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Stroke Patient Outcomes in US Hospitals Prior to the Start of the Joint Commission Primary Stroke Center Certification Program

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Abstract

Background and Purpose—The Joint Commission (JC) began certifying Primary Stroke Centers in November, 2003. Cross-sectional studies assessing the impact of certification could be biased if these centers had better outcomes prior to the start of the program. We determined whether hospitals certified within the first years of the JC program had better outcomes than non-certified hospitals prior to the start of the certification program.

Methods—The study sample included Medicare fee-for-service beneficiaries ≥65 years of age discharged with ischemic stroke in 2002 from 5070 hospitals, 317 of which were JC-certified by June, 2007. Hierarchical logistic regression and Cox proportional hazards models were used to compare in-hospital and 30-day mortalities and 30-day readmission for patients treated at future JC-certified versus non-certified hospitals.

Results—Among 366,551 patients, 18% (66,300) were treated at hospitals with centers that were JC-certified within the first few years of the program. These patients were younger, more likely to be white and male, and had fewer comorbidities and hospitalizations within the prior year. Unadjusted in-hospital mortality (4.7% vs. 5.5%), 30-day mortality (9.8% vs. 11.3%) and readmissions (13.8% vs. 14.6%) were lower in the future JC-certified hospitals (all p<0.001). These differences remained after risk adjustment (in-hospital mortality, OR=0.93, 95%CI 0.90–0.96; 30-day mortality, OR=0.92, 95%CI 0.87–0.96; 30-day readmission, HR=0.97, 95%CI 0.95–0.99).

Conclusions—JC Primary Stroke Center-certified hospitals had better outcomes than non-certified hospitals even before the program began. Cross-sectional studies assessing the effects of stroke center certification need to account for these pre-existing differences.

Keywords

ischemic stroke; certified stroke center; outcomes

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There are no conflicts of interest to report.

Introduction

The Joint Commission (JC) began certifying Primary Stroke Centers in November, 2003 based on the recommendations from the Brain Attack Coalition and the American Stroke Association (ASA).[1-4] The JC awards certification to Primary Stroke Centers that demonstrate compliance with national standards, Primary Stroke Center recommendations, clinical practice guidelines, and performance measurement and improvement activities. Certified centers undergo an on-site review every 2 years and report on quality measures quarterly. Studies that examine the impact of Primary Stroke Center certification have focused on the evaluation of process measures[5-8] and information on patient outcomes is limited. Studies analyzing the potential impact of the Primary Stroke Center program using cross-sectional analysis may be biased if hospitals obtaining JC certification have better outcomes even before participating in the program. We hypothesized that patient outcomes from hospitals that obtained JC certification during the early phases of the program differed from those that did not seek certification before the program began. To test this hypothesis, we compared the unadjusted and risk-adjusted 30-day mortality and readmission rates of elderly ischemic stroke patients treated at hospitals that would become JC certified within the first few years of the program as compared to those treated at hospitals that did not subsequently become JC certified within the same time period.

Methods

Study sample

The study population included all Medicare fee-for-service (FFS) beneficiaries 65 years of age or older hospitalized with a primary discharge diagnosis of ischemic stroke from January 1, 2002, through December 31, 2002 who were identified based on the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM 433, 434, 436). Data were obtained from the Medicare Provider Analysis and Review (MEDPAR) files that included demographic information, primary and secondary discharge diagnosis codes, and procedure codes for each hospitalization for all FFS Medicare patients. Patients who were under 65 years of age were not included in the analysis because they do not represent typical Medicare patients. Patients who were discharged from non-acute care facilities, transferred to or from another acute care facility, discharged within one day of admission, or who left the hospital against medical advice were excluded. We further limited the cohort to patients with at least 12 months of continuous FFS status prior to the index ischemic stroke hospitalization to allow assessment of comorbid conditions.

We identified 317 JC-certified Primary Stroke Centers from the start of the program in November, 2003 through May 30, 2007 by matching the Medicare provider numbers with an online list of JC-certified centers.[9] In addition, we identified hospitals that were certified under state programs in New York,[10] Massachusetts,[10, 11] and Florida.[12] Hospitals with state certification were included in secondary analyses.

Patient and hospital characteristics

Patient characteristics included age, sex, race, number of hospitalizations in the previous year (dichotomized as ≥2 vs. <2), Deyo comorbidity index[13] (dichotomized as ≥3 vs. <3), medical history, and comorbid conditions. Conditions included prior stroke, myocardial infarction, congestive heart failure (CHF), atrial fibrillation (AF), chronic obstructive pulmonary disease (COPD), dementia, diabetes, cancer, coronary artery bypass graft surgery (CABG) and percutaneous transluminal coronary angioplasty (PTCA), smoking status, and hypertension. These were identified from MEDPAR files using ICD-9-CM diagnostic codes in the year prior to the index hospitalization to avoid misclassifying pre-existing conditions as complications.

Hospital characteristics (hospital bed size, teaching status, and hospital setting) were obtained from the American Hospital Association's 2002 Annual Survey Database. Hospital bed size was categorized as <100, 100–199, 200–299, and ≥300 beds. Hospital setting was categorized as rural (<10,000 population), micropolitan (10,000–50,000 population), metropolitan (>50,000 population) and division (part of a metropolitan area with >2.5 million population).

Outcomes

Primary outcomes included in-hospital mortality, defined as death during the index hospitalization, and 30-day all-cause mortality, defined as death from any cause 30 days following the index admission. Mortality data were determined using the Medicare Enrollment Database. The accuracy of ascertainment of vital status using these data resources is high for this age group age.[14-16] Secondary outcomes, including all-cause hospital readmission and readmission for recurrent vascular disease and common complications, were assessed within 30 days of the index hospital discharge. Patients who died during the index hospitalization or were transferred to another acute care facility were excluded from the 30-day readmission analyses. Recurrent vascular events and complications that warranted readmission within 30 days included recurrent ischemic stroke, any stroke, pneumonia, peripheral arterial disease, urinary tract infection, hip fracture, pulmonary embolism, and coronary artery disease and were identified using the principle diagnostic code at discharge (E-Figure 1).

Statistical analysis

Bivariate analyses were conducted to compare patient characteristics by JC certification status using t-tests for continuous variables and chi-squared statistics for categorical variables. Hierarchical random effects logistic models were used to assess the difference in odds of mortality between patients admitted to JC-certified and non-certified hospitals while adjusting for patient clustering within hospitals. Readmission rates were compared by JC certification status using Cox proportional hazards models with censoring for deaths. Models were adjusted for patient characteristics and medical history. In secondary analyses, we used the same analytic approach to compare outcomes stratified by certification type (JC and state-certified hospitals), using hospitals that did not receive JC or state certification as the referent group. All analyses were conducted using SAS version 9.1.3 (SAS Institute Incorporated, Cary, North Carolina).

Results

A total of 366,551 Medicare ischemic stroke discharges were included in the analyses. The mean age of beneficiaries was 78.2 ± 7.6 years, 56.2% were women and 85.7% were white (Table 1). A total of 66,300 discharges (18%) were from centers that would become JC-certified within the first few years of the program. Beneficiaries treated at hospitals with future JC-certified Primary Stroke Centers were more likely to be white, younger, and male ($p<0.0001$ for all comparisons). These patients were less likely to have 3 or more comorbid conditions and had lower rates of prior stroke, CHF, COPD, dementia and diabetes, but higher rates of hypertension, AF, prior myocardial infarction, and prior cardiac procedures compared with patients who were not treated at hospitals with future JC-certified centers ($p<0.001$ for all comparisons). They were also more likely to have been hospitalized two or more times during the year prior to the index stroke hospitalization.

Hospitals that received JC Primary Stroke Center certification were larger than those that did not (mean bed size of 419.9 ± 239.9 vs. 158.0 ± 164.2, $p<0.001$; Table 2). Almost one-third of certified centers were in teaching hospitals as compared to only 4.7% of non-certified hospitals. JC-certified stroke centers were generally located in more populous areas, with over 97% situated within a metropolitan or division setting as compared with 60% for non-certified hospitals.

Unadjusted in-hospital mortality was lower in JC-certified hospitals as compared with non-certified hospitals (4.7% vs. 5.5%, p<0.001; Figure 2). Outcomes at 30 days were also better for patients treated at hospitals with future JC-certified stroke centers, including mortality (9.8% vs. 11.3%, p<0.001), readmission for selected complications (7.3% vs. 7.9%, p<0.001), and all cause readmission (13.8% vs. 14.6%, p<0.001). The risk of hospital admission within 30 days was lower for stroke, pneumonia, and peripheral arterial disease, but was similar for urinary tract infection, hip fracture, pulmonary embolism, and coronary artery disease (Table 3). In risk-adjusted analyses (Figure 3), the patients who were treated at hospitals with future JC-certified Primary Stroke Centers had lower risks of death during the acute hospitalization (Odds Ratio (OR)=0.93, 95% CI 0.90 to 0.96) and after 30 days (OR=0.92, 95% CI 0.87 to 0.96). These patients also had a lower risk of readmission for selected complications (HR=0.93, 95% CI 0.90 to 0.96) and all-cause readmission (Hazards Ratio (HR)=0.97, 95% CI 0.95 to 0.99) within 30 days following hospital discharge.

Because three states (New York, Florida, and Massachusetts) had their own certification programs, we repeated our analyses comparing state-certified centers with non-certified centers. Hospitals with state-certified stroke centers had a lower risk-adjusted 30-day mortality (OR=0.89, 95% CI 0.85 to 0.94) as compared with the non-certified hospitals, but had comparable 30-day readmission rates (HR=1.04, 95% CI 1.00 to 1.09).

Discussion

In this study of elderly FFS Medicare beneficiaries, we found that hospitals obtaining early JC Primary Stroke Center certification had lower 30-day patient mortality and readmission rates (all-cause and for selected complications) than non-certified centers at least 11 months before the certification program began. These pre-existing differences need to be accounted for in studies that assess the impact of Primary Stroke Centers on patient outcomes.

Participation in quality improvement efforts and registries that focus on health care practices improve adherence with recommended therapies.[17-20] It has been suggested that hospitals with quality improvement strategies and stroke units are more experienced and facile in providing interventions such as thrombolytic therapy.[6, 21] A recent study evaluating the impact of the AHA Get With the Guidelines Stroke program found that the duration of participation, independent of secular trends, was associated with increased adherence to all stroke performance measures.[19] Participating hospitals with larger bed capacity, higher annual stroke volume, and teaching status had greater improvements. We found that these characteristics were also more common in hospitals that later received JC certification. Thus, there appear to be differences between the hospitals that obtained Primary Stroke Center certification and those that did not. These preexisting differences may prepare hospitals to more easily meet the requirements for JC certification resulting in better patient outcomes. In secondary analyses, we also found that state certified Primary Stroke Centers had lower mortality rates than non-certified centers, but not lower 30-day readmission rates as was found for JC-certified hospitals. This may reflect differences in the characteristics of the centers as well as differences in the rigor with which the programs are reviewed.

We found that the risk of hospital admission within 30 days in early JC-certified hospitals was lower for stroke, pneumonia, and peripheral arterial disease, but was similar to non-certified hospitals for urinary tract infection, hip fracture, pulmonary embolism, and coronary artery disease. The reasons for this finding are not clear, but may in part reflect the low prevalence rates for some of these conditions. In addition, we identified differences in the characteristics of patients who presented to the hospitals that received JC certification within the first few years of the program. These may be due to patient self-selection and/or referral patterns to

these hospitals; however, differences in outcomes persisted after adjusting for demographic and clinical factors.

The present study has a number of limitations. The index ischemic stroke cases and complications were ascertained using ICD-9 codes and were restricted to hospitalized events. Positive predictive values for the selected codes for ischemic stroke, however, are high,[22, 23] and there is no reason to expect differences in data coding across institutions by subsequent JC-certification status. Although our results only reflect hospitalized events, community-based studies indicate that less than 15% of strokes are not admitted to the hospital.[24, 25] Medicare inpatient data does not contain information on medication utilization; therefore, we were unable to address potential differences in the receipt of recommended acute or secondary preventive therapies, including the administrative of tPA, which was not a reimbursable code at the time of these analyses. Additional factors affecting stroke outcomes, such as stroke severity, are not reflected in administrative records. Because our analyses are limited to beneficiaries over age 65 years, the data may not be applicable to younger stroke patients cared for at these hospitals. Our results, however, do reflect the experiences of all fee-for-service ischemic stroke patients hospitalized within the United States, and the longitudinal data, including outcomes after the index hospitalization, cannot be obtained from current registries.[19]

Patients treated at hospitals that received Joint Commission certification within the first few years of the program had better outcomes than patients treated at non-certified centers even before the certification program began. To avoid incorrectly attributing possible benefits of Primary Stroke Center certification on patient outcomes, cross-sectional studies need to account for pre-existing differences between certified and non-certified hospitals.

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Figure 1.
Location of Joint Commission Certified Primary Stroke Centers in the United States

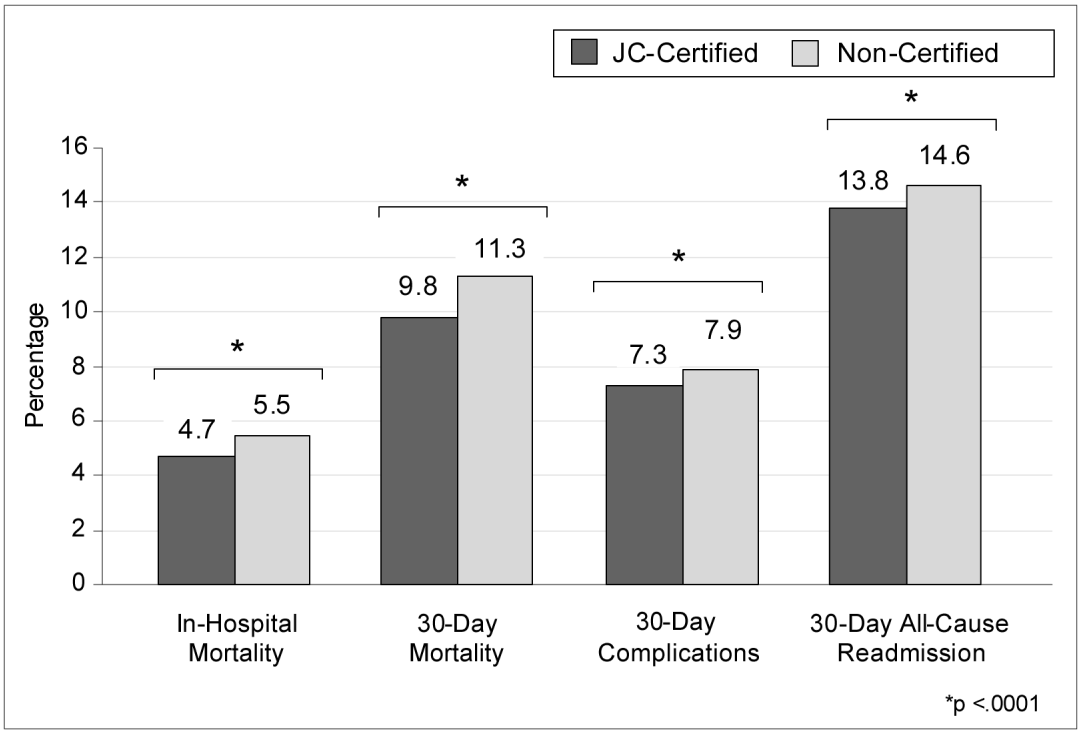

Figure 2.
Unadjusted Outcomes by Status of Joint Commission Certification

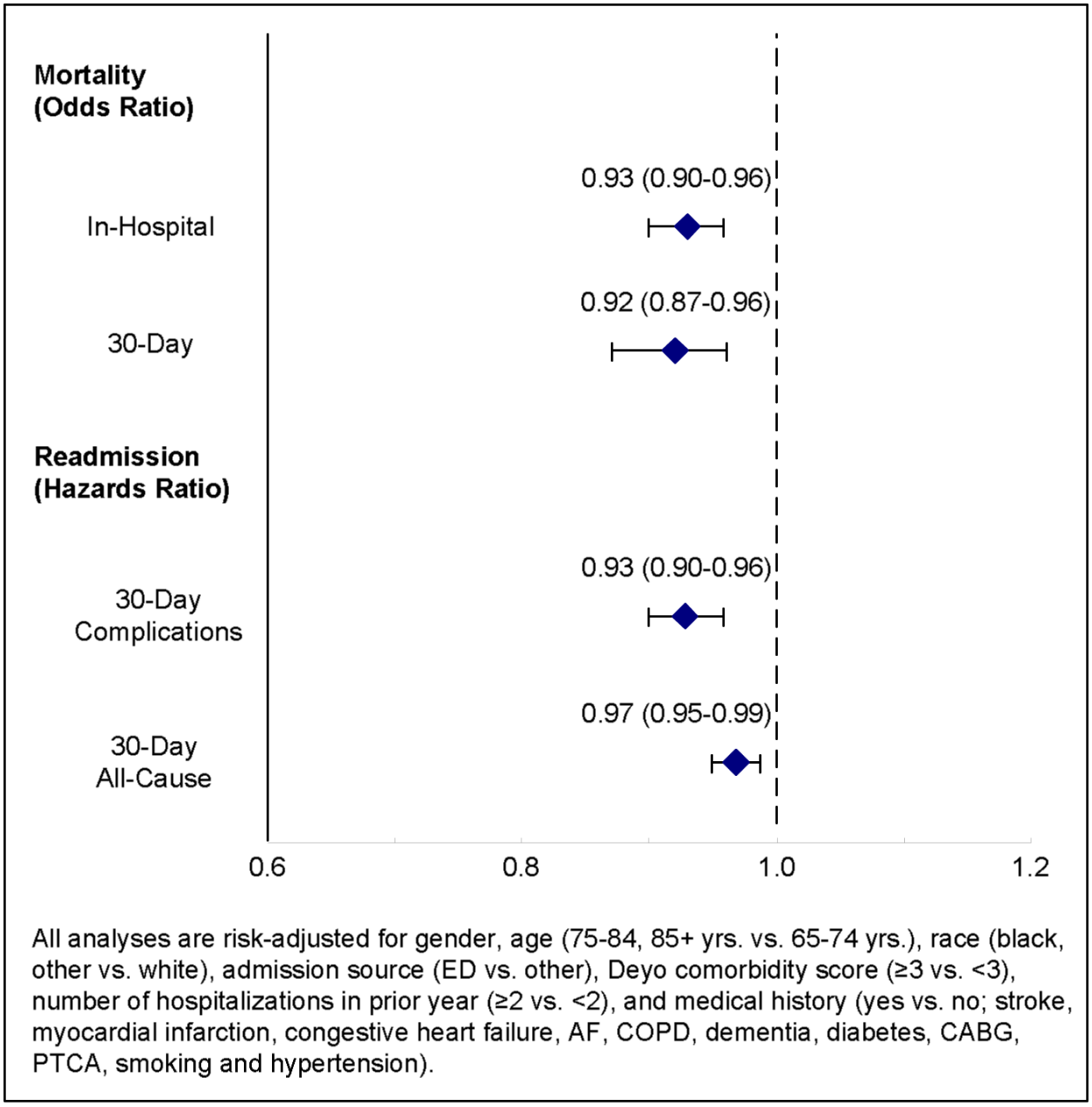

Figure 3.
Risk-Adjusted Mortality and Hospital Readmission (Joint Commission Certified vs. Non-Certified Hospitals)

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Table 1

Characteristics of Stroke Patients by Joint Commission Primary Stroke Center Certification Status

Characteristics	Total (N=366,551)		JC-Certified (N=66,300)	Non-Certified (N=300,251)	
	N	%	%	%	P-value
Age (mean ± SD, years)	78.2 ± 7.6		77.8 ± 7.4	78.3 ± 7.6	<.0001
65–74	124,801	34.1	36.0	33.6	
75–84	161,713	44.1	44.5	44.0	
85+	80,037	21.8	19.5	22.4	
Women	205,972	56.2	53.5	56.8	<.0001
Race					<.0001
White	314,181	85.7	87.2	85.4	
Black	36631	10.0	9.6	10.1	
Hispanic	6,299	1.7	0.9	1.9	
Other	9,440	2.6	2.3	2.6	
Hospitalizations in Past Year ≥ 2	52,549	14.3	12.6	14.7	<.0001
Deyo Comorbidity Score ≥ 3	97,804	26.7	24.3	27.2	<.0001
Medical History					
Stroke	44,924	12.3	11.7	12.4	<.0001
Myocardial Infarction	38,028	10.4	11.8	10.1	<.0001
Congestive Heart Failure	39,830	10.9	9.4	11.2	<.0001
Atrial Fibrillation	73,102	19.9	20.7	19.8	<.0001
COPD	71,710	19.6	18.5	19.8	<.0001
Dementia	27,446	7.5	6.2	7.8	<.0001
Diabetes	107,330	29.3	27.7	29.6	<.0001
Cancer	9,506	2.6	2.5	2.6	0.0211
CABG	33,120	9.0	11.0	8.6	<.0001
PTCA	11,041	3.0	4.0	2.8	<.0001
Smoker	35,248	9.6	13.0	8.9	<.0001
Hypertension	239,273	65.3	66.9	64.9	<.0001

Table 2

Hospital Characteristics by Joint Commission Primary Stroke Center Certification Status

	Total (N=5,070)		JC-Certified (N=317)	Non-Certified (N=4,753)	
	N	%	%	%	P-value
Bed size (mean ± SD, number)	177.0 ± 183.8		419.9 ± 239.9	158.0 ± 164.2	<.0001
<100 beds	1,871	43.5	2.5	46.7	<.0001
100–299 beds	1,652	38.4	31.1	38.9	
300 or more beds	783	18.2	66.4	14.4	
Teaching Hospital	290	6.7	31.7	4.7	<.0001
Setting					<.0001
Rural (Pop. <10k)	885	20.3	0.3	21.9	
Micropolitan (Pop. 10–25K)	751	17.2	2.5	18.4	
Metropolitan (Pop. >50K)	2,012	46.2	75.0	43.9	
Division (Pop. >2.5 mil)	709	16.3	22.2	15.8	

Table 3

Unadjusted Outcomes by Joint Commission Primary Stroke Center Certification Status

	Total		JC-Certified	Non-Certified	
	N	%	%	%	P-value
Length of Stay (mean ± SD, days)	5.0 ± 4.3		4.6 ± 4.0	5.1 ± 4.4	<.0001
In-Hospital Mortality	19,614	5.4	4.7	5.5	<.0001
30-Day Mortality	40,421	11.0	9.8	11.3	<.0001
30-Day All-Cause Readmission*	48,628	14.5	13.8	14.6	<.0001
30-Day Complications*†	26,158	7.8	7.3	7.9	<.0001
Ischemic Stroke	12,498	3.7	3.5	3.8	0.0003
Any Stroke	13,346	4.0	3.7	4.0	0.0006
Pneumonia	2,370	0.7	0.5	0.8	<.0001
Peripheral Arterial Disease	19,176	5.7	5.4	5.8	0.0023
Urinary Tract Infection	1,464	0.4	0.4	0.4	0.0759
Hip Fracture	552	0.2	0.2	0.2	0.2765
Pulmonary Embolism	401	0.1	0.1	0.1	0.8002
Coronary Artery Disease	2,785	0.8	0.8	0.8	0.8900

*Excludes deaths within 30 days and discharges to other acute care facilities

†Individual categories are not mutually exclusive