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Ethnic comparison of 30-day potentially preventable readmissions after stroke in Hawaii

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Abstract

Background and Purpose—Ethnic disparities in readmission after stroke have been inadequately studied. We sought to compare potentially preventable readmissions (PPR) among a multiethnic population in Hawaii.

Methods—Hospitalization data in Hawaii from 2007-2012 were assessed to compare ethnic differences in 30-day PPR following stroke-related hospitalizations. Multivariable models using logistic regression were performed to assess the impact of ethnicity on 30-day PPR after controlling for age group (<65, ≥65 years), sex, insurance, county of residence, substance use, history of mental illness and Charlson Comorbidity Index (CCI).

Results—Thirty-day PPR was seen in 840 (8.4%) of 10,050 any stroke-related hospitalizations, 712 (8.7%) of 8,161 ischemic stroke hospitalizations, and 128 (6.8%) of 1,889 hemorrhagic stroke hospitalizations. In the multivariable models, only the Chinese ethnicity, compared to whites, was associated with 30-day PPR after any stroke hospitalizations (OR [95% CI]: 1.40 [1.05, 1.88]) and ischemic stroke hospitalizations (1.42 [1.04, 1.96]). When considering only one hospitalization per individual, the impact of Chinese ethnicity on PPR after any stroke hospitalization (1.22 [0.89, 1.68]) and ischemic stroke hospitalization (1.21 [0.86, 1.71]) were attenuated. Other factors associated with 30-day PPR after any stroke hospitalizations were CCI [per unit increase] (1.21 [1.18, 1.24]), Medicaid (1.42 [1.07, 1.88]), Hawaii county (0.78 [0.62, 0.97]), and mental illness (1.37 [1.10, 1.70]).

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Conflict of Interest/Disclosure: None

Conclusion—In Hawaii, Chinese may have a higher risk of 30-day PPR after stroke compared to whites. However, this appears to be driven by the high number of repeated PPR within the Chinese ethnic group.

Keywords

Stroke; Patient Readmission; Minority Health

Subject Terms

Cerebrovascular Disease / Stroke; Complications; Quality and Outcomes; Race and Ethnicity

Introduction

Potentially preventable hospital readmissions (PPR) within 30 days are the focus of recent national initiatives towards the goal of improving quality of care and reducing health care costs.[1, 2] Stroke is an important condition to target in this effort since it affects approximately 795,000 people each year in the United States,[3] and as many as 14% of stroke patients are readmitted within 30 days after the initial hospitalization.[4, 5] Although not all readmissions are considered “potentially preventable,” stroke patients who are readmitted within 30 days have higher mortality and incur greater healthcare costs than patients who were not readmitted.[6] Therefore, recent research and practice have devoted considerable attention to identify and appropriately intervene on stroke patients who are at high risk for PPR.

Overall, ethnic minorities have been shown to have higher rates of potentially preventable hospitalizations in conditions such as diabetes, congestive heart failure, myocardial infarction, and pneumonia compared to whites.[7-11] In some of the stroke-specific studies, ethnic minorities have also been shown to have higher rates of 30-day readmission after stroke compared to non-Hispanic whites.[12, 13] However, the reported impact of ethnicity on 30-day readmission after stroke has been inconsistent[14] and remains unclear. Furthermore, there is paucity of data on stroke readmissions that have disaggregated Pacific Islanders from Asian Americans. Prior studies suggested that Asian Americans may have a lower rate of rehospitalization after stroke compared to non-Hispanic whites.[15] However, Asian Americans, Native Hawaiians and other Pacific Islanders in Hawaii have high burden of cardiovascular disease,[16] and may have poorer access to health care compared to whites.[17] Therefore, they may be at higher risk for 30-day PPR after stroke. We hypothesized that Native Hawaiians and other Pacific Islanders have higher rates of 30-day PPR compared to whites.

Methods

We received approval from the University of Hawaii Institutional Review Board to conduct a retrospective study using Hawai'i Health Information Corporation (HHIC) inpatient data from 2007 to 2012. HHIC cleans and compiles discharge data from all hospitalizations in Hawaii by all payers, and the data set includes specific race/ethnicity, insurer, age, sex,

International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9) primary diagnosis, secondary diagnosis, and procedure codes.

All stroke-related hospitalizations by any individual aged ≥18 years from December 2007 to 2012 were initially identified (n=14,882). Stroke as a discharge diagnosis in the primary position was identified through ICD-9 codes as follows: ischemic stroke (433.01, 433.11, 433.21, 433.31, 433.81, 433.91, 434.01, 434.11, 434.91, or 436.00) and hemorrhagic stroke (430.00 or 431.00). We compared PPR following any stroke (ischemic or hemorrhagic stroke), ischemic stroke, and hemorrhagic stroke. Hospitalizations at Tripler Army Medical Center (the Department of Defense hospital) (n=286) were excluded since these hospitalizations did not report detailed Asian and Pacific Islander racial/ethnic data during the study period. Hospitalizations were also excluded if they otherwise did not report race/ethnicity data (n=287) or if they were not a resident of Hawaii since they would likely return to their home following the initial hospitalization and would not be followed in Hawaii (n=776). Hospitalizations that were not eligible to be considered for avoidable readmissions based on the 3M methods[18] were also excluded (n=2,067). These excluded hospitalizations consisted of patients who died during the index stay (stroke hospitalization) or those for some conditions, such as terminal cancer, for which readmissions are due to complex and/or extremely severe clinical factors and are unlikely to be avoidable given current technology. As a result, a total of 11,466 eligible hospitalizations were obtained (77.0% of total stroke hospitalizations). Some of these hospitalizations included multiple stroke visits by the same patient. Therefore, if a stroke patient had more than one stroke visit, only the initial visit was included as the index hospitalization. For the final analysis, a total of 10,050 stroke patients' data were used. As we focused on the primary reason for hospitalization to identify stroke, patients could not be diagnosed with both ischemic and hemorrhagic stroke during the same initial hospitalization.

Race/ethnicity

The primary purpose of the study was to compare the prevalence of 30-day PPR after stroke across race/ethnic groups using HHIC race/ethnicity classifications. Only one primary race/ethnicity is reported by all hospitals from patient self-report at intake, with the six largest groups (Native Hawaiian, Japanese, Filipinos, Chinese, other Pacific Islander, and white) accounting for 90% of the population. All other races as well as mixed-race individuals who did not choose one primary racial/ethnic classification were included in the “other” group. Whites were the reference group for the comparative analyses.

Control variables

The following factors were selected a priori to be included in the multivariable models: age (continuous), age group (<65; 65+), sex, co-morbidity, defined by the Charlson Comorbidity Index (CCI),[19] substance abuse, mental illness, insurance (Department of Defense, Medicare, Medicaid, Private, and Other), and location of residence by county (Hawaii, Kauai, Maui and Oahu). Our models also accounted for discharge year and clustering in the 18 hospitals represented in the study sample.

Outcome variable

Thirty-day PPR rate following a stroke hospitalization was the outcome variable, identified using 3M's PPR methodology, that identifies readmissions considered potentially preventable, adjusting for clinically relevant factors.[18] PPRs were used to measure re-hospitalizations across any hospital in Hawai'i. The 3M's PPR method is extensively validated.[18] Among hospitalizations that are eligible to have potentially avoidable readmissions, the PPR method creates admission chains of the number of avoidable admissions clinically related to that stay. An index hospitalization can have 0, 1, or more 30-day preventable admissions following, which is called a readmission chain. This study analysis focused on one potential stroke-related PPR chain per unique individual. For those with a stroke-related PPR during the study period, the first stroke-related hospitalization with a PPR was used as the index hospitalization. For those with no stroke-related PPR, the first stroke-related visit in the study period was used as the index hospitalization.

The identification of avoidable readmissions from an index hospitalization is based on the clinical portrait for that specific index hospitalization type.[18] For instance, a hospitalization for recurrent stroke, pneumonia, septicemia, pulmonary edema/respiratory failure, heart failure, seizure, hypovolemia & related electrolyte disorders, and renal failure within 30 days of an initial hospitalization for stroke would be considered a potentially avoidable readmission. In contrast, a hospitalization for elective extracranial vascular procedures (i.e. carotid revascularization), acute myocardial infarction, cardiac arrhythmia, and various cardiac procedures within 30 days of a stroke hospitalization would not be considered an avoidable readmission. In the Hawaii data, which identifies unique individuals, chains are measured across all hospitals and across years to track all subsequent hospitalizations.

Statistical Analysis

Our analysis had three parts. First, characteristics of patients with and without 30-day PPR were summarized by descriptive statistics and compared by type using Chi-squared tests or Fisher's exact tests (for categorical variables) and analysis of variance (ANOVA) or non-parametric Kruskal-Wallis tests, if the normality assumption was not satisfied (for continuous variables). Second, using all hospitalizations following the first stroke-related index admission of each individual (including the index visit and any 30-day PPRs following in a chain), a logistic regression model was developed to estimate the likelihood of PPR after any stroke, ischemic stroke and hemorrhagic stroke separately. Finally, we considered the PPR analysis at the level of the index visit in which, from each index hospitalization, patients could only have one PPR-related outcome (yes or no, based on whether they had 1 or more PPR=yes or 0 PPR=no following the index admission). This removed repeated PPR per patients from the analyses and focused the analysis at the level of the index visit.

For both sets of multivariable models, hospital clustering was adjusted by using Generalized Estimating Equations (GEE) for the logistic regression model. Multivariable adjusted odds ratios (OR) and their 95% confidence intervals were obtained. All data analyses were performed in SAS 9.3 (Cary, N.C., 2011). A two-tailed p-value of less than 0.05 was regarded as statistically significant. Since the positive predictive value of classifying stroke patients may vary based on the use of the primary or any position of the discharge diagnosis

code(s),[20] we performed sensitivity analyses by comparing the ethnicity factor in the multivariable models after selecting patients with stroke in any position of the discharge diagnoses.

Results

Clinical characteristics of 10,050 stroke patients (27.5% Japanese, 24.0% white, 15.4% Filipino, 13.1% Native Hawaiian, 9.6% other race, 5.8% Chinese, and 4.6% other Pacific Islander) are shown in Table 1. Thirty-day PPR was seen in 840 (8.4%) of 10,050 any stroke-related hospitalizations, 712 (8.7%) of 8,161 ischemic stroke hospitalizations and 128 (6.8%) of 1,889 hemorrhagic stroke hospitalizations. A list of the top 15 All Patients Refined Diagnosis Related Groups (APR DRG) for 30-day PPR following a stroke hospitalization is shown in Table 2.

In bivariate analyses, no ethnic differences in 30-day PPR were seen after any stroke, ischemic stroke and hemorrhagic stroke. Age group was associated with 30-day PPR in any stroke and ischemic stroke patients but not in hemorrhagic stroke patients. Those with 30-day PPR were more likely to be above 65 years compared to those without 30-day PPR after any stroke and ischemic stroke. Thirty-day PPR was significantly different among insurance types. Those with Medicaid were more likely to have 30-day PPR compared to those with private insurance after any stroke and ischemic stroke. There were significant differences in the location of residence for 30-day PPR. County of Oahu (urban island) had higher prevalence of 30-day PPR compared to other counties (rural islands) after any stroke and ischemic stroke. CCI was significantly associated with 30-day PPR in all three conditions (P values <0.0001).

In the multivariable models predicting the likelihood of 30-day PPR (including repeated PPRs) (Table 3), only Chinese ethnicity, compared to whites, was associated with 30-day PPR after any stroke and ischemic stroke hospitalizations. Other factors associated with 30-day PPR were CCI, Medicaid, Hawaii county, and mental illness.

In the multivariable models at the level of the index visit (Table 4), none of the ethnic groups were associated with 30-day PPR. In this model, younger age (<65 years) was associated with lower risk of PPR. Medicaid was no longer significantly associated with PPR. Hawaii county and Maui county (compared to Oahu county) had a lower risk of 30-day PPR. Substance use and CCI were associated with 30-day PPR.

The Hosmer-Lemeshow's goodness-of-fit test showed that both sets of regression models for any stroke, ischemic stroke and hemorrhagic strokes fit the data well (P value >0.05 for all). In the sensitivity analyses using stroke in any position of the discharge, Chinese ethnicity was no longer a significant predictor of 30-day total PPR (OR [95% CI]: 0.87 [0.62, 1.22]) nor was Chinese ethnicity significant in the PPR index visit-level multivariable analyses (OR [95% CI]: 0.96 [0.73, 1.26]).

Discussion

In this large statewide sample, we compared the 30-day PPR after stroke among multiethnic populations in Hawaii. Overall, our study showed that only a small proportion (8.4%) of stroke discharges were readmitted for potentially “preventable” causes according to the 3M definition, which is consistent with a prior study in a different population.[21] The results of our first multivariable model (including multiple PPRs arising from the first stroke admission) suggests that Chinese ethnicity is associated with higher risk of 30-day PPR compared to whites. However, when considering analyses at the level of the index hospitalization (removing multiple PPRs), the impact of ethnicity was attenuated.

The findings from our second multivariable model suggest that there are no significant ethnic differences in the proportion of patients with a 30-day PPR after stroke. The findings from our first model, however, suggests that Chinese have a higher prevalence of patients with multiple PPR within 30-days from the initial stroke admission compared to whites.

Based on our anecdotal clinical experience, there is a high number of non-English speaking Chinese patients who are re-hospitalized with a chief complaint of worsening or fluctuation of the recent stroke symptoms without having another separate stroke event. These patients may be re-hospitalized, perhaps repeatedly to the same or to different hospitals, partially due to their language barriers and inability to accurately describe their concerns in the Emergency Department. This is consistent with a prior study that demonstrated language barrier to be a significant contributor of readmission among Chinese and Latino ethnic groups even after accounting for socioeconomic factors and comorbidities.[22] Furthermore, we have clinically observed a number of Chinese stroke patients who decide to not take the newly prescribed medications and prefer to use the traditional Chinese herbal medicine after discharge, which is consistent with a prior study that showed 25% medication nonadherence rate for antihypertensive medications among Chinese immigrants in San Francisco Bay Area, and their preference for Chinese herbs over Western medications.[23] However, our speculations among the Chinese population in Hawaii need to be substantiated by a further study.

Contrary to our hypotheses, 30-day PPR following stroke was not significantly higher among the Native Hawaiians and other Pacific Islanders compared to whites. In other chronic conditions such as diabetes and congestive heart failure, ethnic disparities in potentially preventable hospitalizations have been shown among Native Hawaiians and other Pacific Islanders in Hawaii.[8-11] The ethnic differences in conditions such as diabetes and congestive heart failure could be explained by the disparities in high-quality primary care since acute exacerbation of these conditions could potentially be prevented with intensive primary care management with frequent monitoring. Unfortunately, many of the post-stroke complications (i.e. recurrent stroke, aspiration pneumonia, urinary tract infection, feeding tube site infection, falls, etc.) are often difficult to prevent despite having adequate, high-quality primary care access, which may explain the lack of significant ethnic differences among Native Hawaiians and other Pacific Islanders.

In the multivariable model, CCI,[19] a frequently used comorbidity score based on factors predicting ten-year mortality, was the strongest clinical predictor of 30-day PPR. As expected, the presence of mental illness, which has been associated with higher rates of readmission after other medical conditions,[24, 25] was also an independent predictor of 30-day PPR. Interestingly, residence on a more rural island compared to the island of Oahu, was associated with a lower rate of 30-day PPR. More urban Oahu was chosen as the reference county based on the assumption that access to care is often worse on the other islands and that Oahu has the only tertiary primary stroke center with presumably better quality of inpatient stroke care. The reason for this apparent geographical association is unclear and bears further investigation. It is possible that residents of more rural islands have the tendency to not return to the hospitals for less major medical issues.

Strengths of our study include the large sample size of over 10,000 stroke-related hospitalizations, the detailed race and ethnicity information on this diverse multiethnic population, which allowed disaggregation of Pacific Islanders from the Asians and further disaggregation of each Asian ethnicity from each other, and the population-based aspect of our sample that includes all stroke admissions in Hawaii that met our inclusion criteria. However, there are some limitations to the study. Although the most common APR DRG for 30-day PPR are shown, the administrative database lacked clinical documentation that specified the exact reasons for readmissions. The database also lacked specific neuroimaging data such as the presence of new restricted diffusion lesion on readmissions to determine the presence of new stroke. Also, the database lacked information on post-discharge medication adherence, which would have allowed us to better determine the reasons for higher 30-day PPR among the Chinese who were hospitalized for stroke. Furthermore, stroke-specific measures such as stroke severity (i.e., NIH Stroke Scale) and the discharge disability level (i.e., modified Rankin Scale) were not available in this administrative data set. Similarly, specific occurrence of medical complication during the initial hospitalization (i.e., neurogenic urinary retention requiring indwelling Foley catheter, aspiration event, poorly controlled diabetes, or congestive heart failure) was not adequately captured in the database and were thus not included in our models.

Conclusions

In Hawaii, Chinese patients may have a higher rate of 30-day PPR compared to white patients after stroke. However, this observation appeared to be driven by the high number of repeated PPR visits following an index stroke admission by individuals in this ethnic group. A similar ethnic difference was not observed among Native Hawaiians and other Pacific Islanders, the ethnic groups who have been shown to have higher rates of potentially preventable hospitalizations in other medical conditions. This study emphasizes the concept that disparities patterns by ethnicity are not always the same across all medical conditions; and highlights the importance of exploring for the possibility of unexpected inequitable outcomes that may exist in an understudied, multiethnic community.

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Table 1

Clinical characteristics

	All Stroke (n=10,050)			Ischemic (n=8,161)			Hemorrhagic (n=1,889)		
	No PPR	**Have PPR**	**P value**	**No PPR**	**Have PPR**	**P value**	**No PPR**	**Have PPR**	**P value**
Number of patients	9,210	840		7,449	712		1,761	128	
Race			0.1705			0.1485			0.0781
Chinese	520 (89.7%)	60 (10.3%)		402 (89.5%)	47 (10.5%)		118 (90.1%)	13 (9.9%)	
Filipino	1,421 (91.6%)	130 (8.4%)		1,084 (91.0%)	107 (9.0%)		337 (93.6%)	23 (6.4%)	
Native Hawaiian	1,201 (91.3%)	114 (8.7%)		1,010 (91.7%)	91 (8.3%)		191 (89.3%)	23 (10.7%)	
Japanese	2,538 (92.0%)	221 (8.0%)		2,015 (91.3%)	192 (8.7%)		523 (94.7%)	29 (5.3%)	
Other Pacific Islander	414 (89.0%)	51 (11.0%)		341 (87.9%)	47 (12.1%)		73 (94.8%)	4 (5.2%)	
Other Race	892 (92.2%)	75 (7.8%)		714 (92.4%)	59 (7.6%)		178 (91.8%)	16 (8.2%)	
White	2,224 (92.2%)	189 (7.8%)		1,883 (91.8%)	169 (8.2%)		341 (94.5%)	20 (5.5%)	
Age Group			0.0001			0.0009			0.1082
<65	3,276 (93.1%)	242 (6.9%)		2,473 (92.8%)	193 (7.2%)		803 (94.2%)	49 (5.8%)	
65+	5,934 (90.8%)	598 (9.2%)		4,976 (90.6%)	519 (9.4%)		958 (92.4%)	79 (7.6%)	
Sex			0.2581			0.3382			0.4339
Female	4,516 (91.3%)	429 (8.7%)		3,616 (91.0%)	359 (9.0%)		900 (92.8%)	70 (7.2%)	
Male	4,694 (91.9%)	411 (8.1%)		3,833 (91.6%)	353 (8.4%)		861 (93.7%)	58 (6.3%)	
Insurance			<.0001			0.0006			0.1523
Department of Defense	103 (96.3%)	4 (3.7%)		89 (95.7%)	4 (4.3%)		14 (100%)	0 (0%)	
Medicaid/Quest	835 (90.8%)	85 (9.2%)		642 (89.9%)	72 (10.1%)		193 (93.7%)	13 (6.3%)	
Medicare	5,634 (90.8%)	572 (9.2%)		4,726 (90.6%)	492 (9.4%)		908 (91.9%)	80 (8.1%)	
Other	341 (95.3%)	17 (4.7%)		249 (95.4%)	12 (4.6%)		92 (94.8%)	5 (5.2%)	
Private Insurance	2,297 (93.4%)	162 (6.6%)		1,743 (93.0%)	132 (7.0%)		554 (94.9%)	30 (5.1%)	
County			0.0058			0.0091			0.421
Hawaii	1,195 (93.2%)	87 (6.8%)		987 (92.7%)	78 (7.3%)		208 (95.9%)	9 (4.1%)	
Kauai	450 (92.0%)	39 (8.0%)		352 (91.9%)	31 (8.1%)		98 (92.5%)	8 (7.5%)	
Maui	855 (93.8%)	57 (6.3%)		697 (93.8%)	46 (6.2%)		158 (93.5%)	11 (6.5%)	
Oahu	6,710 (91.1%)	657 (8.9%)		5,413 (90.7%)	557 (9.3%)		1,297 (92.8%)	100 (7.2%)	

	All Stroke (n=10,050)			Ischemic (n=8,161)			Hemorrhagic (n=1,889)		
	No PPR	**Have PPR**	**P value**	**No PPR**	**Have PPR**	**P value**	**No PPR**	**Have PPR**	**P value**
Substance Use			0.3879			0.098			0.6126
No	8,757 (91.7%)	793 (8.3%)		7,157 (91.4%)	675 (8.6%)		1,600 (93.1%)	118 (6.9%)	
Yes	453 (90.6%)	47 (9.4%)		292 (88.8%)	37 (11.2%)		161 (94.2%)	10 (5.8%)	
Mental Illness			0.187			0.2889			0.3821
No	8,341 (91.8%)	749 (8.2%)		6,745 (91.4%)	636 (8.6%)		1,596 (93.4%)	113 (6.6%)	
Yes	869 (90.5%)	91 (9.5%)		704 (90.3%)	76 (9.7%)		165 (91.7%)	15 (8.3%)	
	Mean	**SD**		**Mean**	**SD**		**Mean**	**SD**	
Age	70.5 ± 15.4	72.6 ± 14.6	0.0002	71.4 ± 14.9	73.2 ± 14.3	0.0018	66.5 ± 16.7	69.1 ± 15.7	0.1062
Charlson Comorbdity Index	3.49 ± 2.38	4.56 ± 2.67	<.0001	3.62 ± 2.41	4.64 ± 2.66	<.0001	2.95 ± 2.16	4.13 ± 2.72	<.0001

Table 2

Top 15 All Patients Refined Diagnosis Related Groups (APR DRG) for 30-day PPR

Rank	APR DRG	Description	Frequency	%
1	45	CVA & PRECEREBRAL OCCLUSION W INFARCT	263	26.57
2	720	SEPTICEMIA & DISSEMINATED INFECTIONS	81	8.18
3	137	MAJOR RESPIRATORY INFECTIONS & INFLAMMATIONS	77	7.78
4	44	INTRACRANIAL HEMORRHAGE	60	6.06
5	194	HEART FAILURE	49	4.95
6	58	OTHER DISORDERS OF NERVOUS SYSTEM	35	3.54
7	139	OTHER PNEUMONIA	33	3.33
8	47	TRANSIENT ISCHEMIA	32	3.23
9	460	RENAL FAILURE	24	2.42
10	463	KIDNEY & URINARY TRACT INFECTIONS	21	2.12
11	253	OTHER & UNSPECIFIED GASTROINTESTINAL HEMORRHAGE	20	2.02
12	53	SEIZURE	17	1.72
13	420	DIABETES	16	1.62
14	133	PULMONARY EDEMA & RESPIRATORY FAILURE	15	1.52
15	204	SYNCOPE & COLLAPSE	15	1.52

Table 3

Multivariable Analyses for total 30-day PPR

		All Stroke			Ischemic			Hemorrhagic		
Variable		**OR**	**95% CI**		**OR**	**95% CI**		**OR**	**95% CI**	
Race	Chinese	1.40	1.05	1.88	1.42	1.04	1.96	1.34	0.62	2.90
	Filipino	1.19	0.94	1.50	1.25	0.97	1.61	0.92	0.49	1.74
	Native Hawaiian	1.03	0.80	1.33	0.96	0.73	1.26	1.43	0.72	2.84
	Japanese	1.01	0.82	1.25	1.07	0.86	1.33	0.75	0.40	1.43
	Other Pacific Islander	1.04	0.72	1.51	1.09	0.74	1.60	0.64	0.21	2.01
	Other Race	1.00	0.75	1.36	1.00	0.72	1.38	0.99	0.46	2.12
	White	Ref			ref			Ref		
Age group	<65	0.89	0.66	1.18	0.87	0.63	1.19	0.99	0.51	1.91
	65+	Ref			ref			Ref		
Sex	Female	1.06	0.92	1.22	1.06	0.91	1.23	1.15	0.78	1.68
	Male	Ref			ref			Ref		
Insurance	Department of Defense	0.62	0.24	1.58	0.54	0.19	1.53	1.14	0.13	9.72
	Medicaid/Quest	1.42	1.07	1.88	1.42	1.04	1.95	1.30	0.66	2.58
	Medicare	1.10	0.82	1.46	1.04	0.76	1.43	1.31	0.68	2.51
	Other	0.80	0.50	1.30	0.81	0.47	1.40	0.86	0.30	2.47
	Private Insurance	Ref			ref			Ref		
County	Hawaii	0.78	0.62	0.97	0.81	0.64	1.03	0.58	0.30	1.13
	Kauai	0.98	0.70	1.36	0.95	0.65	1.39	1.09	0.53	2.22
	Maui	0.78	0.58	1.05	0.76	0.55	1.05	0.99	0.51	1.92
	Oahu	Ref			ref			Ref		
Substance Use	Yes	0.70	0.48	1.02	0.79	0.52	1.22	0.50	0.22	1.13
	No	Ref			ref			Ref		
Mental Illness	Yes	1.37	1.10	1.70	1.81	1.17	2.82	1.65	0.98	2.80
	No	Ref			ref			Ref		
CCI	1 unit increase	1.21	1.18	1.24	1.17	1.12	1.22	1.24	1.16	1.33

Table 4

Multivariable Analyses by index admission for having a 30-day PPR following a stroke-related index admission

		All Stroke			Ischemic			Hemorrhagic		
Variable		**OR**	**95% CI**		**OR**	**95% CI**		**OR**	**95% CI**	
Race	Chinese	1.22	0.89	1.68	1.21	0.86	1.71	1.44	0.68	3.05
	Filipino	1.06	0.88	1.29	1.08	0.89	1.30	1.11	0.60	2.06
	Native Hawaiian	0.97	0.82	1.16	0.88	0.69	1.13	1.71	0.91	3.24
	Japanese	0.97	0.74	1.27	1.02	0.79	1.30	0.79	0.44	1.44
	Other Pacific Islander	1.21	0.84	1.73	1.26	0.94	1.70	0.69	0.22	2.22
	Other Race	0.94	0.59	1.50	0.87	0.54	1.40	1.39	0.69	2.78
	White	Ref			ref			Ref		
Age group	<65	0.73	0.59	0.91	0.69	0.53	0.91	1.06	0.55	2.03
	65+	Ref			ref			Ref		
Gender	Female	1.07	0.95	1.22	1.07	0.90	1.27	1.20	0.83	1.75
	Male	Ref			ref			ref		
Payer	Department of Defense	0.61	0.25	1.48	0.66	0.27	1.57	NA	NA	NA
	Medicaid/Quest	1.22	0.97	1.52	1.24	0.99	1.56	1.04	0.51	2.10
	Medicare	0.98	0.80	1.20	0.91	0.71	1.17	1.39	0.71	2.73
	Other	0.79	0.60	1.06	0.74	0.51	1.09	1.07	0.40	2.86
	Private Insurance	Ref			ref			ref		
County	Hawaii	0.83	0.77	0.89	0.86	0.78	0.94	0.62	0.30	1.27
	Kauai	1.02	0.73	1.43	0.96	0.67	1.38	1.35	0.64	2.82
	Maui	0.76	0.68	0.84	0.70	0.60	0.83	1.12	0.59	2.15
	Oahu	Ref			ref			ref		
Substance Use	Yes	1.31	1.07	1.60	1.54	1.24	1.93	0.80	0.38	1.65
	No	Ref			ref			ref		
Mental Health	Yes	1.17	0.97	1.42	1.16	0.94	1.44	1.18	0.66	2.11
	No	Ref			ref			ref		
CCI	1 unit increase	1.19	1.15	1.23	1.19	1.15	1.22	1.22	1.13	1.31