Testing Hospital-level Acute Ischemic Stroke 30-day Mortality & Readmission Measures in California All-Payer Data

Submitted By Yale New Haven Health Services Corporation – Center for Outcomes Research and Evaluation (YNHHSC/CORE)

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Introduction

The Centers for Medicare & Medicaid Services (CMS) has developed hospital 30-day risk-standardized mortality and readmission measures for patients hospitalized for acute ischemic stroke. The measures were developed for Medicare fee-for-service (FFS) beneficiaries aged 65 years and older. In response to request by the National Quality Forum's Neurology Steering Committee, Yale New Haven Health Services Corporation – Center for Outcomes Research and Evaluation (YNHHSC/CORE), has assessed whether CMS' stroke mortality and readmission measures can be applied to and perform well in an all-payer patient population of adults aged 18 years and older. In this report, we detail our approach to addressing this question and present the findings.

The mortality and readmission measures employ administrative data, and are calculated using hierarchical logistic regression models to account for the clustering of observations within hospitals and differences in the number of admissions across hospitals. For risk adjustment, patient comorbidities are identified through claims data from each index hospitalization, and from inpatient and outpatient Medicare claims during the 12 months prior to the index hospitalization. The measure development process in the Medicare FFS population is available in the detailed methodology reports for each measure.

The results of the present analysis support expanding the stroke mortality and readmission measures' patient population to include both non-FFS Medicare patients aged 65+ years and all-payer patients aged 18-64 years. Based on the results presented below, we conclude that CMS' risk-standardized mortality and readmission rates (RSMR and RSRR) for acute ischemic stroke perform well when applied to all-payer data (all patients aged 18+ years). For each measure, model testing demonstrated both strong patient-level model performance and consistent hospital-level results.

Methods

Data Source: For our analyses, we used 2006 all-payer data from California. California is a diverse state, and, with more than 37 million residents, California represents 12% of the US population. We used the California Patient Discharge Data (CPD Data), a large database of patient hospital admissions. Records are linked by a unique patient identification number, allowing us to determine patient history from previous hospitalizations and to evaluate rates of both readmission and mortality (via linking with California vital statistics records). In 2006, there were approximately 3 million adult discharges from more than 450 non-Federal acute care hospitals.

Using all-payer data from California as well as CMS Medicare FFS data for California hospitals, we performed analyses to determine whether the stroke measures can be applied to all adult patients, including FFS Medicare patients aged 65+, non-FFS Medicare patients aged 65+, and patients aged 18-64 years at the time of admission. The stroke models developed in Medicare FFS 65+ patients use inpatient and outpatient data for risk adjustment (consistent with CMS' publicly reported mortality and readmission measures for acute myocardial infarction (AMI), heart failure (HF), and pneumonia[1-6]).

To determine whether the measures can be used in all-payer data, the following questions must be addressed:

Question 1: Given that outpatient claims are not available in the all-payer dataset, how do the current CMS models perform when using only admission claims data (i.e., hospital claims for admitted patients)? That is, does the exclusion of outpatient claims data adversely affect measure performance and results at the patient level and at the hospital level?

Question 2: When applied to all patients 18 years and older (18+), do the models perform well both at the patient level and at the hospital level? That is, at the patient level, do the models, when derived in the full 18+ population, have good discrimination, predictive ability, and model fit across patient subgroups? In addition, when new patients are added, do potential differences in the effect of risk factors across patient subgroups affect risk prediction at the patient level and risk profiling at the hospital level?

Question 1 analyses: Limiting risk-adjustment data to inpatient claims

In testing other administrative claims-data measures developed in Medicare FFS data, including mortality and readmission measures for acute myocardial infarction (AMI), heart failure, pneumonia and chronic obstructive pulmonary disease (COPD), we have validated both the accuracy of the CPD Data in capturing Medicare claims as well as the use of only inpatient data for risk adjustment. We also found that, although the prevalence of most risk factors is lower when using only inpatient claims data, the magnitude of effect for most risk factors was similar when comparing the models that use all patient history data with those using only admission claims data. Over 95% of patients were in a similar risk category (defined as being in the same or adjacent category) regardless of risk-adjustment dataset, and the integrated discrimination improvement values were relatively low (ranging from -0.001 for COPD readmission, to 0.005 for COPD mortality). For all measures, the c-statistic was also qualitatively similar between the two approaches (the greatest difference in c-statistic between inpatient only versus all patient history data risk adjustment models was 0.012 for AMI mortality). Moreover, when comparing the models using full history data with a model using only inpatient claims data, hospital-level risk-standardized rates were highly correlated (ICCs ranged 0.978 for COPD readmission to 0.986 for COPD mortality[7]). Based on this reassuring data across measures, we did not repeat these analyses for the stroke mortality and readmission measures, but rather assumed that inpatient claims data would provide adequate risk adjustment information for application of the measures in all-payer data.

Question 2 analyses: Can the models be used in all-payer patient population of adults 18 years and older?

To address the main question of how well the models perform when applied to all patients 18+, we used the CPD Data. Specifically, using 2006 data, we created measure cohorts with up to one year of hospital admission claims history and 30-day follow-up data. For both measures, we:

1. Created the patient cohort using the CMS measure inclusion and exclusion criteria (with the exceptions of including all patients 18+ and dropping the hospice exclusion for the mortality measures), and compared the FFS 65+, non-FFS 65+, and 18-64 year-old patient subgroups with respect to the distribution of risk factors and the crude outcome rate.
2. Fit the model in all patients 18+ and: (i) examined overall model performance in terms of the c-statistic; (ii) compared performance (c-statistic, predictive ability) across the patient subgroups (FFS 65+, non-FFS 65+, all 65+, and all-payer 18-64); and (iii) compared the distribution of Pearson residuals (model fit) across the patient subgroups.

3. Fit the model separately in each patient subgroup and compared odds ratios (ORs) associated with the risk factors to assess differences in magnitude or direction of ORs among the subgroups.

To determine whether the relationship between each risk factor and the outcome differed for those aged 65 years and older (65+) vs. 18-64 year olds (18-64) in ways that would affect measure results, we:

1. Fit the model in all patients 18+ and tested interaction terms between age (65+ vs. 18-64) and each of the other risk factors.
2. Fit the model in all patients 18+ with interaction terms and compared performance (c-statistic, predictive ability) across the patient subgroups.
3. Fit the model in all patients 18+ with and without interaction terms and (i) conducted a reclassification analysis to compare risk prediction at the patient level; (ii) compared the c-statistic; and (iii) compared hospital-level risk-standardized rates (scatterplot and ICC) to assess whether the model with interactions is statistically different from the current model in profiling hospital rates.

All patient-level models were estimated using a logistic regression model; next, hospital-level RSMR and RSRR analyses were conducted using a hierarchical logistic regression model approach.

Results

Can the models be used in all-payer patient population of adults 18 years and older?

1. The stroke mortality and readmission cohorts are presented in Figure 1a-Figure 1b respectively. As the results in Table 1a-Table 1b indicate, for each measure, there are some differences in the risk factor profile and crude outcome rate among patient subgroups. In general, the prevalence of risk factors was similar in FFS 65+ and non-FFS 65+ patients. When comparing risk factor prevalence estimates between those 65+ and younger patients aged 18-64, frequencies were generally either lower in the younger cohort or similar between the groups. For some risk factors, including major cancers, and extensive paralysis, odds ratio estimates were in fact higher in younger than in older patients (Table 1a-Table 1b). As expected, the crude mortality rate was substantially lower in the younger cohort (Table 1a); however, crude readmission rates were nearly identical across the patient subgroups (Table 1b).
2. Nevertheless, when the current models were applied to all patients 18+, overall discrimination was good (c-statistic= 0.753 for stroke mortality and 0.623 for stroke readmission) (Table 2a-Table 2b). There was also good discrimination and predictive ability in all subgroups of patients (Table 3a-Table 3b). For the stroke readmission measure, predictive ability was observed to be greater in newly added younger patients aged 18-64 years than those aged 65+ years; in addition, the c-statistic was significantly higher in younger patients than in older patients (Table 3b). Moreover, for both measures, the distribution of Pearson residuals was comparable across the patient subgroups (Table 4a-Table 4b).
3. For both measures, ORs were generally similar for FFS 65+ and non-FFS 65+ patients. For some risk factors, there were differences in magnitude of effect between younger and older patients (Table 5a-Table 5b).

4. For each measure, few significant age-by-risk-factor interaction terms were found (Table 6a-Table 6b).
5. Nevertheless, inclusion of the interaction terms did not substantively change the level of discrimination and predictive ability across the patient subgroups (Table 7a-Table 7b).
6. In addition, when comparing patient risk classifications for each measure with and without interaction terms, the reclassification analysis demonstrated good patient-level risk prediction across measures: for all measures and all patient subgroups, nearly 100% of patients were in a similar risk category (defined as being in the same or adjacent category) regardless of risk-adjustment strategy, and the IDI values were relatively small in magnitude (Table 8a-Table 8b). Moreover, the c-statistic was nearly identical with and without interaction terms (0.758 vs. 0.753, respectively, for stroke mortality and 0.627 vs. 0.623, respectively, for stroke readmission) (Table 10a-Table 10b). Finally, when comparing each measure with and without interaction terms, the hospital-level risk-standardized rates estimated by the two models were highly correlated (ICC= 0.998 for stroke mortality and ICC= 0.998 for stroke readmission) (Figure 2a-Figure 2b).

Conclusions

Based on the results presented above, we conclude that CMS' stroke mortality and readmission measures perform well when applied to all-payer data (all patients aged 18+ years). Although there are some statistically significant age-by-risk-factor interaction terms, we do not recommend changing the model variables (with the exception of the slight modification of changing "age-65" to fully continuous age), as the inclusion of the interactions did not substantively affect either patient-level model performance or hospital-level results. We have demonstrated that the models can be applied to all patients aged 18+ years and that they perform well when using only admission claims data to determine patient history. Thus, based on these results, the measure specifications could be modified to include the 18+ population and to allow for the use of admission claims only for risk adjustment when complete claims history (i.e., outpatient data) is unavailable.

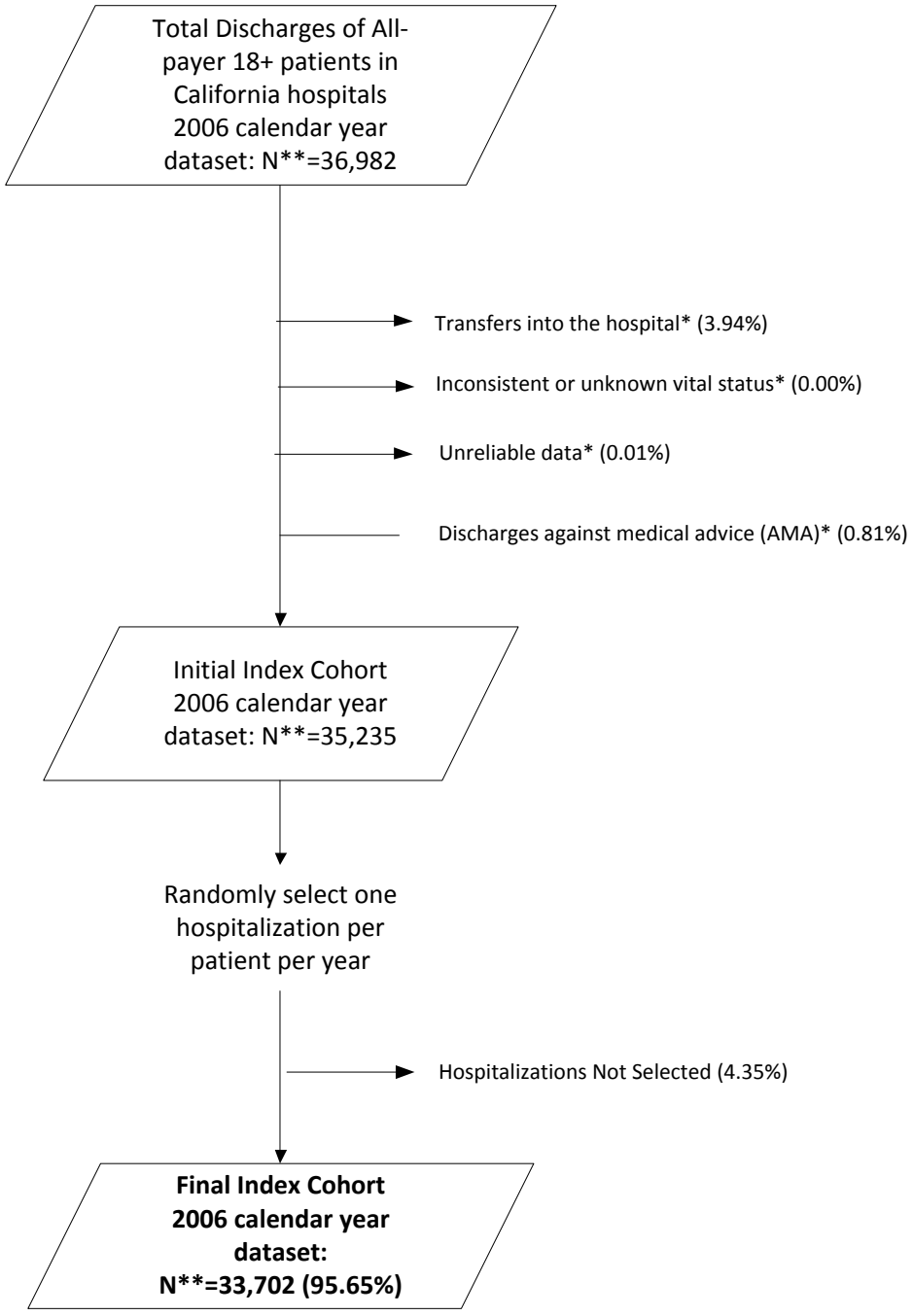
The California Patient Discharge Data have some limitations. Data on previous admissions and 30-day readmissions are available only from California hospitals; however, it is unlikely that a high proportion of patients sought hospital inpatient care outside the state given that relatively few California residents live in cities bordering other U.S. states. Likewise, linked data on 30-day mortality outside the hospital are available only for deaths in California. Moreover, although we were able to test how the measures perform without the use of outpatient data for risk adjustment in the FFS Medicare 65+ population, we were not able to do the same for non-FFS Medicare 65+ patients and younger patients aged 18-64 years given the lack of outpatient claims in the all-payer hospital discharge database. However, had the testing been possible, it is unlikely to have altered the conclusions, as all other testing demonstrated comparability between FFS Medicare and non-FFS Medicare patients aged 65+ years. In addition, given the generally lower rates of health care utilization in younger adults, lack of outpatient claims for those aged 18-64 years would be less likely to have substantively affected their subgroup results than for those aged 65+ years.

In summary, CMS's stroke measures – hospital 30-day RSMR and RSRR for acute ischemic stroke– perform well when used in all-payer data (all patients aged 18+ years). For each measure, model testing demonstrated both strong patient-level model performance and consistent hospital-level results.

References

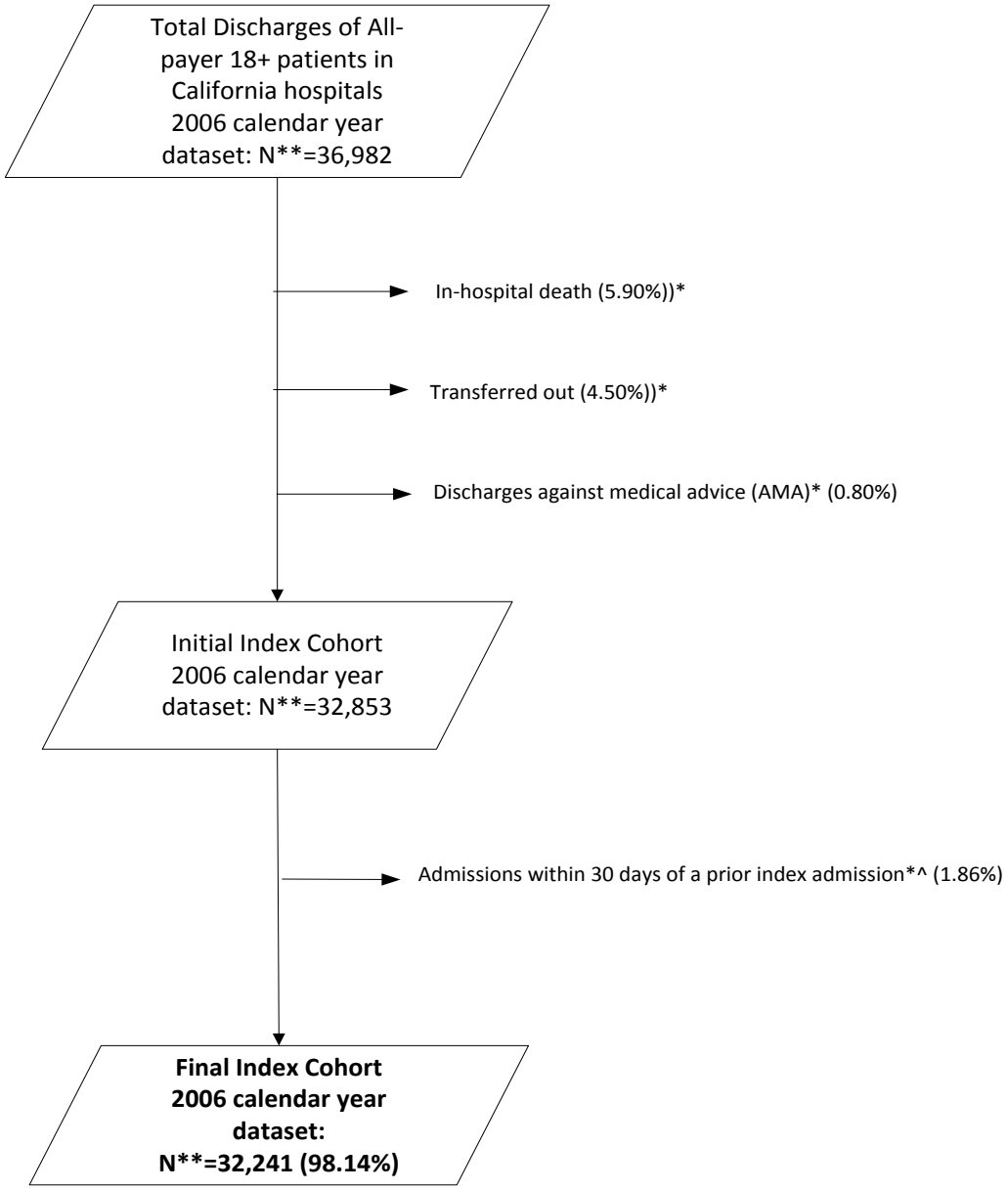
1. Krumholz HM, Wang Y, Mattera JA, Wang Y-F, Han LF, Ingber MJ, Roman S, Normand SL. An administrative claims model suitable for profiling hospital performance based on 30-day mortality rates among patients with an acute myocardial infarction. Circulation. 2006 Apr 4;113(13):1683-92.
2. Krumholz HM, Lin Z, Drye EE, Desai MM, Han LF, Rapp MT, Mattera JA, Normand SL. An administrative claims measure suitable for profiling hospital performance based on 30-day all-cause readmission rates among patients with acute myocardial infarction. Circulation: Cardiovascular Quality and Outcomes. 2011 Mar 1;4(2):243-52.
3. Krumholz HM, Wang Y, Mattera JA, Wang Y-F, Han LF, Ingber MJ, Roman S, Normand SL. An administrative claims model suitable for profiling hospital performance based on 30-day mortality rates among patients with heart failure. Circulation. 2006 Apr 4;113(13):1693-701.
4. Keenan PS, Normand SL, Lin Z, Drye EE, Bhat KR, Ross JS, Schuur JD, Stauffer BD, Bernheim SM, Epstein AJ, Wang Y-F, Herrin J, Chen J, Federer JJ, Mattera JA, Wang Y, Krumholz HM. An administrative claims measure suitable for profiling hospital performance on the basis of 30-day all-cause readmission rates among patients with heart failure. Circulation: Cardiovascular Quality and Outcomes. 2008 Sep;1(1):29-37.
5. Bratzler DW, Normand SL, Wang Y, O'Donnell WJ, Metersky M, Han LF, Rapp MT, Krumholz HM. An administrative claims model for profiling hospital 30-day mortality rates for pneumonia patients. Public Library of Science One. 2011 Apr 12;6(4):e17401.
6. Lindenauer PK, Normand SL, Drye EE, Lin Z, Goodrich K, Desai MM, Bratzler DW, O'Donnell WJ, Metersky ML, Krumholz HM. Development, validation, and results of a measure of 30-day readmission following hospitalization for pneumonia. Journal of Hospital Medicine. 2011 Mar;6(3):142-50.
7. Yale New Haven Health Services Corporation – Center for Outcomes Research and Evaluation (YNHHSC/CORE) (January 2012). Hospital 30-Day, All-Cause, Risk-Standardized Readmission Rate (RSRR) following Chronic Obstructive Pulmonary Disease (COPD) Hospitalization. In *Testing Chronic Obstructive Pulmonary Disease 30-Day Mortality and Readmission Measures in California All-Payer Data* (Figures 2a-2b). Retrieved from http://www.qualityforum.org/Projects/Pulmonary_Endorsement_Maintenance.aspx#t=2&s=&p=3.

Figure 1a. 2006 Stroke Mortality Cohort Using California Patient Discharge Data for All-payer Patients 18+ Admitted to California Hospitals



*Categories are not mutually exclusive
**N refers to the number of discharges

Figure 1b. 2006 Stroke Readmission Cohort Using California Patient Discharge Data for All-payer Patients 18+ Admitted to California Hospitals



*Categories are not mutually exclusive
**N refers to the number of discharges
^If a patient has more than one admission within 30 days of discharge from the index hospitalization, only one is counted as a readmission. No admissions within 30 days of discharge from an index admission are considered as additional index admission.

Table 1a. Prevalence of Risk Factors in Stroke Mortality Model for All Patients Aged 18+ Years, FFS 65+ Patients, Non-FFS 65+ Patients, and All Patients 18-64 Years of Age

Description	All 18+ (Total) # (%)	FFS 65+ # (%)	Non-FFS 65+ # (%)	Age 18-64 Years # (%)
All	33,702 (100.00)	14,530 (100.00)	10,088 (100.00)	9,084 (100.00)
Demographic				
Age (continuous)	72.80 (14.11)	8,0.19 (8.04)	79.27 (7.90)	53.79 (8.42)
Male	15,618 (46.34)	6,020 (41.43)	4,383 (43.45)	5,215 (57.41)
Cardiovascular/Cerebrovascular				
Congestive Heart Failure	3,541 (10.51)	1,880 (12.94)	1,070 (10.61)	591 (6.51)
Valvular and Rheumatic Heart Disease	3,330 (9.88)	1,844 (12.69)	974 (9.66)	512 (5.64)
Congenital Cardiac/Circulatory Defects	367 (1.09)	98 (0.67)	47 (0.47)	222 (2.44)
Hypertensive Heart Disease	913 (2.71)	571 (3.93)	167 (1.66)	175 (1.93)
Specified Heart Arrhythmias	3,484 (10.34)	2,018 (13.89)	1,157 (11.47)	309 (3.40)
Cerebral Hemorrhage	259 (0.77)	114 (0.78)	57 (0.57)	88 (0.97)
Ischemic or Unspecified Stroke	1,733 (5.14)	784 (5.40)	465 (4.61)	484 (5.33)
Precerebral Arterial Occlusion and Transient Cerebral Ischemia	1,170 (3.47)	583 (4.01)	350 (3.47)	237 (2.61)
Cerebral Atherosclerosis and Aneurysm	1,459 (4.33)	716 (4.93)	455 (4.51)	288 (3.17)
Hemiplegia/Hemiparesis	1,361 (4.04)	654 (4.50)	345 (3.42)	362 (3.99)
Comorbidities				
History of Infection	2,001 (5.94)	1,006 (6.92)	526 (5.21)	469 (5.16)
Metastatic Cancer and Acute Leukemia and Other Major Cancers	762 (2.26)	377 (2.59)	221 (2.19)	164 (1.81)
Lymphatic, Head and Neck, Brain, Breast, Colorectal and Other Major Cancers	1,988 (5.90)	951 (6.55)	676 (6.70)	361 (3.97)
Protein-Calorie Malnutrition	1,049 (3.11)	573 (3.94)	321 (3.18)	155 (1.71)
Other Significant Endocrine and Metabolic Disorders	20,666 (61.32)	8,874 (61.07)	6,323 (62.68)	5,469 (60.20)
Other Gastrointestinal Disorders	7,964 (23.63)	3,915 (26.94)	2,438 (24.17)	1,611 (17.73)
Disorders of the Vertebrae and Spinal Discs	1,831 (5.43)	1,008 (6.94)	505 (5.01)	318 (3.50)
Osteoarthritis of Hip or Knee	880 (2.61)	468 (3.22)	298 (2.95)	114 (1.25)
Other Musculoskeletal and Connective Tissue Disorders	9,943 (29.50)	4,669 (32.13)	3,164 (31.36)	2,110 (23.23)
Iron Deficiency and Other/Unspecified Anemia and Blood Disease	7,294 (21.64)	3,689 (25.39)	2,181 (21.62)	1,424 (15.68)
Dementia or senility	5,929 (17.59)	3,482 (23.96)	2,060 (20.42)	387 (4.26)
Major Psychiatric Disorders	1,215 (3.61)	521 (3.59)	273 (2.71)	421 (4.63)
Quadriplegia, Other Extensive Paralysis	234 (0.69)	99 (0.68)	69 (0.68)	66 (0.73)
Multiple Sclerosis	1,852 (5.50)	702 (4.83)	444 (4.40)	706 (7.77)
Seizure Disorders and Convulsions	2,378 (7.06)	1,047 (7.21)	551 (5.46)	780 (8.59)

Description	All 18+ (Total) # (%)	FFS 65+ # (%)	Non-FFS 65+ # (%)	Age 18-64 Years # (%)
Hypertension	25,286 (75.03)	11,061 (76.13)	7,870 (78.01)	6,355 (69.96)
Peripheral Vascular Disease	1,847 (5.48)	910 (6.26)	576 (5.71)	361 (3.97)
Chronic Obstructive Pulmonary Disease	4,425 (13.13)	2,337 (16.08)	1,320 (13.08)	768 (8.45)
Pneumonia	2,800 (8.31)	1,469 (10.11)	877 (8.69)	454 (5.00)
Pleural Effusion/Pneumothorax	373 (1.11)	194 (1.34)	108 (1.07)	71 (0.78)
Other Eye Disorders	351 (1.04)	148 (1.02)	89 (0.88)	114 (1.25)
Other Ear, Nose, Throat, and Mouth Disorders	1,491 (4.42)	658 (4.53)	401 (3.98)	432 (4.76)
Dialysis Status	443 (1.31)	174 (1.20)	101 (1.00)	168 (1.85)
Renal Failure	2,431 (7.21)	1,134 (7.80)	736 (7.30)	561 (6.18)
Urinary Tract Infection	2,245 (6.66)	1,239 (8.53)	696 (6.90)	310 (3.41)
Male Genital Disorders	2,207 (6.55)	1,117 (7.69)	877 (8.69)	213 (2.34)
Decubitus Ulcer of Skin	284 (0.84)	144 (0.99)	96 (0.95)	44 (0.48)
Chronic Ulcer of Skin, Except Decubitus	553 (1.64)	240 (1.65)	164 (1.63)	149 (1.64)
Other Dermatological Disorders	796 (2.36)	326 (2.24)	223 (2.21)	247 (2.72)
Outcome				
Death within 30-days of admission	4,206 (12.48)	2,214 (15.24)	1,564 (15.50)	428 (4.71)

Data Source: 2006 California Patient Discharge Data for All-payer Patients 18+ Admitted to California Hospitals

Note:

1. FFS is defined as payer category=Medicare and payer type of coverage=Traditional.
2. The distribution for all risk factors is significantly different (at the p=0.05 level) across subgroups except “Quadriplegia, Other Extensive Paralysis” and “Chronic Ulcer of Skin, Except Decubitus”

Table 1b. Prevalence of Risk Factors in Stroke Readmission Model for All Patients Aged 18+ Years, FFS 65+ Patients, Non-FFS 65+ Patients, and All Patients 18-64 Years of Age

Description	All 18+ (Total) # (%)	FFS 65+ # (%)	Non-FFS 65+ # (%)	Age 18-64 Years # (%)
All	32,241 (100.00)	13,709 (100.00)	9,591 (100.00)	8,941 (100.00)
Demographic				
Age (continuous)	72.45 (14.12)	80.01 (7.98)	79.06 (7.86)	53.75 (8.39)
Male	14,934 (46.32)	5,690 (41.51)	4,179 (43.57)	5,065 (56.65)
Cardiovascular/Cerebrovascular				
Congestive Heart Failure	3,259 (10.11)	1,694 (12.36)	991 (10.33)	574 (6.42)
Hypertensive heart disease	889 (2.76)	548 (4.00)	164 (1.71)	177 (1.98)
Cerebral Hemorrhage	267 (0.83)	113 (0.82)	57 (0.59)	97 (1.08)
Ischemic or Unspecified Stroke	1,941 (6.02)	860 (6.27)	531 (5.54)	550 (6.15)
Cerebrovascular Disease	1,210 (3.75)	593 (4.33)	356 (3.71)	261 (2.92)
Hemiplegia, paraplegia, paralysis, functional disability	1,946 (6.04)	909 (6.63)	519 (5.41)	518 (5.79)
Comorbidities				
Metastatic cancer and acute leukemia	472 (1.46)	217 (1.58)	144 (1.50)	111 (1.24)
Cancer	1,965 (6.09)	950 (6.93)	666 (6.94)	349 (3.90)
Diabetes and DM complications	11,256 (34.91)	4,462 (32.55)	3,231 (33.69)	3,563 (39.85)
Protein-calorie malnutrition	947 (2.94)	503 (3.67)	298 (3.11)	146 (1.63)
Disorders of Fluid/Electrolyte/Acid-Base	3,935 (12.20)	1,971 (14.38)	1,099 (11.46)	865 (9.67)
Obesity/disorders of thyroid, cholesterol, lipids	18,739 (58.12)	7,770 (56.68)	5,754 (59.99)	5,215 (58.33)
Severe Hematological Disorders	208 (0.65)	98 (0.71)	43 (0.45)	67 (0.75)
Iron Deficiency and Other/Unspecified Anemias and Blood Disease	6,869 (21.31)	3,424 (24.98)	2,060 (21.48)	1,385 (15.49)
Dementia and senility	5,528 (17.15)	3,238 (23.62)	1,935 (20.18)	355 (3.97)
Quadriplegia, paraplegia, functional disability	424 (1.32)	169 (1.23)	114 (1.19)	141 (1.58)
Seizure Disorders and Convulsions	2,199 (6.82)	960 (7.00)	503 (5.24)	736 (8.23)
Vascular or circulatory disease	2,491 (7.73)	1,236 (9.02)	767 (8.00)	488 (5.46)
COPD	4,133 (12.82)	2,133 (15.56)	1,232 (12.85)	768 (8.59)
Other lung disorder	1,347 (4.18)	682 (4.97)	404 (4.21)	261 (2.92)
End-stage renal disease or dialysis	412 (1.28)	161 (1.17)	92 (0.96)	159 (1.78)
Renal Failure	2,276 (7.06)	1,040 (7.59)	692 (7.22)	544 (6.08)
Other urinary tract disorders	2,777 (8.61)	1,378 (10.05)	877 (9.14)	522 (5.84)
Decubitus ulcer or chronic skin ulcer	719 (2.23)	322 (2.35)	223 (2.33)	174 (1.95)
Major Symptoms, Abnormalities	3,550 (11.01)	1,677 (12.23)	1,032 (10.76)	841 (9.41)

Description	All 18+ (Total) # (%)	FFS 65+ # (%)	Non-FFS 65+ # (%)	Age 18-64 Years # (%)
Outcome				
Readmission within one month of discharge	4,151 (12.87)	1,862 (13.58)	1,337 (13.94)	952 (10.65)

Data Source: 2006 California Patient Discharge Data for All-payer Patients 18+ Admitted to California Hospitals

Note:

1. FFS is defined as payer category=Medicare and payer type of coverage=Traditional.
2. The distribution for all risk factors is significantly different (at the p=0.05 level) across subgroups except “Metastatic cancer and acute leukemia” and “Decubitus ulcer or chronic skin ulcer”

Table 2a. Odds Ratios for Risk Factors in Stroke Mortality Measure for All Patients 18+ Years – GLM (N=33,702, C-Statistic=0.753, Adjusted R-Square=0.1594)

Description	OR (95% CI)
Demographic	
Age (continuous)	1.05 (1.05-1.06)
Male	0.98 (0.90-1.05)
Cardiovascular/Cerebrovascular	
Congestive Heart Failure	1.38 (1.22-1.55)
Valvular and Rheumatic Heart Disease	0.92 (0.83-1.03)
Congenital Cardiac/Circulatory Defects	0.74 (0.46-1.17)
Hypertensive Heart Disease	0.81 (0.66-1.00)
Specified Heart Arrhythmias	1.54 (1.38-1.72)
Cerebral Hemorrhage	0.90 (0.61-1.33)
Ischemic or Unspecified Stroke	1.08 (0.92-1.28)
Precerebral Arterial Occlusion and Transient Cerebral Ischemia	0.86 (0.71-1.03)
Cerebral Atherosclerosis and Aneurysm	0.78 (0.66-0.93)
Hemiplegia/Hemiparesis	0.90 (0.75-1.09)
Comorbidities	
History of Infection	0.91 (0.78-1.06)
Metastatic Cancer and Acute Leukemia and Other Major Cancers	3.83 (3.22-4.55)
Lymphatic, Head and Neck, Brain, Breast, Colorectal and Other Major Cancers	1.16 (1.02-1.33)
Protein-Calorie Malnutrition	1.44 (1.23-1.69)
Other Significant Endocrine and Metabolic Disorders	0.78 (0.73-0.84)
Other Gastrointestinal Disorders	0.88 (0.81-0.95)
Disorders of the Vertebrae and Spinal Discs	0.78 (0.67-0.91)
Osteoarthritis of Hip or Knee	0.70 (0.56-0.88)
Other Musculoskeletal and Connective Tissue Disorders	0.74 (0.68-0.80)
Iron Deficiency and Other/Unspecified Anemia and Blood Disease	1.19 (1.09-1.29)
Dementia or senility	1.57 (1.44-1.70)
Major Psychiatric Disorders	0.78 (0.64-0.95)
Quadriplegia, Other Extensive Paralysis	2.91 (2.11-3.99)
Multiple Sclerosis	0.78 (0.65-0.93)
Seizure Disorders and Convulsions	1.52 (1.34-1.71)
Hypertension	0.77 (0.71-0.83)
Peripheral Vascular Disease	1.18 (1.03-1.36)
Chronic Obstructive Pulmonary Disease	1.07 (0.97-1.18)
Pneumonia	1.38 (1.24-1.54)
Pleural Effusion/Pneumothorax	1.01 (0.78-1.32)
Other Eye Disorders	0.92 (0.66-1.27)
Other Ear, Nose, Throat, and Mouth Disorders	0.83 (0.70-0.99)
Dialysis Status	1.02 (0.76-1.36)
Renal Failure	1.18 (1.02-1.35)
Urinary Tract Infection	1.28 (1.12-1.47)
Male Genital Disorders	0.85 (0.74-0.98)
Decubitus Ulcer of Skin	1.04 (0.77-1.41)
Chronic Ulcer of Skin, Except Decubitus	1.38 (1.09-1.74)
Other Dermatological Disorders	0.93 (0.74-1.16)

Data Source: 2006 California Patient Discharge Data for All-payer Patients 18+ Admitted to California Hospitals

Table 2b. Odds Ratios for Risk Factors in Stroke Readmission Measure for All Patients 18+ Years – GLM (N=32,241, C-Statistic=0.623, Adjusted R-Square=0.0387)

Description	OR (95% CI)
Demographic	
Age (continuous)	1.01 (1.00-1.01)
Male	1.04 (0.97-1.11)
Cardiovascular/Cerebrovascular	
Congestive Heart Failure	1.15 (1.03-1.28)
Hypertensive heart disease	0.87 (0.71-1.07)
Cerebral Hemorrhage	0.82 (0.58-1.16)
Ischemic or Unspecified Stroke	0.99 (0.85-1.16)
Cerebrovascular Disease	1.12 (0.96-1.32)
Hemiplegia, paraplegia, paralysis, functional disability	1.11 (0.96-1.29)
Comorbidities	
Metastatic cancer and acute leukemia	1.58 (1.24-2.02)
Cancer	1.17 (1.02-1.34)
Diabetes and DM complications	1.30 (1.21-1.39)
Protein-calorie malnutrition	1.18 (0.99-1.39)
Disorders of Fluid/Electrolyte/Acid-Base	1.14 (1.02-1.26)
Obesity/disorders of thyroid, cholesterol, lipids	0.89 (0.83-0.96)
Severe Hematological Disorders	1.24 (0.88-1.76)
Iron Deficiency and Other/Unspecified Anemias and Blood Disease	1.26 (1.15-1.37)
Dementia and senility	1.04 (0.96-1.14)
Quadriplegia, paraplegia, functional disability	1.16 (0.90-1.48)
Seizure Disorders and Convulsions	1.13 (1.00-1.28)
Vascular or circulatory disease	1.06 (0.93-1.19)
COPD	1.20 (1.09-1.31)
Other lung disorder	1.23 (1.06-1.42)
End-stage renal disease or dialysis	1.47 (1.15-1.87)
Renal Failure	1.27 (1.11-1.45)
Other urinary tract disorders	1.26 (1.13-1.40)
Decubitus ulcer or chronic skin ulcer	1.28 (1.06-1.54)
Major Symptoms, Abnormalities	1.18 (1.06-1.31)

Data Source: 2006 California Patient Discharge Data for All-payer Patients 18+ Admitted to California Hospitals

Table 3a. Stroke Mortality Model Performance for Models with All 18+ Patients and by Subgroups of Patients

Model with*	N	C-statistic	SE	Lower C-stat	Upper C-stat	Predictive ability[#], % (lowest decile – highest decile)
All 65+	24,618	0.720	0.004	0.712	0.729	(2.78%, 34.71%)
FFS, 65+	14,530	0.719	0.006	0.708	0.731	(5.00%, 33.73%)
Non-FFS, 65+	10,088	0.724	0.007	0.710	0.737	(0.00%, 36.51%)
All 18-64	9,084	0.715	0.014	0.688	0.742	(1.95%, 43.48%)
All 18+ (overall)	33,702	0.753	0.004	0.745	0.760	(1.96%, 34.77%)

Data Source: 2006 California Patient Discharge Data for All-payer Patients 18+ Admitted to California Hospitals

*Note that a single overall model for all 18+ is applied to the subgroups of patients.

Table 3b. Stroke Readmission Model Performance for Models with All 18+ Patients and by Subgroups of Patients

Model with*	N	C-statistic	SE	Lower C-stat	Upper C-stat	Predictive ability[#], % (lowest decile – highest decile)
All 65+	23,300	0.595	0.005	0.585	0.606	(4.90%, 22.80%)
FFS, 65+	13,709	0.606	0.007	0.592	0.620	(5.64%, 22.78%)
Non-FFS, 65+	9,591	0.581	0.009	0.564	0.597	(4.02%, 22.85%)
All 18-64	8,941	0.666	0.010	0.646	0.685	(6.12%, 31.30%)
All 18+ (overall)	32,241	0.623	0.005	0.614	0.632	(5.94%, 24.10%)

Data Source: 2006 California Patient Discharge Data for All-payer Patients 18+ Admitted to California Hospitals

*Note that a single overall model for all 18+ is applied to the subgroups of patients.

Table 4a. Distribution of Pearson Chi-Square Residuals for Stroke Mortality Model by Patient Subgroups

	All 18+ (TOTAL)	All 65+	FFS 65+	Non-FFS 65+	All 18-64
N	33,702	24,618	14,530	10,088	9,084
Mean	0.00	-0.01	-0.03	0.01	0.03
Std Deviation	0.99	0.97	0.96	0.99	1.05
100% Max	10.63	6.46	6.46	5.56	10.63
99%	4.04	3.45	3.40	3.51	5.64
95%	2.33	2.37	2.32	2.45	-0.08
90%	1.51	1.75	1.70	1.82	-0.11
75% Q3	-0.18	-0.25	-0.26	-0.25	-0.15
50% Median	-0.28	-0.34	-0.34	-0.33	-0.18
25% Q1	-0.40	-0.44	-0.45	-0.43	-0.21
10%	-0.53	-0.57	-0.59	-0.55	-0.25
5%	-0.63	-0.68	-0.70	-0.65	-0.29
1%	-0.90	-0.96	-0.96	-0.93	-0.42
0% Min	-2.80	-2.80	-2.80	-2.43	-0.88

	All 18+ (TOTAL)	All 65+	FFS 65+	Non-FFS 65+	All 18-64
Residual < -2	6 (0.02%)	6 (0.02%)	3 (0.02%)	3 (0.03%)	0 (0.00%)
-2 <= Residual < 0	29,490 (87.50%)	20,834 (84.63%)	12,313 (84.74%)	8,521 (84.47%)	8,656 (95.29%)
0 <= Residual < 2	1,908 (5.66%)	1,881 (7.64%)	1,154 (7.94%)	727 (7.21%)	27 (0.30%)
Residual >= 2	2,298 (6.82%)	1,897 (7.71%)	1,060 (7.30%)	837 (8.30%)	401 (4.41%)

Data Source: 2006 California Patient Discharge Data for All-payer Patients 18+ Admitted to California Hospitals

Table 4b. Distribution of Pearson Chi-Square Residuals for Stroke Readmission Model by Patient Subgroups

	All 18+ (TOTAL)	All 65+	FFS 65+	Non-FFS 65+	All 18-64
N	32,241	23,300	13,709	9,591	8,941
Mean	0.00	0.01	-0.01	0.02	-0.02
Std Deviation	1.00	1.01	1.00	1.03	0.95
100% Max	3.77	3.48	3.48	3.29	3.77
99%	3.16	3.09	3.06	3.10	3.39
95%	2.76	2.75	2.71	2.79	2.84
90%	2.15	2.24	2.18	2.33	1.60
75% Q3	-0.31	-0.32	-0.32	-0.32	-0.29
50% Median	-0.35	-0.36	-0.36	-0.35	-0.32
25% Q1	-0.39	-0.40	-0.41	-0.40	-0.35
10%	-0.46	-0.48	-0.48	-0.47	-0.40
5%	-0.52	-0.54	-0.55	-0.53	-0.45
1%	-0.69	-0.70	-0.71	-0.68	-0.63
0% Min	-1.51	-1.51	-1.17	-1.51	-0.94

	All 18+ (TOTAL)	All 65+	FFS 65+	Non-FFS 65+	All 18-64
Residual < -2	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
-2 <= Residual < 0	28,090 (87.13%)	20,101 (86.27%)	11,847 (86.42%)	8,254 (86.06%)	7,989 (89.35%)
0 <= Residual < 2	685 (2.12%)	549 (2.36%)	341 (2.49%)	208 (2.17%)	136 (1.52%)
Residual >= 2	3,466 (10.75%)	2,650 (11.37%)	1,521 (11.09%)	1,129 (11.77%)	816 (9.13%)

Data Source: 2006 California Patient Discharge Data for All-payer Patients 18+ Admitted to California Hospitals

Table 5a. Odds Ratios for Risk Factors in Stroke Mortality Measure -- Stratified Results for FFS Patients 65+, Non-FFS Patients 65+, All Patients 65+, and All Patients 18-64 Years of Age

Risk Factor	OR (95% CI) for All 65+ (N=24,618, C-statistic=0.720)	OR (95% CI) for FFS 65+ (N=14,530, C-Statistic=0.721)	OR (95% CI) for Non-FFS 65+ (N=10,088, C-Statistic=0.724)	OR (95% CI) for All 18-64 (N=9,084, C-Statistic=0.750)
Demographic				
Age (continuous)	1.07 (1.06-1.07)	1.07 (1.06-1.08)	1.07 (1.06-1.08)	1.02 (1.01-1.04)
Male	0.98 (0.90-1.06)	0.99 (0.89-1.11)	0.96 (0.85-1.10)	1.21 (0.97-1.51)
Cardiovascular/Cerebrovascular				
Congestive Heart Failure	1.36 (1.20-1.54)	1.27 (1.08-1.49)	1.54 (1.25-1.89)	1.76 (1.17-2.65)
Valvular and Rheumatic Heart Disease	0.92 (0.82-1.03)	0.96 (0.83-1.10)	0.86 (0.71-1.04)	0.91 (0.59-1.41)
Congenital Cardiac/Circulatory Defects	0.54 (0.30-1.00)	0.43 (0.19-1.01)	0.72 (0.29-1.77)	1.07 (0.53-2.17)
Hypertensive Heart Disease	0.82 (0.66-1.02)	0.82 (0.63-1.05)	0.89 (0.58-1.38)	0.93 (0.44-1.98)
Specified Heart Arrhythmias	1.58 (1.41-1.77)	1.61 (1.39-1.86)	1.53 (1.27-1.85)	1.13 (0.69-1.85)
Cerebral Hemorrhage	0.99 (0.66-1.51)	1.07 (0.64-1.79)	0.85 (0.41-1.77)	0.43 (0.14-1.33)
Ischemic or Unspecified Stroke	1.07 (0.90-1.28)	1.00 (0.80-1.27)	1.19 (0.90-1.58)	1.06 (0.66-1.70)
Precerebral Arterial Occlusion and Transient Cerebral Ischemia	0.87 (0.71-1.05)	0.77 (0.60-1.00)	1.02 (0.76-1.38)	0.79 (0.41-1.51)
Cerebral Atherosclerosis and Aneurysm	0.82 (0.69-0.98)	0.72 (0.57-0.90)	1.00 (0.76-1.31)	0.55 (0.28-1.07)
Hemiplegia/Hemiparesis	0.92 (0.75-1.12)	0.88 (0.68-1.14)	1.03 (0.75-1.42)	0.86 (0.50-1.48)
Comorbidities				
History of Infection	0.91 (0.78-1.07)	0.94 (0.76-1.15)	0.89 (0.68-1.17)	0.71 (0.45-1.14)
Metastatic Cancer and Acute Leukemia and Other Major Cancers	3.07 (2.52-3.72)	2.72 (2.12-3.49)	3.81 (2.78-5.22)	11.68 (7.78-17.52)
Lymphatic, Head and Neck, Brain, Breast, Colorectal and Other Major Cancers	1.17 (1.02-1.35)	1.19 (0.99-1.42)	1.13 (0.91-1.41)	1.06 (0.69-1.63)
Protein-Calorie Malnutrition	1.40 (1.18-1.65)	1.51 (1.23-1.86)	1.23 (0.93-1.63)	2.38 (1.43-3.96)
Other Significant Endocrine and Metabolic Disorders	0.82 (0.76-0.88)	0.82 (0.74-0.91)	0.80 (0.71-0.91)	0.69 (0.56-0.87)
Other Gastrointestinal Disorders	0.88 (0.80-0.96)	0.89 (0.80-1.00)	0.85 (0.74-0.98)	0.86 (0.65-1.14)
Disorders of the Vertebrae and Spinal Discs	0.79 (0.67-0.93)	0.82 (0.67-1.01)	0.75 (0.56-0.99)	0.65 (0.34-1.24)

Risk Factor	OR (95% CI) for All 65+ (N=24,618, C-statistic=0.720)	OR (95% CI) for FFS 65+ (N=14,530, C-Statistic=0.721)	OR (95% CI) for Non-FFS 65+ (N=10,088, C-Statistic=0.724)	OR (95% CI) for All 18-64 (N=9,084, C-Statistic=0.750)
Osteoarthritis of Hip or Knee	0.66 (0.52-0.84)	0.65 (0.48-0.88)	0.68 (0.47-0.99)	1.65 (0.75-3.67)
Other Musculoskeletal and Connective Tissue Disorders	0.74 (0.68-0.80)	0.73 (0.65-0.81)	0.76 (0.67-0.86)	0.67 (0.51-0.88)
Iron Deficiency and Other/Unspecified Anemia and Blood Disease	1.15 (1.05-1.25)	1.14 (1.01-1.28)	1.17 (1.01-1.35)	1.49 (1.13-1.96)
Dementia or senility	1.47 (1.35-1.59)	1.43 (1.28-1.59)	1.53 (1.34-1.75)	3.69 (2.62-5.19)
Major Psychiatric Disorders	0.75 (0.61-0.93)	0.70 (0.53-0.92)	0.83 (0.58-1.18)	0.78 (0.49-1.26)
Quadriplegia, Other Extensive Paralysis	2.50 (1.74-3.59)	2.44 (1.52-3.93)	2.59 (1.47-4.56)	5.22 (2.67-10.17)
Multiple Sclerosis	0.75 (0.62-0.91)	0.69 (0.54-0.89)	0.83 (0.62-1.12)	0.92 (0.61-1.39)
Seizure Disorders and Convulsions	1.43 (1.25-1.64)	1.47 (1.24-1.74)	1.38 (1.10-1.73)	1.96 (1.47-2.62)
Hypertension	0.79 (0.73-0.86)	0.78 (0.70-0.87)	0.80 (0.70-0.92)	0.75 (0.59-0.94)
Peripheral Vascular Disease	1.18 (1.02-1.38)	1.28 (1.06-1.55)	1.03 (0.80-1.32)	1.28 (0.82-2.00)
Chronic Obstructive Pulmonary Disease	1.13 (1.02-1.25)	1.13 (0.99-1.29)	1.13 (0.96-1.33)	0.77 (0.54-1.11)
Pneumonia	1.30 (1.16-1.46)	1.31 (1.13-1.52)	1.30 (1.08-1.56)	2.35 (1.64-3.36)
Pleural Effusion/Pneumothorax	0.98 (0.74-1.31)	1.14 (0.80-1.61)	0.78 (0.47-1.29)	1.35 (0.64-2.87)
Other Eye Disorders	0.88 (0.62-1.26)	0.76 (0.48-1.22)	1.05 (0.60-1.84)	1.07 (0.50-2.31)
Other Ear, Nose, Throat, and Mouth Disorders	0.89 (0.74-1.07)	0.90 (0.71-1.15)	0.87 (0.64-1.19)	0.38 (0.19-0.73)
Dialysis Status	1.05 (0.75-1.46)	0.76 (0.49-1.19)	1.64 (0.98-2.75)	0.84 (0.43-1.64)
Renal Failure	1.21 (1.04-1.40)	1.35 (1.12-1.63)	0.99 (0.78-1.27)	0.95 (0.59-1.54)
Urinary Tract Infection	1.25 (1.09-1.45)	1.27 (1.06-1.52)	1.23 (0.97-1.56)	2.04 (1.28-3.27)
Male Genital Disorders	0.84 (0.73-0.98)	0.80 (0.66-0.98)	0.89 (0.71-1.11)	1.07 (0.60-1.92)
Decubitus Ulcer of Skin	1.13 (0.82-1.54)	1.22 (0.81-1.83)	0.97 (0.58-1.62)	0.41 (0.14-1.16)
Chronic Ulcer of Skin, Except Decubitus	1.35 (1.05-1.74)	1.16 (0.83-1.63)	1.68 (1.13-2.48)	1.51 (0.81-2.83)
Other Dermatological Disorders	0.92 (0.72-1.18)	1.06 (0.78-1.44)	0.71 (0.46-1.09)	0.86 (0.46-1.58)

Data Source: 2006 California Patient Discharge Data for All-payer Patients 18+ Admitted to California Hospitals

Table 5b. Odds Ratios for Risk Factors in Stroke Readmission Measure -- Stratified Results for FFS Patients 65+, Non-FFS Patients 65+, All Patients 65+, and All Patients 18-64 Years of Age

Risk Factor	OR (95% CI) for All 65+ (N=23,300, C-statistic=0.596)	OR (95% CI) for FFS 65+ (N=13,709, C-Statistic=0.608)	OR (95% CI) for Non-FFS 65+ (N=9,591, C-Statistic=0.587)	OR (95% CI) for All 18-64 (N=8,941, C-Statistic=0.673)
Demographic				
Age (continuous)	1.01 (1.00-1.01)	1.00 (1.00-1.01)	1.01 (1.00-1.02)	0.99 (0.99-1.00)
Male	1.05 (0.97-1.14)	0.99 (0.90-1.10)	1.15 (1.02-1.29)	1.05 (0.91-1.21)
Cardiovascular/Cerebrovascular				
Congestive Heart Failure	1.16 (1.02-1.31)	1.14 (0.97-1.34)	1.20 (0.98-1.46)	1.23 (0.95-1.59)
Hypertensive heart disease	0.88 (0.71-1.10)	0.87 (0.67-1.13)	0.95 (0.61-1.48)	0.87 (0.53-1.42)
Cerebral Hemorrhage	0.75 (0.48-1.18)	1.00 (0.60-1.66)	0.35 (0.12-0.98)	0.77 (0.44-1.37)
Ischemic or Unspecified Stroke	0.96 (0.80-1.14)	0.88 (0.70-1.11)	1.07 (0.81-1.42)	1.04 (0.78-1.40)
Cerebrovascular Disease	1.10 (0.92-1.32)	1.05 (0.84-1.33)	1.18 (0.89-1.57)	1.26 (0.89-1.78)
Hemiplegia, paraplegia, paralysis, functional disability	1.04 (0.88-1.24)	1.05 (0.84-1.31)	1.05 (0.79-1.40)	1.28 (0.95-1.73)
Comorbidities				
Metastatic cancer and acute leukemia	1.33 (1.00-1.77)	1.27 (0.88-1.84)	1.40 (0.89-2.20)	2.31 (1.39-3.84)
Cancer	1.09 (0.94-1.27)	1.15 (0.95-1.40)	1.01 (0.79-1.28)	1.75 (1.26-2.43)
Diabetes and DM complications	1.25 (1.16-1.36)	1.28 (1.15-1.43)	1.21 (1.07-1.38)	1.47 (1.27-1.71)
Protein-calorie malnutrition	1.23 (1.03-1.48)	1.31 (1.04-1.65)	1.10 (0.81-1.50)	0.93 (0.61-1.44)
Disorders of Fluid/Electrolyte/Acid-Base	1.09 (0.97-1.22)	1.07 (0.92-1.25)	1.11 (0.91-1.34)	1.30 (1.03-1.63)
Obesity/disorders of thyroid, cholesterol, lipids	0.89 (0.82-0.96)	0.86 (0.78-0.95)	0.93 (0.82-1.05)	0.88 (0.76-1.03)
Severe Hematological Disorders	1.31 (0.87-1.97)	1.50 (0.93-2.42)	0.98 (0.44-2.17)	1.02 (0.52-1.98)
Iron Deficiency and Other/Unspecified Anemias and Blood Disease	1.25 (1.14-1.37)	1.27 (1.12-1.43)	1.22 (1.05-1.42)	1.28 (1.06-1.55)
Dementia and senility	1.03 (0.94-1.13)	0.98 (0.87-1.10)	1.11 (0.96-1.28)	1.38 (1.02-1.85)
Quadriplegia, paraplegia, functional disability	1.07 (0.79-1.45)	1.33 (0.91-1.93)	0.72 (0.42-1.23)	1.22 (0.79-1.90)
Seizure Disorders and Convulsions	1.14 (0.99-1.33)	1.13 (0.94-1.36)	1.19 (0.93-1.52)	1.02 (0.81-1.29)

Risk Factor	OR (95% CI) for All 65+ (N=23,300, C-statistic=0.596)	OR (95% CI) for FFS 65+ (N=13,709, C-Statistic=0.608)	OR (95% CI) for Non-FFS 65+ (N=9,591, C-Statistic=0.587)	OR (95% CI) for All 18-64 (N=8,941, C-Statistic=0.673)
Vascular or circulatory disease	1.07 (0.94-1.23)	1.01 (0.84-1.20)	1.20 (0.97-1.49)	1.03 (0.78-1.36)
COPD	1.13 (1.01-1.25)	1.04 (0.91-1.19)	1.27 (1.08-1.50)	1.50 (1.21-1.86)
Other lung disorder	1.24 (1.06-1.46)	1.23 (1.00-1.51)	1.27 (0.98-1.64)	1.16 (0.83-1.64)
End-stage renal disease or dialysis	1.47 (1.08-1.99)	1.34 (0.91-1.96)	1.73 (1.05-2.84)	1.16 (0.76-1.78)
Renal Failure	1.18 (1.01-1.38)	1.32 (1.08-1.60)	0.99 (0.77-1.27)	1.61 (1.20-2.16)
Other urinary tract disorders	1.23 (1.09-1.39)	1.31 (1.12-1.52)	1.12 (0.92-1.36)	1.36 (1.06-1.74)
Decubitus ulcer or chronic skin ulcer	1.26 (1.01-1.56)	1.24 (0.93-1.64)	1.29 (0.92-1.82)	1.35 (0.91-2.01)
Major Symptoms, Abnormalities	1.10 (0.97-1.25)	1.14 (0.98-1.34)	1.05 (0.86-1.28)	1.46 (1.17-1.82)

Data Source: 2006 California Patient Discharge Data for All-payer Patients 18+ Admitted to California Hospitals

Table 6a. Stroke Mortality Model with Interaction Terms -- GLM (N=33,702, C-Statistic=0.758, Adjusted R-Square=0.1677)

Risk Factor	Estimate	Standard Error	Wald Chi-Square	P-value	OR	LOR	UOR
Intercept	-6.45	0.19	1149.53	0.00			
Demographic							
Age (continuous)	0.06	0.00	655.34	0.00	1.06	1.06	1.07
Male	0.16	0.11	1.95	0.16	1.17	0.94	1.46
Cardiovascular/Cerebrovascular							
Congestive Heart Failure	0.62	0.21	8.52	0.00	1.85	1.22	2.80
Valvular and Rheumatic Heart Disease	-0.12	0.22	0.30	0.59	0.89	0.57	1.37
Congenital Cardiac/Circulatory Defects	0.29	0.36	0.63	0.43	1.33	0.65	2.72
Hypertensive Heart Disease	-0.17	0.39	0.18	0.67	0.85	0.40	1.81
Specified Heart Arrhythmias	0.05	0.25	0.04	0.83	1.05	0.64	1.73
Cerebral Hemorrhage	-0.86	0.58	2.17	0.14	0.42	0.13	1.33
Ischemic or Unspecified Stroke	0.08	0.24	0.11	0.74	1.08	0.67	1.75
Precerebral Arterial Occlusion and Transient Cerebral Ischemia	-0.27	0.33	0.64	0.42	0.77	0.40	1.47
Cerebral Atherosclerosis and Aneurysm	-0.63	0.34	3.43	0.06	0.53	0.28	1.04
Hemiplegia/Hemiparesis	-0.14	0.28	0.24	0.62	0.87	0.51	1.50
Comorbidities							
History of Infection	-0.28	0.24	1.37	0.24	0.75	0.47	1.21
Metastatic Cancer and Acute Leukemia and Other Major Cancers	2.39	0.21	132.64	0.00	10.87	7.24	16.32
Lymphatic, Head and Neck, Brain, Breast, Colorectal and Other Major Cancers	0.06	0.22	0.07	0.79	1.06	0.69	1.62
Protein-Calorie Malnutrition	0.91	0.26	12.01	0.00	2.48	1.48	4.16
Other Significant Endocrine and Metabolic Disorders	-0.41	0.11	13.20	0.00	0.66	0.53	0.83
Other Gastrointestinal Disorders	-0.18	0.14	1.47	0.23	0.84	0.63	1.11
Disorders of the Vertebrae and Spinal Discs	-0.48	0.33	2.10	0.15	0.62	0.33	1.18
Osteoarthritis of Hip or Knee	0.47	0.41	1.31	0.25	1.59	0.72	3.54
Other Musculoskeletal and Connective Tissue Disorders	-0.42	0.14	9.14	0.00	0.66	0.50	0.86
Iron Deficiency and Other/Unspecified Anemia and Blood Disease	0.39	0.14	7.79	0.01	1.48	1.12	1.96
Dementia or senility	1.29	0.18	53.44	0.00	3.63	2.57	5.13
Major Psychiatric Disorders	-0.22	0.24	0.79	0.37	0.80	0.50	1.30
Quadriplegia, Other Extensive Paralysis	1.73	0.34	25.45	0.00	5.65	2.88	11.06
Multiple Sclerosis	0.00	0.21	0.00	0.99	1.00	0.66	1.51
Seizure Disorders and Convulsions	0.74	0.15	24.95	0.00	2.10	1.57	2.80
Hypertension	-0.39	0.12	11.55	0.00	0.68	0.54	0.85

Risk Factor	Estimate	Standard Error	Wald Chi-Square	P-value	OR	LOR	UOR
Peripheral Vascular Disease	0.23	0.23	0.96	0.33	1.25	0.80	1.97
Chronic Obstructive Pulmonary Disease	-0.34	0.19	3.47	0.06	0.71	0.49	1.02
Pneumonia	0.89	0.18	23.78	0.00	2.44	1.71	3.50
Pleural Effusion/Pneumothorax	0.27	0.39	0.50	0.48	1.31	0.61	2.81
Other Eye Disorders	0.07	0.40	0.04	0.85	1.08	0.49	2.35
Other Ear, Nose, Throat, and Mouth Disorders	-0.97	0.34	8.12	0.00	0.38	0.20	0.74
Dialysis Status	-0.20	0.34	0.36	0.55	0.82	0.42	1.59
Renal Failure	-0.11	0.25	0.21	0.65	0.89	0.55	1.45
Urinary Tract Infection	0.70	0.24	8.21	0.00	2.01	1.25	3.23
Male Genital Disorders	-0.03	0.30	0.01	0.93	0.97	0.54	1.75
Decubitus Ulcer of Skin	-1.03	0.55	3.51	0.06	0.36	0.12	1.05
Chronic Ulcer of Skin, Except Decubitus	0.43	0.32	1.78	0.18	1.54	0.82	2.89
Other Dermatological Disorders	-0.15	0.31	0.21	0.64	0.86	0.47	1.60
Old (Age>=65)	-0.27	0.16	2.71	0.10	0.76	0.56	1.05
Interactions							
Male	-0.19	0.12	2.53	0.11	0.83	0.65	1.05
Cardiovascular/Cerebrovascular							
Congestive Heart Failure	-0.31	0.22	2.01	0.16	0.73	0.47	1.13
Valvular and Rheumatic Heart Disease	0.04	0.23	0.03	0.85	1.04	0.67	1.63
Congenital Cardiac/Circulatory Defects	-0.90	0.48	3.58	0.06	0.40	0.16	1.03
Hypertensive Heart Disease	-0.03	0.40	0.01	0.93	0.97	0.44	2.13
Specified Heart Arrhythmias	0.41	0.26	2.52	0.11	1.51	0.91	2.50
Cerebral Hemorrhage	0.85	0.62	1.86	0.17	2.34	0.69	7.91
Ischemic or Unspecified Stroke	-0.01	0.26	0.00	0.96	0.99	0.59	1.64
Precerebral Arterial Occlusion and Transient Cerebral Ischemia	0.12	0.35	0.12	0.73	1.13	0.57	2.22
Cerebral Atherosclerosis and Aneurysm	0.42	0.35	1.47	0.23	1.53	0.77	3.04
Hemiplegia/Hemiparesis	0.05	0.29	0.03	0.87	1.05	0.59	1.87
Comorbidities							
History of Infection	0.19	0.26	0.56	0.46	1.21	0.73	2.00
Metastatic Cancer and Acute Leukemia and Other Major Cancers	-1.28	0.23	30.98	0.00	0.28	0.18	0.44
Lymphatic, Head and Neck, Brain, Breast, Colorectal and Other Major Cancers	0.10	0.23	0.19	0.66	1.11	0.71	1.73
Protein-Calorie Malnutrition	-0.57	0.28	4.34	0.04	0.56	0.33	0.97
Other Significant Endocrine and Metabolic Disorders	0.20	0.12	2.83	0.09	1.22	0.97	1.55

Risk Factor	Estimate	Standard Error	Wald Chi-Square	P-value	OR	LOR	UOR
Other Gastrointestinal Disorders	0.05	0.15	0.09	0.76	1.05	0.78	1.41
Disorders of the Vertebrae and Spinal Discs	0.25	0.34	0.53	0.47	1.28	0.66	2.48
Osteoarthritis of Hip or Knee	-0.88	0.42	4.28	0.04	0.42	0.18	0.95
Other Musculoskeletal and Connective Tissue Disorders	0.12	0.14	0.68	0.41	1.13	0.85	1.49
Iron Deficiency and Other/Unspecified Anemia and Blood Disease	-0.26	0.15	3.00	0.08	0.77	0.58	1.03
Dementia or senility	-0.89	0.18	24.18	0.00	0.41	0.29	0.58
Major Psychiatric Disorders	-0.08	0.27	0.08	0.78	0.93	0.55	1.57
Quadriplegia, Other Extensive Paralysis	-0.83	0.39	4.55	0.03	0.44	0.20	0.93
Multiple Sclerosis	-0.29	0.23	1.58	0.21	0.75	0.47	1.18
Seizure Disorders and Convulsions	-0.39	0.16	5.80	0.02	0.67	0.49	0.93
Hypertension	0.16	0.12	1.61	0.20	1.17	0.92	1.49
Peripheral Vascular Disease	-0.06	0.24	0.06	0.80	0.94	0.58	1.51
Chronic Obstructive Pulmonary Disease	0.46	0.19	5.75	0.02	1.59	1.09	2.31
Pneumonia	-0.63	0.19	10.67	0.00	0.53	0.37	0.78
Pleural Effusion/Pneumothorax	-0.29	0.41	0.51	0.48	0.74	0.33	1.68
Other Eye Disorders	-0.20	0.44	0.21	0.65	0.82	0.35	1.93
Other Ear, Nose, Throat, and Mouth Disorders	0.85	0.35	5.79	0.02	2.33	1.17	4.65
Dialysis Status	0.23	0.38	0.37	0.54	1.26	0.60	2.67
Renal Failure	0.30	0.26	1.33	0.25	1.35	0.81	2.24
Urinary Tract Infection	-0.47	0.25	3.40	0.07	0.63	0.38	1.03
Male Genital Disorders	-0.13	0.31	0.19	0.67	0.87	0.48	1.60
Decubitus Ulcer of Skin	1.14	0.57	3.99	0.05	3.12	1.02	9.54
Chronic Ulcer of Skin, Except Decubitus	-0.13	0.35	0.14	0.71	0.88	0.44	1.73
Other Dermatological Disorders	0.06	0.34	0.04	0.85	1.07	0.55	2.07

Data Source: 2006 CMS Medicare Claims Data Patients Admitted to California Hospitals

Table 6b. Stroke Readmission Model with Interaction Terms -- GLM (N=32,241, C-Statistic=0.627, Adjusted R-Square=0.0438)

Risk Factor	Estimate	Standard Error	Wald Chi-Square	P-value	OR	LOR	UOR
Intercept	-2.75	0.14	381.47	0.00			
Demographic							
Age (continuous)	0.00	0.00	1.08	0.30	1.00	1.00	1.01
Male	0.04	0.07	0.34	0.56	1.04	0.91	1.20
Cardiovascular/Cerebrovascular							
Congestive Heart Failure	0.21	0.13	2.65	0.10	1.24	0.96	1.60
Hypertensive heart disease	-0.15	0.25	0.37	0.54	0.86	0.52	1.40
Cerebral Hemorrhage	-0.26	0.29	0.80	0.37	0.77	0.44	1.36
Ischemic or Unspecified Stroke	0.04	0.15	0.08	0.78	1.04	0.78	1.40
Cerebrovascular Disease	0.22	0.18	1.56	0.21	1.25	0.88	1.76
Hemiplegia, paraplegia, paralysis, functional disability	0.24	0.15	2.54	0.11	1.28	0.95	1.72
Comorbidities							
Metastatic cancer and acute leukemia	0.82	0.26	10.07	0.00	2.27	1.37	3.77
Cancer	0.54	0.17	10.34	0.00	1.71	1.23	2.38
Diabetes and DM complications	0.37	0.07	23.84	0.00	1.44	1.25	1.67
Protein-calorie malnutrition	-0.07	0.22	0.09	0.76	0.94	0.61	1.44
Disorders of Fluid/Electrolyte/Acid-Base	0.26	0.12	5.07	0.02	1.30	1.03	1.64
Obesity/disorders of thyroid, cholesterol, lipids	-0.14	0.08	3.23	0.07	0.87	0.75	1.01
Severe Hematological Disorders	0.02	0.34	0.00	0.94	1.02	0.52	2.00
Iron Deficiency and Other/Unspecified Anemias and Blood Disease	0.26	0.10	6.99	0.01	1.29	1.07	1.56
Dementia and senility	0.30	0.15	3.94	0.05	1.35	1.00	1.82
Quadriplegia, paraplegia, functional disability	0.20	0.22	0.81	0.37	1.22	0.79	1.90
Seizure Disorders and Convulsions	0.03	0.12	0.08	0.77	1.04	0.82	1.31
Vascular or circulatory disease	0.03	0.14	0.04	0.84	1.03	0.78	1.35
COPD	0.38	0.11	11.94	0.00	1.46	1.18	1.81
Other lung disorder	0.15	0.17	0.74	0.39	1.16	0.83	1.64
End-stage renal disease or dialysis	0.16	0.22	0.52	0.47	1.17	0.76	1.79
Renal Failure	0.47	0.15	9.66	0.00	1.60	1.19	2.14
Other urinary tract disorders	0.30	0.13	5.71	0.02	1.35	1.06	1.74
Decubitus ulcer or chronic skin ulcer	0.30	0.20	2.23	0.14	1.35	0.91	2.00
Major Symptoms, Abnormalities	0.39	0.11	11.92	0.00	1.47	1.18	1.84

Risk Factor	Estimate	Standard Error	Wald Chi-Square	P-value	OR	LOR	UOR
Old (Age>=65)	0.46	0.11	16.97	0.00	1.59	1.27	1.98
Interactions							
Male	0.00	0.08	0.00	0.96	1.00	0.85	1.18
Cardiovascular/Cerebrovascular							
Congestive Heart Failure	-0.06	0.14	0.19	0.67	0.94	0.71	1.25
Hypertensive heart disease	0.03	0.28	0.01	0.92	1.03	0.60	1.77
Cerebral Hemorrhage	-0.02	0.37	0.00	0.95	0.98	0.47	2.01
Ischemic or Unspecified Stroke	-0.09	0.17	0.24	0.62	0.92	0.65	1.29
Cerebrovascular Disease	-0.12	0.20	0.37	0.54	0.89	0.60	1.31
Hemiplegia, paraplegia, paralysis, functional disability	-0.20	0.18	1.34	0.25	0.81	0.58	1.15
Comorbidities							
Metastatic cancer and acute leukemia	-0.54	0.30	3.30	0.07	0.58	0.33	1.04
Cancer	-0.45	0.18	6.06	0.01	0.64	0.44	0.91
Diabetes and DM complications	-0.15	0.09	2.97	0.08	0.86	0.73	1.02
Protein-calorie malnutrition	0.28	0.24	1.35	0.25	1.32	0.83	2.11
Disorders of Fluid/Electrolyte/Acid-Base	-0.18	0.13	1.87	0.17	0.83	0.64	1.08
Obesity/disorders of thyroid, cholesterol, lipids	0.02	0.09	0.03	0.85	1.02	0.86	1.20
Severe Hematological Disorders	0.25	0.40	0.37	0.54	1.28	0.58	2.80
Iron Deficiency and Other/Unspecified Anemias and Blood Disease	-0.03	0.11	0.08	0.78	0.97	0.79	1.20
Dementia and senility	-0.26	0.16	2.75	0.10	0.77	0.56	1.05
Quadriplegia, paraplegia, functional disability	-0.14	0.27	0.26	0.61	0.87	0.51	1.49
Seizure Disorders and Convulsions	0.10	0.14	0.46	0.50	1.10	0.83	1.45
Vascular or circulatory disease	0.04	0.16	0.08	0.78	1.04	0.77	1.42
COPD	-0.26	0.12	4.64	0.03	0.77	0.61	0.98
Other lung disorder	0.07	0.19	0.12	0.73	1.07	0.73	1.56
End-stage renal disease or dialysis	0.22	0.27	0.66	0.42	1.24	0.74	2.09
Renal Failure	-0.30	0.17	3.16	0.08	0.74	0.53	1.03
Other urinary tract disorders	-0.09	0.14	0.45	0.50	0.91	0.69	1.20
Decubitus ulcer or chronic skin ulcer	-0.07	0.23	0.09	0.76	0.93	0.59	1.46
Major Symptoms, Abnormalities	-0.29	0.13	5.12	0.02	0.75	0.58	0.96

Data Source: 2006 CMS Medicare Claims Data Patients Admitted to California Hospitals

Table 7a. Stroke Mortality Model Performance for Models with Interaction Terms by Patient Subgroups

Model with	N	C-statistic	SE	Lower C-stat	Upper C-stat	Predictive Ability*
All 65+	24,618	0.720	0.004	0.711	0.729	(2.94%, 35.80%)
FFS, 65+	14,530	0.720	0.006	0.708	0.731	(5.26%, 34.96%)
Non-FFS, 65+	10,088	0.723	0.007	0.709	0.736	(0.00%, 37.34%)
All 18-64	9,084	0.738	0.014	0.711	0.764	(1.95%, 39.44%)
All 18+	33,702	0.758	0.004	0.750	0.765	(1.96%, 35.99%)

Data Source: 2006 California Patient Discharge Data for All-payer Patients 18+ Admitted to California Hospitals

*Mean observation readmission in the lowest and the highest decile of the predicted mortality.

Table 7b. Stroke Readmission Model Performance for Models with Interaction Terms by Patient Subgroups

Model with	N	C-statistic	SE	Lower C-stat	Upper C-stat	Predictive Ability*
All 65+	23,300	0.596	0.006	0.585	0.607	(5.86%, 23.44%)
FFS, 65+	13,709	0.607	0.007	0.593	0.621	(NA, 23.20%)
Non-FFS, 65+	9,591	0.581	0.009	0.564	0.598	(NA, 23.85%)
All 18-64	8,941	0.672	0.010	0.653	0.692	(6.13%, 31.18%)
All 18+	32,241	0.627	0.005	0.618	0.636	(6.13%, 25.41%)

Data Source: 2006 California Patient Discharge Data for All-payer Patients 18+ Admitted to California Hospitals

*Mean observation readmission in the lowest and the highest decile of the predicted mortality.

Table 8a. Reclassification Table of Risk Categories for Stroke Mortality Model With and Without Interaction Terms

Model Without Interaction	Model With Interaction									
	0 to <5%		5% to <10%		10% to <20%		>=20%		Total	
	#	Column %	#	Column %	#	Column %	#	Column %	#	Column %
Among All 18+ Patients										
Risk Category										
0 to <5%	7,986	23.70	509	1.51	36	0.11	1	0.00	8,532	25.32
5% to <10%	822	2.44	7,536	22.36	516	1.53	44	0.13	8,918	26.46
10% to <20%	6	0.02	705	2.09	8,861	26.29	526	1.56	10,098	29.96
>=20%	0	0.00	0	0.00	368	1.09	5,786	17.17	6,154	18.26
Total	8,814	26.16	8,750	25.96	9,781	29.02	6,357	18.86	33,702	100.00
In All 65+ Patients										
Risk Category										
0 to <5%	1,240	5.04	17	0.07	0	0.00	0	0.00	1,257	5.11
5% to <10%	591	2.40	6,679	27.13	198	0.80	0	0.00	7,468	30.33
10% to <20%	0	0.00	668	2.71	8,784	35.68	356	1.45	9,808	39.84
>=20%	0	0.00	0	0.00	367	1.49	5,718	23.23	6,085	24.72
Total	1,831	7.44	7,364	29.91	9,349	37.97	6,074	24.68	24,618	100.00
In FFS 65+ Patients										
Risk Category										
0 to <5%	662	4.56	10	0.07	0	0.00	0	0.00	672	4.63
5% to <10%	321	2.21	3,759	25.87	117	0.81	0	0.00	4,197	28.89
10% to <20%	0	0.00	398	2.74	5,174	35.61	234	1.61	5,806	39.96
>=20%	0	0.00	0	0.00	218	1.50	3,637	25.03	3,855	26.53
Total	983	6.77	4,167	28.68	5,509	37.92	3,871	26.64	14,530	100.01
In Non-FFS 65+ Patients										
Risk Category										
0 to <5%	578	5.73	7	0.07	0	0.00	0	0.00	585	5.80
5% to <10%	270	2.68	2,920	28.95	81	0.80	0	0.00	3,271	32.43
10% to <20%	0	0.00	270	2.68	3,610	35.79	122	1.21	4,002	39.68
>=20%	0	0.00	0	0.00	149	1.48	2,081	20.63	2,230	22.11

Same category: 89.52
Similar category: 99.74
NRI=0.0211; P=0.0001
IDI=-0.0048; P<0.00001
RIDI=-7.0108

Same category: 91.08
Similar category: 100.00
NRI=0.0194; P=0.0001
IDI=-0.0007; P=0.0429
RIDI=0.7498

Same category: 91.07
Similar category: 100.01
NRI=0.0217; P=0.0011
IDI=-0.0010; P=0.0317
RIDI=0.6529

Same category: 91.10
Similar category: 100.02
NRI=0.0161; P=0.0343

Model Without Interaction	Model With Interaction									
	0 to <5%		5% to <10%		10% to <20%		>=20%		Total	
	#	Column %	#	Column %	#	Column %	#	Column %	#	Column %
Total	848	8.41	3,197	31.70	3,840	38.07	2,203	21.84	10,088	100.02
In All 18-64 Patients										
Risk Category										
0 to <5%	6,746	74.26	492	5.42	36	0.40	1	0.01	7,275	80.09
5% to <10%	231	2.54	857	9.43	318	3.50	44	0.48	1,450	15.95
10% to <20%	6	0.07	37	0.41	77	0.85	170	1.87	290	3.20
>=20%	0	0.00	0	0.00	1	0.01	68	0.75	69	0.76
Total	6,983	76.87	1,386	15.26	432	4.76	283	3.11	9,084	100.00

IDI=-0.0034; P=0.5655
RIDI=0.8898

Same category: 85.29
Similar category: 99.04
NRI=0.2623; P<0.00001
IDI=-0.0550; P<0.00001
RIDI=12.4988

Data Source: 2006 California Patient Discharge Data for All-payer Patients 18+ Admitted to California Hospitals

Table 8b. Reclassification Table of Risk Categories for Stroke Readmission Model With and Without Interaction Terms

Model Without Interaction	Model With Interaction									
	0 to <5%		5% to <10%		10% to <20%		>=20%		Total	
	#	Column %	#	Column %	#	Column %	#	Column %	#	Column%
Among All 18+ Patients										
Risk Category										
0 to <5%	25,017	77.59	611	1.90	23	0.07	2	0.01	25,653	79.6
5% to <10%	471	1.46	3,027	9.39	224	0.69	110	0.34	3,832	11.9
10% to <20%	1	0.00	505	1.57	788	2.44	149	0.46	1,443	4.5
>=20%	0	0.00	2	0.01	351	1.09	960	2.98	1,313	4.1
Total	25,489	79.05	4,145	12.87	1,386	4.29	1,221	3.79	32,241	100.0
In All 65+ Patients										
Risk Category										
0 to <5%	17,311	74.30	367	1.58	0	0.00	0	0.00	17,678	75.9
5% to <10%	420	1.80	2,823	12.12	42	0.18	0	0.00	3,285	14.1
10% to <20%	0	0.00	500	2.15	758	3.25	9	0.04	1,267	5.4
>=20%	0	0.00	1	0.00	347	1.49	722	3.10	1,070	4.6
Total	17,731	76.10	3,691	15.85	1,147	4.92	731	3.14	23,300	100.0
In FFS 65+ Patients										
Risk Category										
0 to <5%	9,943	72.53	222	1.62	0	0.00	0	0.00	10,165	74.2
5% to <10%	266	1.94	1,787	13.04	20	0.15	0	0.00	2,073	15.1
10% to <20%	0	0.00	292	2.13	487	3.55	8	0.06	787	5.7
>=20%	0	0.00	0	0.00	215	1.57	469	3.42	684	5.0
Total	10,209	74.47	2,301	16.79	722	5.27	477	3.48	13,709	100.0
In Non-FFS 65+ Patients										
Risk Category										
0 to <5%	7,368	76.82	145	1.51	0	0.00	0	0.00	7,513	78.3
5% to <10%	154	1.61	1,036	10.80	22	0.23	0	0.00	1,212	12.6
10% to <20%	0	0.00	208	2.17	271	2.83	1	0.01	480	5.0
>=20%	0	0.00	1	0.01	132	1.38	253	2.64	386	4.0

Same category:92.4
Similar category:99.6
NRI=0.0100; P=0.0802
IDI=-0.0031; P<0.00001
RIDI=-6.7809

Same category:92.8
Similar category:100.00
NRI=-0.0208; P=0.0004
IDI=0.0031; P<0.00001
RIDI=-0.8151

Same category: 92.54
Similar category: 100.01
NRI=-0.0199; P=0.0114
IDI=0.0032; P<0.00001
RIDI=-1.6353

Same category: 93.1
Similar category: 100.00
NRI=-0.0221; P=0.0117

Model Without Interaction	Model With Interaction									
	0 to <5%		5% to <10%		10% to <20%		>=20%		Total	
	#	Column %	#	Column %	#	Column %	#	Column %	#	Column%
Total	7,522	78.43	1,390	14.49	425	4.44	254	2.65	9,591	100.0
In All 18-64 Patients										
Risk Category										
0 to <5%	7,706	86.19	244	2.73	23	0.26	2	0.02	7,975	89.2
5% to <10%	51	0.57	204	2.28	182	2.04	110	1.23	547	6.1
10% to <20%	1	0.01	5	0.06	30	0.34	140	1.57	176	2.0
>=20%	0	0.00	1	0.01	4	0.04	238	2.66	243	2.7
Total	7,758	86.77	454	5.08	239	2.68	490	5.48	8,941	100.0

IDI=0.0029; P<0.00001
RIDI=-0.2143

Same category: 91.5
Similar category: 98.5
NRI=0.1352; P<0.00001
IDI=-0.0219; P<0.00001
RIDI=-2.8813

Data Source: 2006 California Patient Discharge Data for All-payer Patients 18+ Admitted to California Hospitals

Table 9a. Stroke RSMR in Models With and Without Interaction

	Without Interaction	With Interaction
N	33,702	33,702
Mean	0.13	0.13
Std Deviation	0.02	0.02
100% Max	0.20	0.19
99%	0.17	0.16
95%	0.15	0.15
90%	0.15	0.15
75% Q3	0.14	0.14
50% Median	0.12	0.12
25% Q1	0.11	0.11
10%	0.10	0.10
5%	0.10	0.10
1%	0.09	0.09
0% Min	0.07	0.07

Data Source: 2006 California Patient Discharge Data for All-payer Patients 18+ Admitted to California Hospitals

*Note that the results are weighted by hospital volume.

Table 9b. Stroke RSRR in Models With and Without Interaction Terms

	Without Interaction	With Interaction
N	32,241	32,241
Mean	0.13	0.13
Std Deviation	0.01	0.01
100% Max	0.16	0.16
99%	0.16	0.15
95%	0.15	0.15
90%	0.15	0.15
75% Q3	0.14	0.14
50% Median	0.13	0.13
25% Q1	0.12	0.12
10%	0.11	0.11
5%	0.11	0.11
1%	0.10	0.11
0% Min	0.10	0.10

Data Source: 2006 California Patient Discharge Data for All-payer Patients 18+ Admitted to California Hospitals

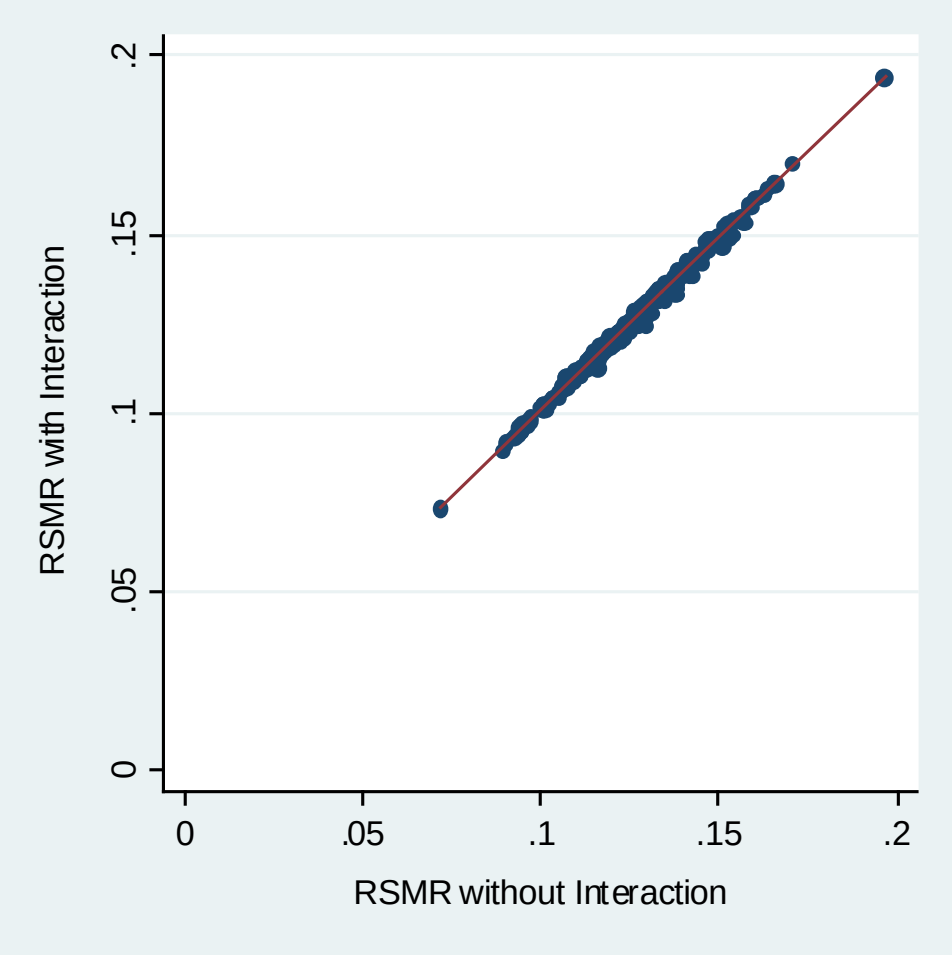
*Note that the results are weighted by hospital volume.

Table 10a. Stroke Mortality Model Performance for Models With and Without Interaction Terms (N = 33,702)

Stroke Mortality Model	C-statistic	SE	Lower C-stat	Upper C-stat
With interaction terms	0.758	0.004	0.750	0.765
Without interaction terms	0.753	0.004	0.745	0.760

Data Source: 2006 California Patient Discharge Data for All-payer Patients 18+ Admitted to California Hospitals

Figure 2a. Scatterplot of Stroke Risk-Standardized Mortality Rates (RSMRs) from Models With and Without Interaction Terms



Data Source: 2006 California Patient Discharge Data for All-payer Patients 18+ Admitted to California Hospitals

Intra-class Correlation Coefficients (ICC): 0.998

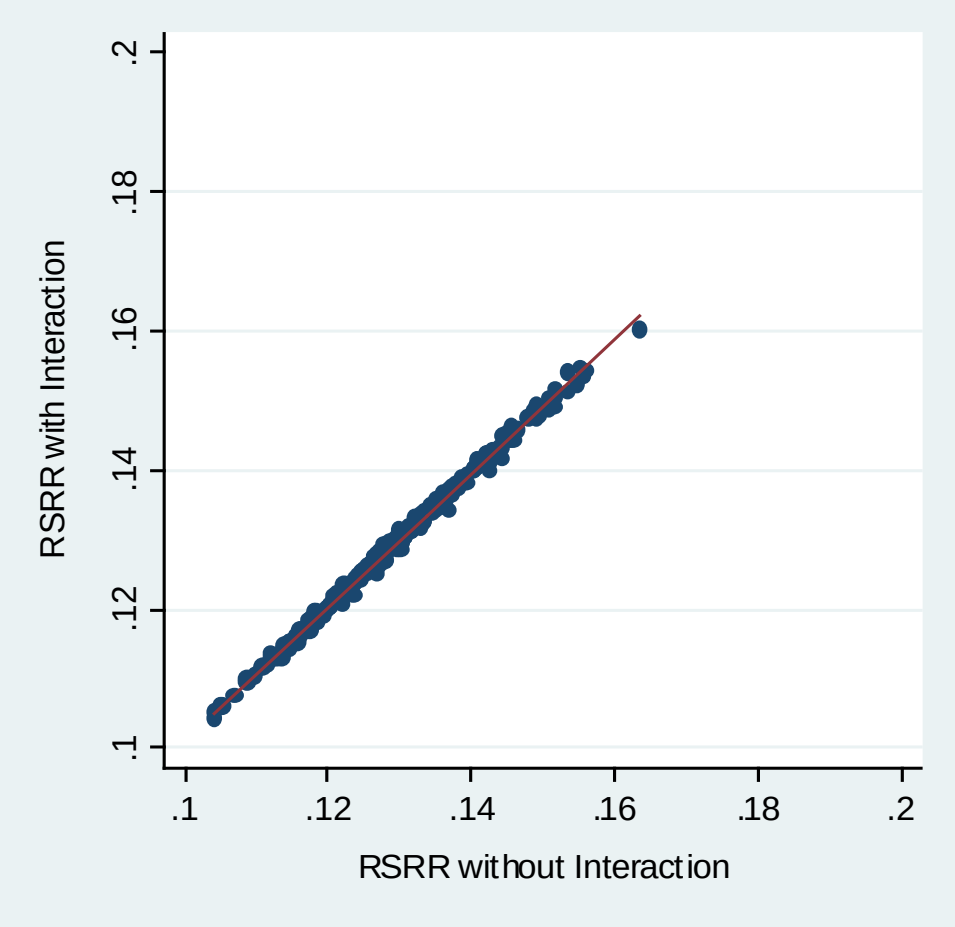
Note: 1) RSMRs are in proportions.
2) Diagonal line represents the fitted line.

Table 10b. Stroke Readmission Model Performance for Models With and Without Interaction Terms (N = 32,241)

Stroke Readmission Model	C-statistic	SE	Lower C-stat	Upper C-stat
With interaction terms	0.627	0.005	0.618	0.636
Without interaction terms	0.623	0.005	0.614	0.632

Data Source: 2006 California Patient Discharge Data for All-payer Patients 18+ Admitted to California Hospitals

Figure 2b. Scatterplot of Stroke Risk-Standardized Readmission Rates (RSRRs) from Models With and Without Interaction Terms



Data Source: 2006 California Patient Discharge Data for All-payer Patients 18+ Admitted to California Hospitals

Intra-class Correlation Coefficients (ICC): 0.998

Note: 1) RSRRs are in proportions.
2) Diagonal line represents the fitted line.