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Do past mortality rates predict future hospital mortality?

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Abstract

BACKGROUND: This study aimed to determine whether hospitals with higher historical mortality rates are independently associated with worse patient outcomes.

METHODS: Observational study of in-hospital mortality in open abdominal aortic aneurysm repair, aortic valve replacement, and coronary artery bypass graft surgery in a California in-patient database was conducted. Hospitals' annual historical mortality rates between 1998 and 2010 were calculated based on 3 years of data before each year. Results were adjusted for race, sex, age, hospital teaching status, admission year, insurance status, and Charlson comorbidity index.

RESULTS: Hospitals were divided into quartiles based on historical mortality rates. For abdominal aortic aneurysm repair, the odds ratio (OR) of in-hospital mortality for hospitals within the highest quartile of prior mortality was 1.30 compared with the lowest quartile (95% confidence interval [CI] 1.03 to 1.63). For aortic valve replacement, the OR was 1.41 for the 3rd quartile (95% CI 1.15 to 1.73) and 1.54 for the highest quartile (95% CI 1.27 to 1.87). For coronary artery bypass graft surgery, the OR was 1.33 for the 3rd (95% CI 1.2 to 1.49) and 1.58 for the highest (95% CI 1.41 to 1.76) quartiles.

CONCLUSION: Patients presenting to hospitals with high historical mortality rates have a 30% to 60% increased mortality risk compared with patients presenting to hospitals with low historical mortality rates.

The relationship between hospital volume and patient outcomes has been extensively studied and a hospital's past procedure volume has been shown to predict subsequent mortality.[1] The predictive value of a hospital's past mortality rate is less well known. One might argue that historical mortality rates are not reliable because of random complications, an unpredictable case mix or immeasurable factors. These factors may not be accounted for by past mortality rates, thus complicating its predictive value.[2] For example, Glance et al[3] found that while 2-year-old data could predict the future performance of individual trauma centers, data that are older than 3 years did not accurately predict trauma center's future performance. On the other hand, procedures that are commonly performed at a hospital should have consistent results, thus supporting the use of mortality rates as a measure of hospital quality.

The purpose of this study is to analyze whether a hospital's past experience with a procedure has an independent impact on future in-patient mortality. Specifically, we hypothesize

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Table 1 Patient characteristics

	AAA	AVR	CABG
Total admissions	60,154	77,967	317,040
Age (years), mean (SD)	69.4 (16.4)	71.1 (13.2)	68.8 (10.5)
Sex			
Female	12,013 (26.72%)	19,837 (38.02%)	162,511 (71.51%)
Male	32,948 (73.28%)	32,342 (61.98%)	64,761 (28.49%)
Race			
Non-Hispanic White	34,993 (85.18%)	38,734 (82.56%)	157,976 (79.05%)
Black	1,484 (3.61%)	1,280 (2.73%)	5,543 (2.77%)
Hispanic	2,658 (6.47%)	4,598 (9.80%)	20,554 (10.28%)
Asian	1,494 (3.64%)	1,540 (3.28%)	11.644 (5.83%)
Indian/Other	450 (1.10%)	764 (1.63%)	4,131 (2.07%)
Insurance			
Medicare or private coverage	51,558 (91.54%)	67,462 (90.96%)	250,448 (88.37%)
Other	4,767 (8.46%)	6,705 (9.04%)	32,976 (11.63%)
Charlson comorbidity index			
0	6,584 (10.95%)	24,410 (31.31%)	73,177 (23.08%)
1–2	40,037 (66.56%)	41,868 (53.70%)	180,323 (56.88%)
3+	13,533 (22.50%)	11,689 (14.99%)	63,540 (20.04%)
Mortality			
Inpatient mortality	4,746 (7.89%)	4,065 (5.21%)	10,803 (3.41%)
Hospital factors			
Teaching hospital	10,833 (18.01%)	13,875 (17.80%)	32,633 (10.29%)
Ruptured AAA	5,356 (8.90%)		

AAA = abdominal aortic aneurysm; AVR = aortic valve replacement; CABG = coronary artery bypass graft; SD = standard deviation.

that hospitals with higher historical mortality rates would be independently associated with higher future all-cause in-patient mortality rates for the same procedure, even after accounting for patient confounders.

Methods

We performed an observational study of in-hospital mortality in open abdominal aortic aneurysm (AAA) repair, aortic valve replacement (AVR), and coronary artery bypass graft surgery (CABG) in a statewide in-patient database from the California Office of Statewide Health Planning and Development (OSHPD).

The study included 3 cohorts: AAA repair, AVR, and CABG. Starting with the list of Leapfrog procedures, operations were selected with high in-hospital mortality risks, because our primary outcome variable was in-hospital mortality, and large patient populations in order to have sufficient sample size for calculations. Patients undergoing AAA repairs were identified by admissions with International Classification of Diseases, 9th Edition (ICD-9) procedure codes 38.34, 38.44, 38.64, 39.25, or 39.71. AVR admissions were identified by ICD-9 procedure codes 35.21 and 35.22. CABG admissions included procedure codes 36.10 to 17.

The primary outcome variable was all-cause in-hospital mortality for each procedure. The primary independent variable was a hospital's all-cause historical mortality for each procedure. These historical mortality rates were calculated for each year between 1998 and 2010. They were calculated based on 3 years of data before each index year. For example, for the 2000 data, the hospital's historical mortality rate was based on their procedural mortality rates from 1997 to 1999. For the 2003 data, those hospitals' historical rates were recalculated based on data from 2000 to 2002. These varying historical mortality rates are the primary independent variable for each year's adjusted analysis. Additional covariates included race, sex, age, hospital teaching status, admission year, insurance status, and Charlson comorbidity index. The Charlson comorbidity index is a measure of comorbidities based on the presence or absence of certain diagnoses in the patient. These are then combined together in a weighted formula.[4] Hospital teaching status was defined by the presence of a general surgical residency program. Statistical analyses were performed using STATA 11.1 software (StataCorp, College Station, TX), with statistical significance set at a P value of less than or equal to .05.

Results

A total of 455,161 patients were analyzed (Table 1). For AAA and AVR, the patients were primarily non-Hispanic white men covered by Medicare or private coverage, while for CABG the average patient was female. Patients typically had a Charlson comorbidity score between 1% and 2%, and 8.9% of patients presenting for AAA repair had a ruptured aneurysm. The mortality rates for AAA repair, AVR, and CABG were 7.9%, 5.2%, and 3.4%, respectively.

Unadjusted analyses of 3-year historical mortality versus current year mortality in 2000, 2005, and 2010 are shown in