Changes in Patterns of Racial Disparities in Attending Low-Mortality Hospitals and Outcomes among Patients with Stroke

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Aim: This exploratory study evaluates patterns of care relative to frequency of admission to high quality hospitals and mortality risk for patients with stroke among varying ethnic groups.

Methods: Information from 273,532 adult patients with stroke was abstracted from the 2000 and 2006 National Inpatient Sample. Race/ethnicity was categorized as White, African American, Hispanic/Latino, or Asian/Pacific Islander. Hospitals were ranked based on the risk-adjusted overall stroke mortality rate and then divided into four groups based on the quartiles of the ranking. Changes in disparities in attending the four groups of hospitals across race/ethnicity from 2000 to 2006 were examined. Disparities in mortality risk among patients in four racial/ethnic groups were also examined.

Results: In 2006 as compared to 2000, African American and Hispanic/Latino patients were increasingly likely to be admitted to high-quality hospitals. Disparities related to outcomes did not vary in a predictable manner during this period. Relatively low likelihood of admission to high-quality hospitals persisted among Asian/Pacific Islanders.

Conclusions: Multiple efforts related to expanded access to care may have contributed to greater likelihood of admission to high-quality hospitals for African American and Hispanic patients, but these efforts do not seem to have affected Asian/Pacific Islander patients. Further research is needed to explore mechanisms for improving outcomes in high-risk populations. Policies should continue to support healthcare quality improvement efforts that have shown positive effects on outcomes of patients of all racial/ethnic groups. Programs that help Asian/Pacific Islander patients to identify and attend high-quality hospitals should also be encouraged. (*Ethn Dis*. 2011;21(2):135-141)

Key Words: Stroke, Race, Mortality, Hospital, Outcomes

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Introduction

Cerebrovascular disease and stroke are the leading causes of long-term disability in the United States. Each year about 795,000 Americans will have a new or recurrent stroke,[1] and the more than 700,000 hospital admissions attributed to stroke-related illnesses[2] make it one of the deadliest and most costly diseases in America. Stroke claimed 137,000 lives in 2006, making it the third leading cause of mortality.[3] The cost of care for stroke was approximately $50 billion in 2009. Once this figure was adjusted for indirect costs, the total rose to $69 billion.[1] Recent trends demonstrate decreasing death rates for White and Black stroke patients since 1950. The disease, however, continues to account for significant morbidity and mortality among all populations including ethnic minorities. As the third leading cause of death in the United States, age-adjusted stroke mortality rates for Whites, African Americans, Hispanics, and Asian/Pacific Islanders were 41.7, 67.1, 34.2, and 37.0 per 100,000 population in 2006, respectively.[3,4]

Hospital-level quality indicators relate to clinical outcomes.[5,6] To assess the quality of hospital care, the Agency for Health Care Research and Quality (AHRQ) recommends using disease or clinical condition-specific, risk-adjusted, hospital mortality rates (eg, mortality rates of acute myocardial infarction mortality, stroke, and pneumonia) as inpatient care quality indicators.[7] Outcome research in some clinical areas has reported applications of these quality indicators. Sarrazin and colleagues, using data from Medicare patients with acute myocardial infarction, found that the risk of admission to high-mortality hospitals was 35% higher for Blacks than for Whites in markets with high residential segregation.[8] Popescu and colleagues reported that Black Medicare patients undergoing coronary artery bypass grafting (CABG) were equally or more likely to be admitted to top-ranked hospitals but that Black patients living in socially disadvantaged zip codes were less likely to receive care at top-ranked hospitals and more likely to bypass top-ranked hospitals located closer to their residence as compared with their White counterparts.[9] Nevertheless, although these studies observed racial disparities related to admission to high-quality hospitals, none has focused on stroke. We hypothesized that, in the case of stroke, minority patients were less likely to be admitted to high-quality hospitals due to limited access related to unfavorable socioeconomic status.[10] In addition, none of the studies assessed outcomes longitudinally.

Notable disparities in other areas combined with limited existing knowledge in stroke dictate the need for further investigation. By including four major ethnic groups (ie, White, African American, Hispanic/Latino, and Asian/

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Pacific Islander) in the United States using a nationally representative dataset, this study examined patterns of racial/ethnic disparities as reflected by admission to high-quality hospitals as well as outcomes represented by hospital mortality among all patients with stroke. Further, potential changes in those patterns were also examined. Findings of our study can aid in prioritizing areas for policy interventions to eliminate racial disparities and improve the health care of the nation at large.

METHODS

Data

We analyzed data from the 2000 and 2006 National Inpatient Sample (NIS). The unit of analysis was hospital discharge. The NIS is the largest all-payer inpatient care database approximating a 20% stratified sample of US community hospitals. It is maintained by the Healthcare Cost and Utilization Project (HCUP) under AHRQ. The principal diagnosis based on the International Classification of Disease – Clinical Modification, 9th Revision (ICD-CM-9) codes 430–438 were used to identify patients with stroke. Further, intracerebral hemorrhagic stroke (ICD-9 code 431) and ischemic stroke including occlusion of cerebral arteries (ICD-9 code 434) and acute, ill defined cerebral vascular disease (ICD 9 code 436) were identified for examining stroke outcomes.[11–13] Hemorrhagic and ischemic stroke were chosen for analysis of clinical outcomes because both entities have common factors that affect outcomes, such as severity of impairment at time of presentation,[14–16] delays between symptom onset and presentation to the hospital,[17,18] and distinct impacting factors, such as intensity of services provided at the point of care for hemorrhagic stroke and extent of control of certain comorbidities for ischemic stroke.[16,19] By looking at patterns of care for each clinical entity, potential contributors to disparities within different aspects of the healthcare system can be identified.

Several exclusionary criteria were applied to make our analysis more valid. Discharges with transient cerebral ischemia (TIA) were first excluded because the early resolution of findings makes this entity inappropriate for outcome-based analysis of health care quality. In addition, discharges that were transferred from another hospital were excluded to avoid double counting discharges in the NIS. Finally, we excluded patients whose length of hospital stay was zero because those patients were more likely to have been transferred to another facility or to have died shortly after arrival.[13] Our final sample was composed of 273,532 adult patients (aged ≥18 years) with stroke in 2000 and 2006 including 12,090 patients with intracerebral hemorrhage and 86,599 patients with ischemic stroke.

Measures

Our main dependant variable, quality of hospital stroke care, was measured by a four-level ordinal variable. It was determined by the Inpatient Quality Indicators (IQIs) that belong to the family of the Healthcare Cost and Utilization Project Quality Indicators (HCUP QIs).[7] These indicators produce hospital-based rates that represent outcome measures such as mortality and complications. Based on complex multivariable techniques, two methods were used: 1) restricted definitions of patient subgroups to isolate homogeneous at-risk populations; and 2) standardized definitions for diverse populations. We created the level of quality of hospital stroke care in two steps. First, we ran the IQIs software (provided by AHRQ) to obtain the overall risk-adjusted stroke mortality rate (ie, IQI 17) for each hospital. Hospitals with fewer than 30 stroke cases each year were excluded due to less reliable mortality rates.[7] Then we ranked the mortality rate, from which a four-level (1–4) ordinal variable was created based on the quartile values of the risk-adjusted mortality rates of the hospitals. The value of "1" was assigned to hospitals in the bottom quartile (eg, lowest mortality rates), "2" was assigned to hospitals in the 25th–50th, and so on. For sensitivity analysis, to verify the level of the hospital quality indicator, we also grouped the hospitals into three groups: top third, middle third, and bottom third. Results were consistent with respect to the relationship between race/ethnicity and level of quality indicator regardless of whether the four-level or three-level ordinal system was used.

In conventional logistic regression, the response variable is a dichotomous variable. When the response variable has more than two values (eg, 1, 2, 3, or 4), multinomial logistic regression is usually applied for measuring the association between independent variables and multiple outcome values. The odds ratio in multinomial logistic regression can be interpreted as the ratio of odds of an event occurring for one group as opposed to another group. For example, assume hospitals' quality is grouped as four levels from 1 to 4 (response variable) and we are interested in comparing attending hospitals with *better* quality (eg, quartile 3 vs quartile 2 or quartile 2 vs quartile 1) between racial groups (ie, African American vs White as the reference group). An odds ratio of 0.50 means that the odds of attending hospitals with better quality for African American patients are half of the odds for White patients.

In addition to quality of hospital stroke care, we examined in-hospital mortality because stroke has relatively high in-hospital mortality. Mortality was defined as a dichotomous variable with a value of "1" indicating that the patient died while in the hospital and a value of "0" indicating that the patient was discharged alive. Due to the significant mortality difference, mortal-

Table 1. Patients' sociodemographic characteristics by race and year*

	All Patients	White	African American	Hispanic/ Latino	Asian/Pacific Islander	*P* value
Year 2000						
Age at admission, mean (SE), by years	71.9 (13.1)	73.2(12.5)	66.3(14.8)	67(14.8)	69.9(13.6)	<.0001
Age group						<.0001
18–39	1.9	1.4	4.0	4.6	2.7	
40–49	4.6	3.6	9.6	8.6	5.8	
50–59	10.9	9.4	18.6	15.4	12.2	
60–69	18.9	18.0	22.9	22.8	21.8	
70–79	32.2	33.5	24.9	27.8	32.5	
≥ 80	31.5	34.2	19.9	20.9	25.0	
Female	54.9	54.4	60.6	52.6	48.7	<.0001
Insurance status						<.0001
Medicare	71.5	75.3	58.4	53.7	49.1	
Medicaid	4.5	2.5	11.8	14.5	14.6	
Private insurance	19.9	19.4	22.3	20.2	28.5	
Uninsured	2.6	1.6	5.7	7.7	5.8	
Other insurance	1.5	1.3	1.9	3.9	2.0	
Year 2006						
Age at admission, mean (SE), by years	70.8 (14.1)	72.4(13.4)	64.6(14.8)	66.7(15.3)	69.9(14.2)	<.0001
Age group						<.0001
18–39	2.3	1.6	4.3	5.2	2.7	
40–49	6.1	4.6	12.0	9.3	6.6	
50–59	13.6	11.6	22.3	16.1	14.7	
60–69	19.6	18.8	22.6	21.9	19.5	
70–79	27.0	28.4	20.8	25.1	27.8	
≥80	31.4	29.9	18.0	22.4	28.9	
Female	53.5	53.0	57.9	51.8	51.0	<.0001
Insurance status						<.0001
Medicare	68.1	72.4	55.4	54.2	58.6	
Medicaid	5.6	3.0	12.5	15.4	13.6	
Private insurance	20.2	20.2	21.6	17.8	19.1	
Uninsured	4.0	2.7	7.7	8.6	5.4	
Other insurance	2.1	1.7	2.8	4.0	3.3	

* Data are expressed as percentage unless otherwise indicated.

ity of intracerebral hemorrhagic stroke and occlusion of cerebral arteries or ill-defined stroke, both representing acute stroke, were analyzed separately. Further, we applied more exclusion criteria when analyzing mortality. In other words, we excluded 25.4% of the patients with any secondary diagnostic codes that were likely to be associated with potentially confounding clinical conditions relative to mortality, identified by another study.[13]

We focused on two independent variables, the year and race. The year was a dichotomous variable with a value of "1" indicating 2006 and a value of "0" indicating 2000. We categorized patients' ethnicity as White, African American, Hispanic or Asian/Pacific Islander, based on patients' self-reported information provided by the data source.

Analytical techniques

Multivariate analysis based on the generalized linear model (GLIMMIX) including the usual fixed effects for regressors and random effects was applied to examine the relationship between the independent variables and the dependent variables. The random cluster effect was used to take into account the cluster effect of discharges within the hospital. We included a set of covariates at both the patient and the hospital levels in the multivariable model. At the patient level, we controlled for patient sociodemographics, such as age, sex, and health insurance status. Age was divided into 18–44, 45–54, 55–64, 65–74, 75–84, and 85 and older groups to create a meaningful interval in the generalized linear mixed model. Health insurance status was categorized as Medicare, Medicaid, uninsured, or privately insured including HMO/prepaid health plans. The interaction terms between year and race were created to examine the time effects for each racial group. Patient mix was controlled by including a set of 29 co-

Table 2. Patients' hospitalization characteristics by race and year*

	All Patients	White	African American	Hispanic/ Latino	Asian/ Pacific Islander	*P* value
Year 2000						
Admitted to a small hospital	11.1	11.6	8.3	8.6	16.5	<.0001
a median hospital	26.1	25.4	28.8	30.2	26.2	
a large hospital	62.8	63.0	62.9	61.2	57.4	
Admitted to a public hospital	9.1	8.0	12.3	17.2	12.5	<.0001
a NFP hospital	79.2	81.0	76.0	61.7	73.1	
a FP hospital	11.7	11.0	11.7	21.1	14.4	
Admitted to a teaching hospital	37.7	35.3	49.8	40.5	53.8	<.0001
Admitted to a rural hospital	13.9	15.2	10.6	5.2	6.5	<.0001
Admitted to a top quality hospital						
Bottom quartile mortality rate (top hospital)	12.5	13.2	10.2	10.4	6.8	<.0001
2nd quartile mortality rate	26.4	27.4	26.7	15.6	15.7	
3rd quartile mortality rate	34.7	34.5	32.8	41.7	34.1	
Top quartile mortality rate (bottom hospital)	26.4	24.9	30.3	32.4	43.4	
Length of stay, mean (SE), day	5.3(6.8)	5(6.1)	6.6(8.2)	6(8.5)	7.5(3.9)	<.0001
Total charges, mean (SE), $	16,802(29,278)	15,563(26,410)	20,187(34,320)	24,010(43,063)	28,230(48,891)	<.0001
Discharge status equals death	5.9	5.7	6.5	6.6	9.9	<.0001
Year 2006						
Admitted to a small hospital	13.2	13.5	12.4	11.0	16.7	<.0001
a median hospital	24.7	25.1	24.3	21.0	25.4	
a large hospital	62.1	61.3	63.3	68.1	57.9	
Admitted to a public hospital	10.2	10.2	9.4	9.9	17.1	<.0001
a NFP hospital	76.4	76.3	75.5	75.2	75.6	
a FP hospital	13.4	13.0	15.2	15.0	7.3	
Admitted to a teaching hospital	45.7	43.1	57.4	47.6	53.9	<.0001
Admitted to a rural hospital	11.2	13.0	8.2	2.6	3.6	
Admitted to a top quality hospital						
Bottom quartile mortality rate (top hospital)	5.2	5.5	3.9	5.6	3.8	<.0001
2nd quartile mortality rate	40.5	38.8	46.7	47.9	32.3	
3rd quartile mortality rate	42.0	41.8	41.0	42.1	54.4	
Top quartile mortality rate (bottom hospital)	12.2	13.9	8.4	4.5	9.5	
Length of stay, mean (SE), day	4.9(6.8)	4.5(5.7)	6.4(9.1)	5.9(8.7)	6.7(10.2)	<.0001
Total charges, mean (SE), $	30,393(45,132)	27,693(39,520)	35,343(54,857)	41,828(60,154)	47,660(70,206)	<.0001
Discharge status equals death	5.2	5.1	5.1	6.0	8.5	<.0001

* Data are expressed as percentage unless otherwise indicated.

morbid conditions, developed by AHRQ, such as neurologic impairment (eg, coma, paralysis), heart attack, congestive heart failure, diabetes, renal failure, hypertension, and depression.[20] At the hospital level, we controlled for volume of hospital admissions for stroke due to a potential positive relationship between volume and outcomes.[21] Other hospital characteristics controlled in multivariable analysis included bed size (in 100s), type of hospital ownership (ie, public, not-for-profit private, investor-owned), teaching hospital status, urban/rural location, and geographic region (Northeast, Midwest, South, and West). Finally, when analyzing the relationship between racial groups and mortality, quality of hospital stroke care also served as one of the covariates.

RESULTS

Unadjusted patients' sociodemographic characteristics are listed in Table 1. Minimal changes were noted between 2000 and 2006. Minority patients were much younger with higher proportions of patients who were uninsured or covered by Medicaid as compared to their white counterparts.

Patients' hospitalization characteristics are displayed in Table 2. From 2000 to 2006, percentages of patients admitted to small hospitals increased for all racial groups except for Asian/Pacific Islanders. Percentages of those admitted to large hospitals for Hispanics increased sizably, and percentages of patients admitted to public hospitals

Table 3. Changes in relationships between race/ethnicity and attending hospitals with better quality: 2000–2006

Level of Hospital Mortality Rate (Quartiles 1–4)	White	African American	Hispanic/Latino	Asian/Pacific Islander
		Odds Ratio [95% CI]	Odds Ratio [95% CI]	Odds Ratio [95% CI]
All stroke (*N*=273,532)				
In 2000	1.00	0.76[0.74, 0.79]	0.52[0.50, 0.55]	0.51[0.48, 0.56]
In 2006	1.00	1.31[1.27, 1.35]	1.25[1.19, 1.29]	0.88[0.82, 0.95]
Intracerebral hemorrhagic stroke (*n*=12,090)				
In 2000	1.00	0.84[0.71, 0.98]	0.59[0.48, 0.72]	0.68[0.53, 0.87]
In 2006	1.00	1.21[1.03, 1.42]	1.42[1.17, 1.72]	0.88[0.69, 1.12]
Occlusion of cerebral arteries (*n*=86,599)				
In 2000	1.00	0.77[0.73, 0.82]	0.56[0.52,0.61]	0.56[0.49, 0.63]
In 2006	1.00	1.18[1.11, 1.25]	1.17[1.08, 1.26]	0.96[0.84, 1.09]

CI: confidence interval

declined markedly for African Americans and Hispanics but increased for Whites and Asians. In 2000, White patients had a significantly higher percentage of admissions to top hospitals (13.2%) than African American (10.2%), Hispanic (10.4%), and Asian (6.8) patients; while White patients had significantly lower percentages of admissions to lower ranked hospitals (24.9%) than other racial groups, with 30.3%, 32.4%, and 43.4%, respectively. By 2006, however, percentages of admissions to top hospitals were significantly higher for White and African American patients (5.5% and 5.6%, respectively) than Hispanic and Asian patients (3.9% and 3.8%, respectively) while percentages of admissions to lower ranked hospitals (13.9%) for White patients was the highest among all racial groups. As for unadjusted hospital mortality, Asian/Pacific Islander, African American and Hispanic patients showed significantly higher rates (9.9%, 6.5% and 6.6%, respectively) than White patients (5.7%) in 2000, and Asian patients demonstrated the highest rate (8.5%) in 2006 (Table 2). Unadjusted mortality rates declined from 2000 to 2006 for all racial groups with White patients having the lowest rate and Asian/Pacific Islander patients having the highest.

Results of the generalized linear model are shown in Table 3. In 2000, all three minority groups showed lower odds of admission to better hospitals as compared to their White counterparts with odds ratios (ORs) and their 95% confidence intervals (CIs) being 0.76 [0.74, 0.79] for African Americans, 0.52 [0.50, 0.55] for Hispanics/Latinos, and 0.51 [0.48, 0.56] for Asians/Pacific Islanders. In 2006, all three minority groups showed improvement in attending better hospitals. As compared to their White counterparts, both African Americans and Hispanic/Latinos were more likely to be admitted to better hospitals (OR [CI], 1.31 [1.27, 1.35] for African Americans and 1.25 [1.19, 1.29] for Hispanics/Latinos) while Asians/Pacific Islanders were slightly less likely to be admitted to better hospitals (OR [CI], 0.88 [0.82, 0.95]). Furthermore, results of intracerebral hemorrhagic stroke and ischemic stroke were consistent with or even better than those of all stroke patients; all three minority groups showed higher or equivalent odds of being admitted to better hospitals as compared to their White counterparts. (Table 3)

As for in-hospital mortality, all racial/ethnic groups showed comparable mortality odds except that Hispanic/Latinos showed lower odds than White

Table 4. Changes in relationships between race/ethnicity and hospital mortality: 2000–2006

Died in Hospital	White	African American	Hispanic/Latino	Asian/Pacific Islander
		Odds Ratio [95% CI]	Odds Ratio [95% CI]	Odds Ratio [95% CI]
Intracerebral hemorrhagic stroke (*n*=12,090)				
In 2000	1.00	0.97[0.82, 1.15]	0.71[0.56, 0.89]	1.15[0.88, 1.50]
In 2006	1.00	0.92[0.76, 1.11]	0.92[0.73, 1.15]	0.96[0.71, 1.30]
Occlusion of cerebral arteries (*n*=86,599)				
In 2000	1.00	0.93[0.77, 1.11]	0.93[0.77,1.11]	0.97[0.75, 1.26]
In 2006	1.00	0.81[0.70, 0.93]	1.12[0.94, 1.34]	1.10[0.82, 1.48]

patients in 2000 (OR=0.71 [CI:0.56, 0.89]) for intracerebral hemorrhage stroke and African Americans showed lower odds than White patients in 2006 (OR=0.81 [CI: 0.70, 0.93]) for occlusion of cerebral arteries (Table 4).

DISCUSSION

Patterns of admissions to higher ranked hospitals for patients with stroke changed significantly from 2000 to 2006. Minority patients compared to White patients were less likely to be admitted to better quality hospitals in 2000. Similar results based on the 1997 to 2000 data for patients with other conditions have been reported in other studies.[22] However, by 2006, all minority groups, except Asian/Pacific Islanders, became more likely to be admitted to better quality hospitals than White patients. Although it does not seem to be clear what might be the main reason for this pattern change, the possibility of increased likelihood of admission to academic medical centers as a result of growth in academically affiliated Community Health Centers has to be considered a potential contributing factor.[23] As our findings indicate, public hospitals continued having poorer rankings in mortality rate from 2000 to 2006. During this period, both African Americans and Hispanic/Latino groups, relatively speaking, became less likely to be admitted to these institutions. On the other hand, Asian/Pacific Islanders seemed to become more likely to be admitted to public institutions during this time period. Further, as teaching hospitals demonstrated progressively higher quality rankings, as compared to their non-teaching counterparts, and as mortality trends for Whites, African Americans, and Latinos improved concomitantly with an increased likelihood of admission to these institutions between 2000 and 2006, the possibility that this trend contributed to the observed declines in mortality must be considered noting that increases in likelihood of admission to teaching institutions was shared by Asian/Pacific Islanders. Similar differences between these groups were noted with respect to admissions to small and investor-owned hospitals, both of which demonstrated favorable outcomes with respect to mortality, with increases in admissions to these institutions noted among White, African American, and Hispanic populations and unchanged rates among Asian/Pacific Islanders during the study period. Finally, the percentage of Hispanic/Latino patients in attending large hospitals increased sizably as the large hospitals became more likely to be high-quality hospitals from 2000 to 2006.

By 2006, all minority groups, except Asian/Pacific Islanders, became more likely to be admitted to better quality hospitals than White patients.

As we see that stroke mortality has declined in recent years, most likely resulting from multiple factors including greater technological sophistication and quality improvement efforts (eg, attending hospitals with better quality),[24,25] minority patients with stroke may have benefited equally comparably to White patients due to multiple national efforts directed toward reducing and eliminating racial disparities in health and health care.[22,26–28] For occlusion of cerebral arteries, much improved disparities in mortality risk between African American patients and White patients in 2006 as compared to those in 2000 might indicate that African American patients benefited even more than Whites from the above factors. That the similar finding did not show for patients with intracerebral hemorrhagic stroke was probably due to limited effective clinical interventions for the case of intracerebral hemorrhagic stroke.

The usual limitations of using administrative data apply here. First, we only used the risk-adjusted mortality to rank the hospitals. Future studies may use other indicators (eg, 24 hour availability of brain imaging including radiological expertise in 'stroke imaging' in the hospital and antithrombotic therapy, ie, antiplatelet medication within ≤48 hours after stroke onset) to rank hospitals to verify the findings of this study.[29] Second, we were unable to analyze subgroups within some racial/ethnic groups. For example, Puerto Ricans, Mexicans, and Cubans are quite different socioeconomically and socially. The same argument applies for Asian/Pacific Islander populations that are quite different subgroups.[30]

In conclusion, African American and Hispanic/Latino patients became increasingly more likely to be admitted to better quality hospitals in 2006 as compared to 2000 while Asian/Pacific Islander patients experienced no improvement and persistent disparities in this area. Further research is needed to achieve a better understanding of underlying factors contributing to disparities, in addition to the quality of the admitting hospital. In addition, further research is needed to understand reasons for persistent disparities relative to admission to high-quality hospitals among Asian/Pacific Islander patients with stroke and whether this population has benefited appropriately from national initiatives geared toward improving quality. Policies should continue to support healthcare quality improvement efforts that have shown positive effects on outcomes of patients of all racial/ethnic groups. Both public and private programs should be encouraged for helping Asian/Pacific Islander patients to identify and attend high-quality hospitals.

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Design concept of study: Shen
Acquisition of data: Shen
Data analysis and interpretation: Shen, Lu
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Statistical expertise: Lu
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