection

In NIS, we identified adult cases with primary diagnosis of ischemic stroke by using ICD9-CM codes 433.01, 433.11, 433.21, 433.31, 433.81, 433.91, 434.01, 434.11, 434.91, and 436 between 2007 and 2011[23,24]. Only hospitals with at least 20 annual ischemic stroke admissions were included. Due to significant variability in the timing of real-world PEG placement after stroke[21], we included cases with a length of stay of at least 3 days. We excluded elective admissions and patients enrolled in a clinical trial (ICD9-CM code V70.7). The unit of observation in NIS is discharge after hospitalization. In order to prevent double counting of transferred patients who may have multiple acute care inpatient records pertaining to the same ischemic stroke event, cases transferred to another hospital were excluded while cases “transferred in” were included in our analysis. This algorithm has been shown to identify acute ischemic stroke with high sensitivity and specificity[25–27]. In addition, cases with missing information on ethnicity/race, sex, and age were excluded.

Primary exposures, hospital strata, and outcome of interest

The primary exposures of interest were self-identified minority ethnicity/race (black, Hispanic, Asian/Pacific Islander, Native American, or other), and hospitals serving varying proportions of ethnic/racial minority stroke patients. Hospitals were stratified into 3 groups based on the proportion of ethnic/racial minority patients: hospitals serving predominantly white stroke patients (<25% ethnic/racial minority patients; “majority-white hospitals”); hospitals serving both ethnic/racial minority and white stroke patients (25–50% ethnic/racial minority patients; “racially integrated hospitals”); and hospitals serving predominantly ethnic/racial minority stroke patients (>50% minority patients; “minority-serving hospitals”). Among ischemic stroke admissions, we compared differences in PEG placement between, and by patient ethnicity/race within, hospitals serving predominantly white or predominantly ethnic/racial minority patients. The outcome of interest was PEG placement as identified by ICD9-CM procedure code 43.11.

Comorbidity and severity adjustment

We calculated the Charlson Comorbidity Index, a weighted score of 17 different comorbidities validated for outcome adjustment for analyses of administrative data sets using ICD9-CM codes[28,29], for each patient. Case severity was determined using the All Patient Refined-Diagnosis Related Groups (APR-DRGs), a 4-point ordinal scale (minor, moderate, major, and extreme risk of mortality) derived from age, primary and secondary diagnoses, and procedures[30]. The APR-DRG algorithm is a validated and reliable indicator of mortality, and is commonly used as a severity indicator in studies relating to stroke[31].

Statistical analysis

Clinical and hospital-level characteristics in the different hospital strata were compared using Chi² for categorical variables and Kruskal-Wallis tests for continuous variables. Multivariable logistic regression was performed to determine the association of PEG placement with the various hospital strata, and ethnic/racial differences within strata of majority-white, minority-serving, and racially integrated hospitals. Models were adjusted for age, hospital characteristics (teaching status, bed size, location, region, and annual volume of stroke cases), discharge quarter, weekend admission, modified Charlson Comorbidity Index, APR-DRG severity subclass, insurance status, median household income per patient's ZIP code, hypertension, diabetes mellitus, dyslipidemia, coronary artery disease, peripheral vascular disease, congestive heart failure, atrial fibrillation, valvular disease, anemia, thrombocytopenia, alcohol abuse, drug abuse, chronic kidney disease, dysphagia, tracheostomy, and palliative care/in-hospital death. We used a Generalized Estimation Equations (GEE) approach to account for clustering of patients within hospitals. Statistical analysis was performed using STATA version 13 (*Stata Statistical Software: Release 13*. College Station, TX). A p-value of <0.05 was considered statistically significant. 95% confidence intervals are reported.

Results

Patient characteristics by hospital type

Among the 246,825 cases that met inclusion criteria (Figure 1), 121,557 (49.2%) were treated at 926 majority-white hospitals, 72,927 (29.6%) were treated at 419 racially integrated hospitals, and 52,341 (21.2%) received care at 328 hospitals serving predominantly ethnic/racial minority stroke patients. Patient and hospital characteristics of cases treated in hospitals with varying proportion of ethnic/racial minority patients are summarized in Table 1.

PEG rates are increased in minority-serving and racial integrated hospitals

In majority-white hospitals, the median rate of PEG placement was 3.8 (IQR 1.8–5.9) per 100 stroke admissions, while in racially integrated and minority-serving hospitals the median PEG rates were 5.5 (IQR 3.2–7.8) and 6.6 (IQR 3.9–8.8) per 100 admissions, respectively ($p < 0.001$). Patient-level PEG placement rates were higher in racially integrated and minority-serving hospitals (7.0% and 7.6%, respectively; Table 2) compared to majority-white hospitals (5.3%, $p < 0.001$; Table 2). Compared to majority-white hospitals, the unadjusted odds of PEG were significantly higher for patients presenting to racially integrated hospitals (OR 1.35, 95% CI 1.30–1.40; Table 2) and minority-serving hospitals (OR 1.47, 95% CI 1.41–1.53). In multivariable models adjusted for age, sex, race, insurance status, income, medical comorbidities and complications, and other hospital characteristics, the odds of PEG were higher in racially integrated (OR 1.25, 95% CI 1.13–1.39; Table 2) and minority-serving hospitals (OR 1.24, 95% CI 1.12–1.38), compared to majority-white hospitals. These models were adjusted for individual patient ethnicity/race, suggesting that a stroke patient receiving care at a minority-serving hospital has increased odds of PEG compared to a patient being cared for at a majority-white hospital regardless of individual patient ethnicity/race.

Individual and system contributions to ethnic/racial differences in PEG use

We investigated the odds of PEG in racially integrated and minority-serving hospitals compared to majority-white hospitals stratified by individual patient ethnicity/race (ethnic/racial minority vs. white) in order to determine whether the overall increase in odds of PEG in racially integrated/minority-serving hospitals affects whites and ethnic/racial minority patients equally. Compared to white patients, ethnic/racial minorities had significantly higher odds of PEG in any hospital strata (Figure 2); however, this discrepancy was largest in majority-white hospitals (OR 1.62, 95% CI 1.48–1.76; Figure 2), and smallest in minority-serving hospitals (OR 1.22, 95% CI 1.11–1.33; p for interaction <0.001 ; Figure 2). Ethnic/racial minority patients had similar odds of PEG irrespective of the type of hospital at which they received care (OR 1.08, 95% CI 0.95–1.23 in racially integrated compared to majority-white hospitals, and OR 1.04, 95% CI 0.92–1.18 in minority-serving compared to majority-white hospitals, p for trend 0.730; Table 3). In contrast, white patients had significantly higher odds of PEG in hospitals with increasing proportions of ethnic/racial minorities (OR 1.28, 95% CI 1.15–1.43 in racially integrated, and OR 1.39, 95% CI 1.23–1.57 in minority-serving, compared to majority-white hospitals, p for trend <0.001 ; Table 3 and Figure 2).

Discussion

In the present study we investigated differences in PEG tube placement after ischemic stroke between hospitals serving low and high proportions of minorities. In addition, we determined differences by ethnicity/race within the respective hospitals in order to disentangle individual- from system-level contributions. We show that patients presenting to hospitals serving predominantly ethnic/racial minorities have a higher likelihood of receiving a PEG regardless of individual patient ethnicity/race and other confounders, including end-of-life care. The increase in PEG rates in racially integrated and minority-serving hospitals was mainly driven by higher odds of PEG among whites in those hospitals. This finding may suggest that ethnic/racial differences in the use of PEG tubes after ischemic stroke are insufficiently explained by individual patient-level preference alone, but are in part due to between-hospital variation. Similar observations, albeit with opposite directionality, have been reported in the use of carotid imaging; i.e. carotid imaging has been shown to be underutilized in ethnic/racial minority-serving compared to majority-white hospitals, but both ethnic/racial minority and white patients had lower likelihood of receiving carotid imaging in hospitals serving ethnic/racial minority communities[32].

System-level differences in PEG placement after stroke have been described previously, including variation by hospital location, region, size, and teaching status[12,15]; however, these hospital characteristics were included in our model and are therefore unlikely to explain the observed between-hospital differences in our study. Similarly, annual hospital stroke case volume and individual patient medical complications, including infections, mechanical ventilation, and tracheostomy placement as surrogates for stroke severity were accounted for. The NIS does not contain data on inpatient rehabilitation services, including speech-language pathology (SLP) services. Therefore, we were unable to explore whether hospital-level differences in access to SLP services, including objective swallow testing with

videofluoroscopic swallow studies, may in part explain the observed differences; however, future studies may focus on potential system-level differences in access to SLP care.

The lack of objective guidelines and criteria on PEG after stroke may contribute to variability in PEG placement[3]. Thus, local PEG practices and hospital “culture” may largely be driven by opinion, preferences, and attitudes of the involved stakeholders. Although individual patient preference is typically thought to explain within-hospital rather than between-hospital differences, it is conceivable that the preference of a majority of patients in a given hospital, i.e. the preference of ethnic/racial minority patients in minority hospitals to be more aggressive with regard to PEG tube placement, may influence and dictate the overall practice pattern within that hospital[33–35]. This may explain why the odds of PEG for white patients approach that of ethnic/racial minority patients within minority-serving hospitals. To our knowledge, physician attitudes and practice patterns regarding PEG tubes in stroke care in the US are not known; however, physician ethnicity/race has been reported to determine the likelihood of recommending a PEG in patients with dementia, i.e. ethnic/racial minority physicians are more likely to recommend PEG compared to whites[36]. We did not have information on physician ethnicity/race distributions at the included hospitals, but it is possible that higher representation of ethnic/racial minority providers at minority-serving hospitals contributed to higher PEG placement rates. Since the discrepancy in PEG placement between ethnic/racial minority and white patients was significantly larger in majority-white than in minority-serving hospitals, individual-level factors, including provider bias[37,38], and patient-provider communication behavior[39,40] may be more influential in determining PEG placement in majority-white than in minority-serving hospitals. Since the NIS lacks information on individual patient or provider decision-making, we were unable to directly investigate the contribution of implicit bias, provider attitudes, and individual patient preference to the observed ethnic/racial differences in PEG placement.

In addition to the above mentioned limitations, our analysis is limited by the potential for miscoded and missing data in large administrative datasets reliant on ICD9-CM coding; however, it is unlikely that there is differential miscoding of diagnoses or procedures by ethnicity/race. While ethnicity/race is typically self-reported, it is possible that information captured in the ethnicity/race variable is not entirely accurate. We attempted to mitigate the absence of clinical and physiological stroke data in NIS by adjusting all regression models for the Charlson Comorbidity Index, a validated measure of patient comorbidities in stroke[28,41], as well as medical complications.

Despite these limitations, our data suggest that ethnic/racial differences in PEG placement after stroke are explained by both individual as well as hospital-level factors. Future studies may determine the underlying drivers of the underlying PEG practices in minority-serving hospitals in order to prevent overutilization of PEG tubes. Our study highlights that mere focus on individual-level determinants of care delivery, such as individual preferences and access to care, are insufficient in fully understanding racial differences in procedure utilization after stroke.

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Figure 1.

Flow diagram indicating selection of the study population. *Not mutually exclusive.

Figure 2.

Graphic representation of odds ratios of PEG for ethnic/racial minority versus white patients, stratified by hospitals; white patients in hospitals serving predominantly white patients are the reference. * $p < 0.001$ for comparison of odds of PEG for ethnic/racial minority compared to white patients within each hospital strata; ** p for interaction < 0.001 for comparison of the difference in odds of PEG between ethnic/racial minorities and whites in minority-serving versus majority-white hospitals.

Table 1

Baseline characteristics of the study population stratified by hospitals with varying proportions of ethnic/racial minority patients (n=246,825). APR-DRG: all patient refined diagnosis-related group.

Characteristics	Majority-white hospitals (n=121,557)	Racially integrated hospitals (n=72,927)	Minority-serving hospitals (n=52,341)	p-value
Age – years: median (IQR)	77 (64–84)	73 (61–83)	70 (58–81)	<0.001
Female – n (%)	67,015 (55.1)	39,407 (54.0)	27,710 (52.9)	<0.001
Ethnicity/Race – n (%)				<0.001
White	106,960 (88.0)	46,367 (63.6)	15,329 (29.3)	
Black	8,697 (7.1)	16,459 (22.6)	19,823 (37.9)	
Hispanic	2,782 (2.3)	5,585 (7.6)	10,404 (19.9)	
Asian or Pacific Islander	1,238 (1.0)	2,252 (3.1)	3,226 (6.1)	
Other	1,880 (1.6)	2,264 (3.1)	3,559 (6.8)	
Primary expected payer – n (%)				<0.001
Private Insurance	20,546 (16.9)	13,989 (19.2)	9,255 (17.7)	
Medicare *	88,782 (73.0)	47,451 (65.1)	30,596 (58.5)	
Medicaid **	5,674 (4.7)	5,413 (7.4)	6,909 (13.2)	
Self-pay	4,015 (3.3)	3,763 (5.2)	3,640 (7.0)	
No charge/other	2,397 (2.0)	2,131 (2.9)	1,814 (3.5)	
Median household income for patient ZIP code: quartiles – n (%)				<0.001
Quartile 1	28,842 (23.7)	21,201 (29.1)	21,016 (40.2)	
Quartile 2	33,005 (27.2)	17,127 (23.5)	10,466 (20.0)	
Quartile 3	29,903 (24.6)	15,902 (21.8)	11,090 (21.2)	
Quartile 4	27,573 (22.7)	17,088 (23.4)	8,246 (15.8)	
Hospital region – n (%)				<0.001
Northeast	33,904 (27.9)	9,736 (13.4)	12,673 (24.2)	
Midwest	26,834 (22.1)	5,960 (8.2)	5,155 (9.9)	
South	41,503 (34.1)	41,891 (57.4)	23,388 (44.7)	
West	19,316 (15.9)	15,340 (21.0)	11,125 (21.3)	
Hospital location – n (%)				<0.001
Rural	15,531 (12.8)	3,829 (5.3)	3,153 (6.0)	
Urban	104,937 (86.3)	68,667 (94.2)	48,290 (92.3)	
Teaching Hospital – n (%)	45,887 (37.8)	36,515 (50.1)	32,422 (61.9)	<0.001
Hospital bed size – n (%)				<0.001
Small	12,558 (10.3)	5,160 (7.1)	3,656 (7.0)	
Medium	30,039 (24.7)	16,222 (22.2)	12,665 (24.2)	
Large	77,871 (64.1)	51,114 (70.1)	35,122 (67.1)	
Hospital stroke case volume (cases/yr)				<0.001
Quartile 1	37,528 (30.9)	13,661 (18.7)	10,920 (20.9)	

Characteristics	Majority-white hospitals (n=121,557)	Racially integrated hospitals (n=72,927)	Minority-serving hospitals (n=52,341)	p-value
Quartile 2	29,210 (24.0)	16,971 (23.3)	15,179 (29.0)	
Quartile 3	30,903 (25.4)	19,260 (26.4)	11,524 (22.0)	
Quartile 4	23,916 (19.7)	23,035 (31.6)	14,718 (28.1)	
Charlson comorbidity index				<0.001
1	29,820 (24.5)	17,487 (24.0)	11,677 (22.3)	
2	25,716 (21.2)	15,618 (21.4)	11,353 (21.7)	
3	27,818 (22.9)	16,615 (22.8)	11,389 (21.8)	
4	38,203 (31.4)	23,207 (31.8)	17,922 (34.2)	
Hypertension – n (%)	96,998 (79.8)	58,879 (80.7)	43,768 (83.6)	<0.001
Diabetes Mellitus – n (%)	39,326 (32.4)	25,639 (35.2)	21,402 (40.9)	<0.001
Dyslipidemia – n (%)	58,547 (48.2)	34,749 (47.7)	23,003 (44.0)	<0.001
Coronary artery disease – n (%)	21,087 (17.4)	11,635 (16.0)	7,948 (15.2)	<0.001
Atrial fibrillation – n (%)	33,994 (28.0)	17,818 (24.4)	10,335 (19.8)	<0.001
Valvular disease – n (%)	15,203 (12.5)	7,772 (10.7)	4,493 (8.6)	<0.001
Peripheral vascular disease – n (%)	12,705 (10.5)	6,793 (9.3)	4,286 (8.2)	<0.001
Chronic kidney disease – n (%)	16,399 (13.5)	10,211 (14.0)	7,936 (15.2)	<0.001
Thrombocytopenia – n (%)	2,558 (2.1)	1,640 (2.3)	1,087 (2.1)	0.054
Alcohol abuse – n (%)	4,572 (3.8)	3,005 (4.1)	2,449 (4.7)	<0.001
Drug abuse – n (%)	1,638 (1.4)	1,750 (2.4)	2,032 (3.9)	<0.001
APR-DRG: loss of function				<0.001
Minor	6,853 (5.6)	4,341 (6.0)	3,534 (6.8)	
Moderate	54,072 (44.5)	31,663 (43.4)	23,398 (44.7)	
Major	48,168 (39.6)	28,141 (38.6)	18,645 (35.6)	
Extreme	12,464 (10.3)	8,782 (12.0)	6,764 (12.9)	

* Medicare is a US government-run federal health insurance program for people aged 65 and above, and for those with severe disabilities

** Medicaid is a federal and state health insurance program for low-income people in the US

Table 2

Rates and odds of PEG among patients presenting to hospitals serving varying proportions of ethnic/racial minority stroke patients.

Variable	N	PEG N (%)	Unadjusted OR (95% CI)	Adjusted* OR (95% CI)
All	246,825	15,432 (6.3)		
Hospital Strata				
Majority-white	121,557	6,392 (5.3)	1.00 (ref)	1.00 (ref)
Racially integrated	72,927	5,070 (7.0)	1.35 (1.24–1.47)	1.25 (1.13–1.39)
Minority-serving	52,341	3,922 (7.6)	1.47 (1.36–1.60)	1.24 (1.12–1.38)

* Models were adjusted for age, sex, ethnicity/race, hospital characteristics (teaching status, bed size, location, region, and annual volume of stroke cases), discharge quarter, weekend admission, modified Charlson Comorbidity Index, APR-DRG severity subclass, insurance status, median household income per patient's ZIP code, hypertension, diabetes mellitus, dyslipidemia, coronary artery disease, peripheral vascular disease, congestive heart failure, atrial fibrillation, valvular disease, anemia, thrombocytopenia, cancer, alcohol abuse, drug abuse, chronic kidney disease, mechanical ventilation, pneumonia, urinary tract infection, sepsis, gastrointestinal bleeding, deep vein thrombosis, pulmonary embolism, dysphagia, tracheostomy, and palliative care/in-hospital death.

Table 3

Adjusted odds ratios of PEG in majority-white, racially integrated, and minority-serving hospitals stratified by patient ethnicity/race.

Variable	Adjusted OR of PEG (95% CI)	p-value	p for trend
White patients			<0.001
Majority-white hospitals	1 (ref)		
Racially integrated hospitals	1.28 (1.15–1.43)	<0.001	
Minority-serving hospitals	1.39 (1.23–1.57)	<0.001	
Ethnic/racial minority patients			0.730
Majority-white hospitals	1 (ref)		
Racially integrated hospitals	1.08 (0.95–1.23)	0.217	
Minority-serving hospitals	1.04 (0.92–1.18)	0.499	