Methods

Measuring Hospital Quality: Can Medicare Data Substitute for All-Payer Data?

Jack Needleman, Peter I. Buerhaus, Soeren Matthe, Maureen Stewart, and Katya Zelevinsky

Objectives. To assess whether adverse outcomes in Medicare patients can be used as a surrogate for measures from all patients in quality-of-care research using administrative datasets.

Data Sources. Patient discharge abstracts from state data systems for 799 hospitals in 11 states. National MedPAR discharge data for Medicare patients from 3,357 hospitals. State hospital staffing surveys or financial reports. American Hospital Association Annual Survey.

Study Design. We calculate rates for 10 adverse patient outcomes, examine the correlation between all-patient and Medicare rates, and conduct negative binomial regressions of counts of adverse outcomes on expected counts, hospital nurse staffing, and other variables to compare results using all-patient and Medicare patient data.

Data Collection/Extraction. Coding rules were established for eight adverse outcomes applicable to medical and surgical patients plus two outcomes applicable only to surgical patients. The presence of these outcomes was coded for 3 samples: all patients in the 11-state sample, Medicare patients in the 11-state sample, and Medicare patients in the national Medicare MedPAR sample. Logistic regression models were used to construct estimates of expected counts of the outcomes for each hospital. Variables for teaching, metropolitan status, and bed size were obtained from the AHA Annual Survey.

Principal Findings. For medical patients, Medicare rates were consistently higher than all-patient rates, but the two were highly correlated. Results from regression analysis were consistent across the 11-state all-patient, 11-state Medicare, and national Medicare samples. For surgery patients, Medicare rates were generally higher than all-patient rates, but correlations of Medicare and all-patient rates were lower, and regression results less consistent.

Conclusions. Analyses of quality of care for medical patients using Medicare-only and all-patient data are likely to have similar findings. Measures applied to surgery patients must be used with more caution, as those tested only in Medicare patients may not provide results comparable to those from all-patient samples or across different samples of Medicare patients.

Key Words. Quality of care, reproducibility of results, Medicare, nursing care

Monitoring quality of care across institutions and over time and examining the correlates of quality are critical to pursuing effective policy to improve quality (Institute of Medicine Committee on Quality of Health Care in America 2001; Kohn et al. 2000). Medical record abstraction has been the "gold standard" for constructing quality measures but the costs associated with abstracting data from the patient's chart makes its use infeasible in monitoring quality and overall health system performance and examining the factors that influence quality. Researchers wishing to conduct analysis on large samples of hospitals have turned to less expensive and more readily available administrative data, primarily patient discharge abstracts, to construct measures of hospital quality (Agency for Healthcare Research and Quality 2000; Ball et al. 1998; Geraci 2000; Iezzoni, Daley, Heeren, Foley, Hughes et al. 1994; Iezzoni, Daley, Heeren, Foley, Fisher et al. 1994; Johantgen et al. 1998; Kuykendall et al. 1995; Silber and Rosenbaum 1997).

Over 40 states now collect discharge abstracts on all hospitalized patients in acute care hospitals. These data vary in completeness, number of primary and secondary diagnoses and procedures reported, presence of other patient information, such as race/ethnicity and insurer, years available, and cost. The Centers for Medicare and Medicaid Services' (CMS) MedPAR system contains information on hospital discharges for all Medicare patients. These data are relatively inexpensive, consistently coded, available for virtually all acute care hospitals in the United States, and have been used in many studies (Lawthers et al. 2000; Romano et al. 1994; Romano et al. 1995; Weingart et al. 2000). There are, however, important differences between the

This research was carried out under contract no. 230-99-0021 with the U.S. Department of Health and Human Services, Health Resources and Services Administration, with funding from the Health Resources and Services Administration, Agency for Healthcare Research and Quality, Centers for Medicare and Medicaid Services, and the National Institute of Nursing Research. Additional analysis was supported by grant no. HS09958 from the Agency for Healthcare Research and Quality. The preparation of this manuscript was supported in part by a Dissemination and Development Grant from Abt Associates Inc. to Dr. Matke. At the time the research was conducted, Dr. Needleman and Ms. Stewart were at the Harvard School of Public Health and Dr. Matke was at the Harvard School of Public Health and Abt Associates.

Address correspondence to Jack Needleman, Ph.D., Department of Health Services, UCLA School of Public Health, P.O. Box 951772, Los Angeles, CA 90095-1772. Peter I. Buerhaus, Ph.D., R.N., F.A.A.N., is the Valere Potter Professor and Senior Associate Dean for Research at Vanderbilt University School of Nursing, Nashville, TN. Soeren Matke, M.D., D.S.c., M.P.H., is with RAND Health in Arlington, VA. Maureen Stewart, B.A., is with Heller School for Social Policy and Management, Brandeis University, Waltham, MA. Katya Zelevinsky, B.A., is with the Department of Health Policy and Management, Harvard School of Public Health, Boston.

state and national discharge data on Medicare patients. For example, the public-use MedPAR data do not include information on dates for procedures and have fewer coded secondary diagnoses and procedures than most state datasets. Nevertheless, the quality of patient care based on Medicare data is often regarded as a surrogate measure of the quality of care for *all* hospitalized patients.

Although the data on Medicare patients contained within all-patient state datasets are generally consistent with information on Medicare patients in the CMS Medicare data (Medstat Group Research and Policy Division 2000), and there is some evidence that hospital admission patterns for all patients can be predicted from the admission patterns of Medicare patients (Radany and Luft 1993), it is an empirical question whether Medicare data can be used as a close substitute for all-patient data for hospital quality studies.

Quality measures have been used in studies to assess quality in specific hospitals and in studies of hospital characteristics associated with quality care. We focus on the second type of study and assess whether all-patient and Medicare data provide the same results in regression-based studies of correlates of quality across a range of measures. We analyze data from a sample of all-patient discharge abstracts for hospitals in 11 states, and patients in a national sample drawn from MedPAR data, examining three samples of patients: the 11-state all-patient sample, the Medicare patients in the 11-state data (11-state Medicare sample), and national MedPAR sample. Our quality indicators were developed and tested in a larger study that examined the association of patient outcomes and nurse staffing in acute care hospitals (Needleman et al. 2002; Needleman et al. 2001).

Our analytic strategy is first to compare rates of adverse outcomes and results from regression analysis of outcomes on nurse staffing in the 11-state all-patient sample to those from analysis of the 11-state Medicare sample. This comparison allows us to draw conclusions on how closely Medicare patients are a surrogate for all patients in the same sample of hospitals using consistently coded discharge data and identical measures of nurse staffing. Because researchers working with Medicare data will likely use data from the CMS national MedPAR files, and because less information is available on these abstracts than in most state discharge abstracts, we compare adverse outcome rates and regression results in the national MedPAR sample with those from our 11-state Medicare and 11-state all-patient samples to determine if the results from the MedPAR and state data are consistent. We find some differences in regression results between the MedPAR and two 11-state samples and conduct additional analyses to determine the source of these differences.

METHODS

Study Population

All-patient hospital discharge abstract data and nurse staffing data were obtained from 11 states that collect both sets of information: Arizona, California, Maryland, Massachusetts, Missouri, Nevada, New York, South Carolina, Virginia, West Virginia, and Wisconsin. We estimated calendar year 1997 staffing as the weighted average of staffing in hospital fiscal years 1997 and 1998, except for Virginia, for which only fiscal 1997 data were available. We obtained discharges for calendar year 1997 (for Virginia, the four calendar quarters matching each hospital's fiscal year). The initial sample was 1,041 hospitals. We then excluded hospitals with an average daily census below 20, occupancy rate below 20 percent, missing staffing data, or reporting extremely low (below the 7.5 percentile) or high (above the 92.5 percentile) staffing per patient day. The final sample included 799 hospitals, which together had 26 percent of the 1997 discharges for nonfederal hospitals in the United States.

To construct a second analytic sample (the national MedPAR sample), we used the CMS public use Medicare MedPAR discharge data file for 1997, and the American Hospital Association (AHA) Annual Survey data for 1997 and 1998. The AHA data were used to apply the same exclusions to the MedPAR sample as used in the 11-state sample. The final sample size for the MedPAR sample was 3,357 hospitals.

Constructing Measures of Adverse Patient Outcomes

Based upon an extensive review of research reported in the literature and unpublished evidence (Blegen, Goode, and Reed 1998; Bryan et al. 1998; Czaplinski and Diers 1998; Iezzoni, Daley, Heeren, Foley, Hughes et al. 1994; Iezzoni, Daley, Heeren, Foley, Fisher et al. 1994; Karon 1999; Keyes 2000; Kovner and Gergen 1998; Lichtig, Knauf, and Milholland 1999; Palmer et al. 1996; Silber, Sainfort, and Zimmerman 1992; U.S. Department of Health and Human Services Agency for Healthcare Research and Policy 2001; Wan and Shukla 1987), we identified measures of adverse outcomes or hospital-acquired complications that could be coded from hospital discharge abstracts. In this study, we use eight measures applicable to both medical patients and major surgery patients: adjusted length of stay, urinary tract infections (UTIs), skin pressure ulcer, pneumonia, shock/cardiac arrest, upper gastrointestinal (UGI) bleeding, sepsis, failure to rescue (defined as death among patients with hospital-acquired pneumonia, shock/cardiac arrest, UGI bleeding, sepsis, or

deep vein thrombosis). Two outcomes applicable to surgical patients only are also examined: surgical wound infection and metabolic derangement (such as diabetic ketoacidosis, postoperative hypovolemia, oliguria, and anuria). Building upon coding rules developed in the Complication Screening Program (Iezzoni, Daley, Heeren, Foley, Hughes et al. 1994; Iezzoni et al. 1992) and in the Agency for Healthcare Research and Quality Hospital Cost and Utilization Project (Agency for Healthcare Research and Quality 2000), detailed coding rules for constructing these 10 outcome measures were developed and are discussed elsewhere (Mattke et al. 2002; Needleman et al. 2001).

Customary practice in studying complications in surgical patients using administrative data is to restrict the sample of patients to those who had their surgical procedure on the first or second day of admission. The underlying assumption is that sicker and unstable patients are more likely to develop complications or those who enter the hospital with complications will be operated on after an initial stabilization period (Ball et al. 1995; Iezzoni et al. 1992). This restriction is intended to create a more homogeneous group of patients admitted for elective procedures. We applied this restriction in coding outcomes in the 11-state all-patient and Medicare samples (except for patients from 33 hospitals in Nevada and West Virginia, for whom day of procedure was not available). Because the public use MedPAR data does not have information on day of procedure, we do not impose this restriction in analysis using these data.

Nurse Staffing Measures

We obtained data to construct measures of nursing personnel for hospitals in the 11-state sample from state hospital financial reports or staffing surveys. Nursing personnel were assigned to the categories RN, LPN, and nursing aide, assistant, or orderly (aide). For states that reported staffing as full time equivalents, we adopted a standard year of 2,080 hours.

For analysis of the MedPAR sample, we used staffing data on RNs and LPNs from the AHA annual surveys for 1997 and 1998, constructing a weighted average for calendar 1997. Unlike the state-level data, the national AHA survey does not contain information on aides. For hospitals in the 11-state sample, state data on RN and LPN staffing and AHA survey data were generally consistent.

With the exception of California, the state and AHA staffing data are reported for the hospital as a whole, and therefore adjustments must be made to take a hospital's outpatient volume into account to estimate inpatient

staffing. We have found, using detailed staffing data from California, that the standard approach for adjusting total hours to reflect both inpatient and outpatient hospital volume ("adjusted patient days" as defined by the AHA [American Hospital Association 1998]) underestimates inpatient staffing in hospitals that have large outpatient volume. To correct the undercounting of inpatient nursing personnel, a correction factor based on analysis of the California data was applied to all hospitals in the 11-state sample and those in the AHA sample for the MedPAR analysis. A description of this adjustment is described elsewhere (Needleman et al. 2002).

To better compare nurse staffing across hospitals, we adjusted nursing hours per day for differences in the nursing care needed by each hospital's patients. We used estimates of the relative nursing care needed for patients in each diagnosis related group (Ballard et al. 1993; Lichtig, Knauf, and Milholland 1999) to construct a nursing case-mix index for each hospital. We divided nursing hours per inpatient day by this index to calculate nursing case-mix-adjusted hours per day. In the MedPAR analysis, acuity was estimated using only Medicare discharges.

Risk Adjustment and Hospital Characteristics

When patient outcomes are influenced by both hospital-level and patient-level variables, to observe the true relationship between the outcomes and hospital-level variables, it is necessary control for differences among hospitals in the risk profile of their patients (Silber, Rosenbaum, and Ross 1995; Silber and Rosenbaum 1997; Silber et al. 1992). We did this by first estimating a patient-level logit regression of the risk for each outcome. Patient-level variables in these regressions included the rate for the outcome in the patient's diagnosis related group (DRG), state, age, sex, primary health insurer, whether an emergency admission, and presence or absence of 13 chronic diseases (cancer with poor prognosis, metastatic cancer, AIDS, coronary artery disease, congestive heart failure, peripheral vascular disease, severe chronic liver disease, chronic renal failure, dementia, functional impairment, diabetes with end organ damage, chronic pulmonary disease, and nutritional deficiencies). The regressions also included interactions of the specific rate of each outcome in each DRG with all the other variables, and interactions between the age and chronic disease variables. (Many DRGs are paired, with the same diagnosis and treatment, but with patients separated by whether or not they have complications or comorbidities. Following the approach being used to construct AHRQ's Quality Indicators, we pooled patients in these paired

DRGs into a single group.) We summed the probabilities predicted by the logit model for patients in each hospital to obtain the expected number of patients in that hospital who would experience each outcome. These same variables were used in an ordinary least squares regression to estimate expected length of stay. We obtained other hospital characteristics (bed size, teaching status, state, and metropolitan location) from the AHA Annual Survey of Hospitals for 1997 and 1998. Separate regressions were run for the three samples: 11-state all-patient, 11-state Medicare, and national MedPAR sample.

Statistical Analysis

With the hospital as the unit of analysis, we calculated rates of adverse outcomes and length of stay, and the proportion of hospitals in each sample with no reported adverse outcomes. The correlations between rates in the 11-state all-patient and 11-state Medicare samples were calculated to provide an indication of the similarity between these two measures of adverse outcomes at the same hospital.

To assess whether analysis using all-patient and Medicare-only samples of patients comes to the same conclusions, we examined the relationship between patient outcomes and staffing while controlling for patient risk and hospital characteristics. In these regressions, we used the actual count for each outcome as the dependent variable in a negative binomial count model regression (Greene 2000) using *STATA*, release 6 (Stata Corporation 1999). Expected counts were included as the measure of exposure. We analyzed length of stay using ordinary least squares regression with expected length of stay included as an independent variable. Independent variables in each regression included nurse staffing variables and categorical variables for state, hospital bed size, teaching status, and location. We tested each coefficient for statistical significance using z-statistics in the negative binomial regressions and t-tests in the OLS regressions.

We estimate incidence risk ratios for the nursing variables in separate regressions for the 11-state all-patient sample, 11-state Medicare sample, and the national MedPAR sample. Similar to other studies that have used staffing data with information only on RNs and LPNs (Kovner and Gergen 1998; Lichtig, Knauf, and Milholland 1999; Network 2000), the staffing variables used in the analysis of the national MedPAR sample included: total licensed (RN plus LPN) nursing hours and the proportion of licensed hours provided by RNs. The staffing specification used in the analysis of the 11-state data, for

which data on aides were available, included those in the MedPAR specification, plus aide hours per patient day.

We hypothesize that the incidence risk ratios associated with nurse staffing variables will be less than one. That is, as staffing increases, the risk of the outcome goes down. Across the regressions in the three samples, we compare the statistical significance of corresponding staffing variables and the magnitudes of the incidence risk ratio. We also test whether the differences in the incidence risk ratios across regression models are statistically significant.

RESULTS

Rates of Adverse Patient Outcomes and Length of Stay

In Table 1, we compare the length of stay and rates of adverse outcomes in the 11-state Medicare sample to those in the 11-state all-patient sample, and length of stay and outcome rates in the national MedPAR sample to those in the 11-state Medicare sample. We also examine the correlation of rates in the 11-state all-patient and 11-state Medicare samples, and examine the frequency with which hospitals report no adverse outcomes. These are compared separately for medical and surgical patients.

For both medical and surgical patients in the 11-state samples, length of stay is approximately 25 percent higher for Medicare patients compared with that for all patients. The rates for each outcome in the 11-state Medicare sample are also higher than in the 11-state all-patient sample. Medicare rates are 10 to 70 percent higher for medical and surgical patients. All differences are statistically significant.

In the national MedPAR sample, among the medical patients, all outcomes rates are slightly lower than in the 11-state Medicare sample. Although the differences are statistically significant for all but three outcomes, the values in the two samples are close, differing on average by 6 percent. Among surgical patients, however, the rates in the national MedPAR sample are substantially higher than in the 11-state Medicare sample, on average 40 percent higher, with the differences statistically significant for all but three outcomes. The higher rates in the national MedPAR sample may be due to the inability to restrict the analysis to patients operated on the first or second day of hospitalization.

Correlation of All-Patient and Medicare Rates

The correlation between hospital rates for the 11-state all-patient and the 11-state Medicare samples is quite high in the medical pool, consistently above .8,

Table 1: Comparison of 11-State All Patient, 11-State Medicare Only, and National Medicare Length of Stay and Rates for 11 Patient Complications

	Outcome or Complication Rates			Correlation of All-Patient and Medicare Rates, 11-State Sample			Proportion of Hospitals with No Code Patient Complications		
	All Patient	Medicare	MedPAR	Medical Patients			All Patient	Medicare	MedPAR
Length of Stay	5.02 (1.98)	6.41 (2.65)	aa 5.79 (2.92)	aa	bb	0.82			
Urinary Tract Infections	6.30% (2.34%)	8.85% (2.77%)	aa 8.81% (3.01%)	aa		0.91	0.00%	0.63%	0.86%
Skin Pressure Ulcer	7.21% (4.46%)	8.07% (5.38%)	aa 6.78% (5.34%)	aa	bb	0.90	1.00%	3.00%	6.76%
Pneumonia	2.34% (1.15%)	3.80% (1.76%)	aa 3.72% (1.79%)	aa		0.85	0.13%	1.38%	1.07%
Shock/Cardiac Failure	0.57% (0.81%)	0.98% (1.03%)	aa 0.94% (0.72%)	aa		0.86	3.50%	6.38%	7.03%
Upper Gastrointestinal Bleeding	1.04% (0.63%)	1.68% (0.90%)	aa 1.53% (0.85%)	aa	bb	0.86	0.13%	1.38%	2.32%
Sepsis	1.29% (0.87%)	1.44% (1.08%)	aa 1.33% (0.98%)	aa	bb	0.86	1.13%	3.13%	6.05%
Failure to Rescue	18.62% (5.92%)	20.53% (6.85%)	aa 19.97% (7.57%)	aa	b	0.87	0.63%	1.00%	2.68%
Length of Stay	4.67 (1.42)	5.84 (1.74)	aa 7.68 (2.90)	aa	bb	0.65			
Urinary Tract Infections	3.30% (2.12%)	5.61% (3.45%)	aa 7.75% (5.94%)	aa	bb	0.86	1.38%	3.50%	3.34%
Skin Pressure Ulcer	5.80% (6.56%)	6.39% (9.10%)	aa 8.13% (8.31%)	aa	bb	0.77	22.28%	30.54%	12.75%

Table A1: Continued

	Outcome or Complication Rates			Correlation of All-Patient and Medicare Rates, 11-State Sample	Proportion of Hospitals with No Coded Patient Complications		
	All Patient	Medicare	MedPAR		All Patient	Medicare	MedPAR
Pneumonia	1.24% (2.19%)	1.93% (2.01%)	aa (3.42%)	0.63	7.13%	12.27%	6.11%
Shock/Cardiac Failure	0.49% (0.55%)	0.87% (1.14%)	aa (1.23%)	0.76	18.52%	29.16%	19.33%
Upper Gastrointestinal Bleeding	0.50% (0.51%)	0.82% (1.04%)	aa (1.37%)	0.79	12.27%	20.40%	12.51%
Sepsis	0.99% (0.84%)	1.39% (1.91%)	aa (2.37%)	0.91	13.02%	21.15%	11.50%
Failure to Rescue	19.69% (13.30%)	23.30% (17.67%)	aa (22.75%)	0.86	13.52%	16.77%	8.67%
Wound Infection	0.79% (0.55%)	1.01% (1.55%)	aa (1.09%)	0.57	8.64%	19.27%	16.89%
Metabolic Derangement	6.84% (7.19%)	10.74% (9.31%)	aa (14.43%)	0.75	0.88%	2.00%	2.80%

Standard deviation in parentheses.
Probability (rate = rate in the all-patient sample): a: $p < .05$, aa: $p < .01$
Probability (rate = rate in 11-state Medicare sample): b: $p < .05$, bb: $p < .01$
Length of stay measured in days.

but lower in the major surgery pool, ranging from .6 to .9. These results suggest that Medicare-patient experience may be a better proxy for all-patient experience among medical patients.

Frequency with Which Hospitals Report No Adverse Outcomes

Given the low rates for some of the outcomes, it is possible that some smaller hospitals will have no patients with adverse outcomes. Zero rates are difficult to interpret in descriptive analysis, since they may result from high quality care, a small cohort of patients at risk, or poor coding. The count models used in the regressions of these outcomes on nurse staffing appropriately take into account zero rates due to the first two causes, but the power to detect statistically significant effects is diminished as the proportion of hospitals with rates of zero increase. Among surgical patients, the proportion of hospitals with zero rates can be quite high; for 4 of the 10 outcomes, more than 20 percent of hospitals in some samples have no events. For both medical and surgical patients, the proportion of hospitals with zero rates is always higher among Medicare patients, a smaller pool, than all patients.

Comparing rates in the two Medicare samples, for medical patients, for all outcomes except pneumonia, the proportion of hospitals with no events in the national MedPAR sample is always higher than in the 11-state Medicare sample. Among surgical patients, by contrast, except for metabolic derangement, the proportion of hospitals with no events in the national MedPAR sample is always lower than in the 11-state Medicare sample. This is consistent with the higher rates of complications in the national MedPAR sample for surgical patients.

Relationship between Patient Outcomes and Nurse Staffing

Means and standard deviations for the nursing variables used in the regression analysis are presented in Table 2. Average licensed hours of nursing staff hours and the mean proportion of hours provided by RNs were greater in the 11-state sample than in the MedPAR sample (Table 2).

To assess whether using outcomes for Medicare patients leads to the same conclusions as those based on all patients, we regressed counts of outcomes for each of these samples of patients on nurse staffing and other hospital variables. We examined whether the results were comparable by assessing whether regression results were in the same direction and statistical significance, and whether the magnitude of the estimated effects were statistically equivalent in regressions where a statistically significant association

Table 2: Mean and Standard Deviation of Hospital Inpatient Nurse Staffing Measures, 1997

	<i>11-State Sample</i>	<i>AHA Data</i>
RN proportion of licensed hours per patient day		
Mean	0.87	0.83**
SD	0.10	0.11
Licensed nursing hours per patient day		
Mean	8.99	10.22**
SD	2.05	3.22
Number of hospitals	799	3,297

Probability (Mean in AHA data = mean in 11-state sample):

* $p < .05$; ** $p < .01$.

Licensed nursing hours is the sum of hours provided by registered nurses and licensed practical nurses.

Data for 11-state sample drawn from state financial reports or staffing surveys.

AHA data from American Hospital Association Annual Survey and used for national MedPAR analysis.

was found. We first compared results in the 11-state all-patient sample to those in the 11-state Medicare sample, and then compared results in the national MedPAR sample to those in these two 11-state samples. We examined medical and surgical patients separately, and in reporting results, present results only for the two measures of nurse staffing—the proportion of licensed hours from RNs and licensed hours per day. Full regression results are in Appendix 1 (online version, which is available at <http://www.blackwellpublishing.com/products/journals/suppmat/HESR/HESR02025/HESR02025sm.htm>).

Medical Patients. Among the eight measures for medical patients (Table 3), there is complete agreement in the results in the 11-state all-patient and 11-state Medicare samples for four measures for which an association with nurse staffing is observed—length of stay, urinary tract infection, pneumonia, and shock/cardiac arrest. There is also complete agreement in the analyses for two measures in which no effect is observed—pressure ulcers and sepsis.

There is disagreement for two measures. With respect to failure to rescue, in the 11-state all-patient sample, there is an association with the proportion of hours provided by RNs. The incidence risk ratio (IRR) on RN proportion for the 11-state Medicare sample is similar in magnitude to that for the all-patient sample, and the p -value for the IRR is .056, indicating that the results are very close. For UGI bleeding, we find a significant association in the

Table 3: Regression of Length of Stay and Patient Complications on Nurse Staffing Variables, Medical Patients in 11-State All-Patient, 11-State Medicare Only, and National MedPAR Samples

	11-State All Patient		11-State Medicare Only		National MedPAR		
	Coefficient	SE	Coefficient	SE	Coefficient	SE	
Length of Stay							
RN Hours/LICENSED Hours	-1.410	0.435**	-2.176	0.585**	-0.818	0.248**	b
LICENSED Hours per Patient Day	-0.094	0.019**	-0.141	0.024**	-0.054	0.010**	bb
Number of Observations	797		797		3,354		
	IRR		IRR		IRR		
Urinary Tract Infection							
RN Hours/LICENSED Hours	0.489	0.060**	0.537	0.065**	0.759	0.047**	aa b
LICENSED Hours per Patient Day	0.998	0.004	1.000	0.004	0.996	0.002*	
Number of Observations	799		799		3,356		
Pressure Ulcer							
RN Hours/LICENSED Hours	0.765	0.157	0.706	0.158	0.892	0.099	
LICENSED Hours per Patient Day	0.997	0.008	0.991	0.008	0.994	0.003	
Number of Observations	799		799		3,314		
Pneumonia							
RN Hours/LICENSED Hours	0.606	0.093**	0.586	0.100**	0.833	0.067*	
LICENSED Hours per Patient Day	0.999	0.006	1.001	0.007	0.999	0.003	
Number of Observations	799		799		3,355		
Shock/Cardiac Arrest							
RN Hours/LICENSED Hours	0.486	0.143*	0.403	0.114**	0.663	0.093**	
LICENSED Hours per Patient Day	0.996	0.012	0.995	0.011	1.001	0.004	
Number of Observations	798		798		3,355		
Upper Gastrointestinal Bleeding							
RN Hours/LICENSED Hours	0.658	0.126*	0.684	0.134	0.957	0.096	
LICENSED Hours per Patient Day	0.988	0.007	0.985	0.007*	0.994	0.003	
Number of Observations	798		798		3,357		
Sepsis							
RN Hours/LICENSED Hours	1.394	0.279	1.105	0.233	1.237	0.137	
LICENSED Hours per Patient Day	0.993	0.007	0.989	0.008	0.994	0.003	
Number of Observations	799		799		3,351		
Failure to Rescue							
RN Hours/LICENSED Hours	0.802	0.084*	0.811	0.089	0.900	0.052	
LICENSED Hours per Patient Day	1.003	0.004	1.003	0.005	1.001	0.002	
Number of Observations	799		791		3,336		

OLS regression coefficients for length of stay and incidence risk ratios (IRRs) for other adverse outcomes, adjusted for expected length of stay or number of expected events, hospital teaching status, metropolitan location, and state. Huber/White/sandwich estimator used to calculate standard errors.

Probability (coefficient = 0)

* $p < .05$, ** $p < .01$, *** $p < .001$.

Probability (coefficient = coefficient in 11-state all-patient regression): a: $p < .05$, aa: $p < .01$

Probability (coefficient = coefficient in 11-state Medicare regression): b: $p < .05$, bb: $p < .01$

11-state all-patient sample for RN proportion, but not for licensed hours per day, while in the 11-state Medicare sample, there is no significant association with RN proportion but there is for licensed hours. However the IRRs for RN proportion and licensed hours are similar in magnitude across these two models, and the p -value for RN proportion in the 11-state Medicare sample is .052, and the p -value for licensed hours in the 11-state all-patient sample is .075. Thus, across all eight measures, the two models generate results that are similar even though not totally concordant.

Similarly, there is a high degree of concordance between the results of the national MedPAR analysis and the 11-state Medicare sample for medical patients. For five outcomes—pneumonia, shock/cardiac arrest, pressure ulcer, sepsis, and failure to rescue—the results agree completely. For two outcomes for which an association with RN proportion is found in the 11-state Medicare sample—length of stay and urinary tract infections—a statistically significant association is also observed in the national MedPAR sample, although the magnitude of the IRR is significantly closer to one in the national MedPAR sample. For another measure, UGI bleeding, a measure in which the results differed somewhat between the 11-state all-patient and 11-state Medicare samples, there is no observed association between nurse staffing in the national MedPAR sample.

Surgical Patients. Results show complete agreement for surgical patients (Table 4) in the 11-state all-patient and 11-state Medicare samples for three measures in which an association with nurse staffing is observed—pneumonia, failure to rescue, and metabolic derangement—and three measures in which no effect is observed—length of stay, sepsis, and wound infection.

There is disagreement in four measures. For one—urinary tract infections—an association is observed with RN proportion in the 11-state all-patient sample, but not the 11-state Medicare sample. The magnitude of the IRRs are close, however, and the p -value on RN proportion in the 11-state Medicare sample is .062. For two measures—pressure ulcer and shock and cardiac arrest—we observe an association of licensed hours or RN proportion in the 11-state Medicare sample but not the 11-state all-patient sample. Here, too, the magnitude of the IRRs across the models is similar and the p -values on the corresponding IRRs in the all-patient sample are below .10 (pressure ulcer: $p = .081$; UGI bleeding: $p = .077$). For shock/cardiac arrest, however, the results differ substantially. An association is observed with RN proportion in the 11-state Medicare sample but not in the 11-state all-patient sample. The IRRs, while not statistically different, are much further apart than for other outcomes, and the p -value in the 11-state all-patient sample is greater than .10.

Table 4: Regression of Length of Stay and Patient Complications on Nurse Staffing Variables, Surgical Patients in 11-State All-Patient, 11-State Medicare Only, and National MedPAR Samples

	11-State All-Patient		11-State Medicare Only		National MedPAR	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Length of Stay						
RN Hours/LICENSED Hours	-0.553	0.435	-0.785	0.565	-0.063	0.313
LICENSED Hours per Patient Day	-0.015	0.015	-0.010	0.030	-0.033	0.016*
Number of Observations	796		793		3,296	
	IRR		IRR		IRR	
Urinary Tract Infection						
RN Hours/LICENSED Hours	0.589	0.119**	0.675	0.142	0.877	0.084
LICENSED Hours per Patient Day	1.006	0.008	1.003	0.008	0.991	0.003**
Number of Observations	795		789		3,288	
Pressure Ulcer						
RN Hours/LICENSED Hours	0.828	0.299	0.811	0.345	0.902	0.111
LICENSED Hours per Patient Day	0.981	0.011	0.967	0.012**	0.986	0.004**
Number of Observations	788		781		3,217	
Pneumonia						
RN Hours/LICENSED Hours	0.522	0.164*	0.356	0.121**	0.936	0.101 bb
LICENSED Hours per Patient Day	1.018	0.012	1.015	0.013	0.989	0.003** a
Number of Observations	796		793		3,293	
Shock/Cardiac Arrest						
RN Hours/LICENSED Hours	0.595	0.205	0.420	0.161**	0.589	0.086**
LICENSED Hours per Patient Day	0.998	0.013	1.002	0.014	0.995	0.005
Number of Observations	796		794		3,295	
Upper Gastrointestinal Bleeding						
RN Hours/LICENSED Hours	0.528	0.191	0.404	0.171*	0.769	0.109
LICENSED Hours per Patient Day	0.989	0.013	0.991	0.014	0.987	0.004**
Number of Observations	797		794		3,297	
Sepsis						
RN Hours/LICENSED Hours	1.107	0.325	0.859	0.286	1.099	0.126
LICENSED Hours per Patient Day	1.006	0.011	0.986	0.012	0.985	0.003**
Number of Observations	796		791		3,289	
Failure to Rescue						
RN Hours/LICENSED Hours	0.715	0.149	0.698	0.168	0.813	0.066*
LICENSED Hours per Patient Day	0.982	0.008*	0.978	0.009*	0.999	0.003 a b
Number of Observations	785		767		3,184	
Wound Infection						
RN Hours/LICENSED Hours	1.327	0.407	0.929	0.351	1.908	0.292**
LICENSED Hours per Patient Day	0.997	0.010	1.010	0.012	1.007	0.004
Number of Observations	796		794		3,297	
Metabolic Derangement						
RN Hours/LICENSED Hours	0.492	0.162*	0.538	0.161*	1.045	0.122 a
LICENSED Hours per Patient Day	0.979	0.012	0.985	0.011	0.994	0.004
Number of Observations	797		790		3,283	

OLS regression coefficients for length of stay and incidence risk ratios (IRRs) for other adverse outcomes, adjusted for expected length of stay or number of expected events, hospital teaching status, metropolitan location, and state. Huber/White/sandwich estimator used to calculate standard errors.

Probability (coefficient = 0)

* $p < .05$, ** $p < .01$, *** $p < .001$.

Probability (coefficient = coefficient in 11-state all-patient regression): a $p < .05$, aa $p < .01$

Probability (coefficient = coefficient in 11-state Medicare regression): b $p < .05$, bb $p < .01$

While there is a high degree of concordance in results for surgical patients between the 11-state all-patient and 11-state Medicare samples, it is lower than that for medical patients.

There is substantial discordance in the results between the 11-state Medicare sample and national MedPAR sample because only two measures are consistent—pressure ulcer and shock/cardiac arrest. These are the two measures for which no statistically significant association was observed in the 11-state all-patient sample, suggesting that these may be more sensitive measures for Medicare surgical patients than patients in general.

For four measures, an association of at least one nursing variable and the outcome is found in the national MedPAR sample but not the 11-state Medicare sample—length of stay, UTI, sepsis, and wound infections. While the coefficients in the length of stay analysis and IRRs for the other three measures are not statistically different, only for sepsis are they the same magnitude and in the predicted direction. For length of stay, the coefficient on licensed hours is three times larger in the national MedPAR sample and the *p*-value for this variable in the 11-state Medicare sample is .73. For urinary tract infection, the IRR on licensed hours, significant with a value of .991 in the national MedPAR sample, is over one in the 11-state Medicare sample. For wound infection, the statistically significant association of RN proportion in the national MedPAR sample is not in the predicted direction.

For one outcome—metabolic derangement—we observe a statistically significant association of RN proportion in the 11-state Medicare sample but not the national MedPAR sample. The IRR in the national MedPAR sample, while not statistically significant, is over one, that is, not in the expected direction.

For the remaining three outcomes—pneumonia, UGI bleeding, and failure to rescue—we find statistically significant associations with one of the two nurse staffing variables in both the 11-state Medicare sample and national MedPAR sample, but the variable that is statistically significant differs across the two models. Only in the case of upper GI bleeding are the IRRs of comparable magnitude statistically equal and in the predicted direction for the two samples.

As noted above, there are substantial differences between the data for outcomes and nurse staffing used in the national MedPAR and 11-state Medicare sample. To determine whether differences in the datasets produced different results across the Medicare samples, we reran the regression analysis in the 11-state Medicare sample so that it more closely matched the national MedPAR analysis. Specifically, we dropped the day of surgery restriction

originally imposed in the 11-state analysis, reestimated the counts of expected cases based on the less restricted definition, and, using the AHA staffing data used in the national MedPAR analysis, reran the count model regressions. Results from the 11-state Medicare sample analyzed using national staffing data and less restrictively coded complications do not match those from national MedPAR sample, and we conclude that the differences in staffing and outcome definitions in the two Medicare samples do not explain the differences observed (results not shown).

CONCLUSIONS

Assessing quality over time and across a large number of health care institutions are important to achieving improved quality in U.S. hospitals, and administrative datasets are important in this effort. The overall question motivating this study was whether measures of hospital quality can be constructed from data on Medicare beneficiaries alone, or whether data on all patients are required when examining correlates of quality using administrative data. We addressed this question in two ways. We examined the correlation between rates of adverse outcomes for the same hospitals for their Medicare patients and all patients at the hospital and found that correlations were high, although lower for major surgery patients. The lower correlation is likely due to the smaller pools of Medicare surgical patients and the larger number of hospitals with no cases of the adverse outcomes in the Medicare pool.

We also applied an operational test of whether comparable conclusions would be drawn from regression analysis involving Medicare-only samples and all-patient data. Comparing regressions of outcomes on measures of hospital nurse staffing, we found that results in an 11-state all-patient sample, an 11-state Medicare sample, and a national MedPAR sample were generally consistent for medical patients, but less consistent for surgical patients. Also among surgical patients, there were only two outcomes among the ten studied in which results in the 11-state Medicare and national MedPAR analyses agreed. Recoding the outcomes in the 11-state Medicare sample and using the same staffing data to make the analysis in the two Medicare samples more comparable did not resolve this conflict.

Overall, we conclude that outcome measures applied to medical patients that are implemented in Medicare-only datasets are likely to yield comparable results to those that would be observed in analyses using all-patient data. Thus,

using national Medicare data from medical patients in studies of hospital quality is justified.

We would urge caution, however, in using quality measures in surgical patients in Medicare-only data; these measures may not provide results comparable to those from all-patient samples or across different samples of Medicare patients. The reasons for the differences across Medicare samples are not clear. The inability to implement day-of-procedure restrictions from public use data does not explain the differences. A more likely explanation is that the smaller size of the surgical pool of patients, their lower risk for many complications, and the higher proportion of hospitals with no reported complications among surgical patients make it harder to obtain consistent results in regression-based studies of surgical patients using administrative data. The three-sample approach to cross-validating measures presented here is one way to test the usefulness of Medicare-only analysis in these patients.

This paper assesses the ability of Medicare data to substitute for all-patient data in studies of correlates of quality using regression-based techniques. A second potential use of Medicare data as a substitute for all-patient data is in studies that assess quality in specific hospitals. The high correlation of the all-patient and Medicare measures presented in Table 1 suggests that Medicare data might be usable for studies of hospital-specific quality. To fully assess this potential, additional analysis is required. This would include: examining the degree of agreement in ranking hospitals by rates of complications when using each dataset; determining whether observed disagreements are associated with specific hospital characteristics, especially the relative and absolute size of the hospital's Medicare patient population; and assessing how stable rates are for quality measures for hospitals with small numbers of patients.

In conducting the comparisons reported here, we encountered many challenges that arose principally from weaknesses of currently available data, particularly the well-known problems associated with using discharge data to construct quality measures (Geraci 2000; Geraci et al. 1997; Lawthers et al. 2000; Weingart et al. 2000). Because there is no reliable coding of "present on admission" status for secondary diagnoses reported on discharge abstracts, constructing coding and exclusion rules for each adverse outcome requires considerable clinical judgment and technical skill. Complications and adverse outcomes are likely to be underreported, and underreporting may be higher where staffing is low.

Despite these difficulties, we believe that administrative datasets offer a valuable tool for understanding factors influencing quality across hospitals.

While more states are making available all patient discharge datasets, these are not universally available. Moreover, creating consistent data across many states can be both time-consuming and expensive. As a consequence of this, Medicare MedPAR data will remain a major data source for analyzing hospital quality. The CMS should take steps to improve the usefulness of these data, including adding day-of-procedure codes to public use datasets. The CMS, the Agency for Healthcare Research and Quality through its Healthcare Cost and Utilization Project (HCUP), and individual states should take additional actions to improve the usefulness of their discharge data for studying quality. They should require consistent and accurate coding of present-on-admission status for secondary diagnoses and identify a set of “must code” secondary diagnoses that are hospital acquired and related to quality. With these changes to discharge abstracts, the ability to monitor quality of care, whether using all-patient or Medicare data, will be enhanced considerably.

ACKNOWLEDGMENTS

We thank Carole Gassert, Evelyn Moses, Judy Goldfarb, Tim Cuerdon, Cheryl Jones, Peter Gergen, Carole Hudgings, Pamela Mitchell, Donna Diers, Chris Kovner, Mary Blegen, Margaret Sovie, Nancy Donaldson, Ann Minnick, Lisa Iezzoni, Leo Lichtig, Robert Knauf, Alan Zaslavsky, Lucian Leape, Sheila Burke, Barbara Berney, and Gabrielle Hermann-Camara for their advice. We also gratefully acknowledge the California Office of Statewide Health Planning and Development and State of Maryland for contributing their data for this study, and the staffs of the agencies in each state from which we obtained data, for their assistance. We also thank the anonymous reviewers of this manuscript. The opinions expressed are those of the authors and not necessarily those of the funding or data agencies, or others acknowledged.

REFERENCES

- Agency for Healthcare Research and Quality. 2000. *HCUP Quality Indicators: User Guide. Outcome, Utilization, and Access Measures for Quality Improvement*. Agency for Healthcare Research and Quality, Rockville, MD.
- American Hospital Association. 1998. *The AHA Annual Survey Database: Fiscal Year 1997 Documentation*. Chicago: American Hospital Association.

- Ball, J. K., A. Elixhauser, M. Johantgen, D. R. Harris, and M. Goldfarb. 1998. *HCUP Quality Indicators, Methods, Version 1.1: Outcome, Utilization, and Access Measures for Quality Improvement*. Rockville, MD: Agency for Health Care Policy and Research.
- Ball, J. K., A. Elixhauser, M. Johantgen, D. R. Harris, and M. Goldfarb. 1995. *HCUP-3 Quality Indicators, Methods, Version 1.1*. Rockville, MD: Agency for Health Care Policy and Research.
- Ballard, K. A., R. F. Gray, R. A. Knauf, and P. Uppal. 1993. "Measuring Variations in Nursing Care per DRG." *Nursing Management* 24 (4): 33-6.
- Blegen, M. A., C. J. Goode, and L. Reed. 1998. "Nurse Staffing and Patient Outcomes." *Nursing Research* 47 1 (1): 43-50.
- Bryan, Y. E., K. S. Hitchings, M. A. Fuss, M. A. Fox, M. T. Kinneman, and M. J. Young. 1998. "Measuring and Evaluating Hospital Restructuring Efforts: Eighteen-Month Follow-up and Extension to Critical Care, Part 1." *Journal of Nursing Administration* 28 (9): 21-7.
- Czaplinski, C., and D. Diers. 1998. "The Effect of Staff Nursing on Length of Stay and Mortality." *Medical Care* 36 (12): 1626-38.
- Geraci, J. M. 2000. "In-Hospital Complication Occurrence as a Screen for Quality-of-Care Problems: What's Next?" *Medical Care* 38 (8): 777-80.
- Geraci, J. M., C. M. Ashton, D. H. Kuykendall, M. L. Johnson, and L. Wu. 1997. "International Classification of Diseases, 9th Revision, Clinical Modification Codes in Discharge Abstracts Are Poor Measures of Complication Occurrence in Medical Inpatients." *Medical Care* 35 (6): 589-602.
- Greene, W. H. 2000. *Econometric Analysis*. New York: Macmillan.
- Iezzoni, L. I., J. Daley, T. Heeren, S. M. Foley, J. S. Hughes, E. S. Fisher, C. C. Duncan, and G. A. Coffman. 1994. "Using Administrative Data to Screen Hospitals for High Complication Rates." *Inquiry* 31 (1): 40-55.
- Iezzoni, L. I., S. M. Foley, T. Heeren, J. Daley, C. C. Duncan, E. S. Fisher, and J. Hughes. 1992. "A Method for Screening the Quality of Hospital Care Using Administrative Data: Preliminary Validation Results." *QRB. Quality Review Bulletin* 18 (11): 361-71.
- Iezzoni, L. I., J. Daley, T. Heeren, S. M. Foley, E. S. Fisher, C. Duncan, J. S. Hughes, and G. A. Coffman. 1994. "Identifying Complications of Care Using Administrative Data." *Medical Care* 32 (7): 700-15.
- Iezzoni, L. I., Y. D. Mackiernan, M. J. Cahalane, R. S. Phillips, R. B. Davis, and K. Miller. 1999. *Screening Quality of Care Using Administrative Data*. Boston, MA: Beth Israel Deaconess Hospital.
- Institute of Medicine Committee on Quality of Health Care in America. 2001. *Crossing the Quality Chasm: A New Health System for the Twenty-first Century*. Washington, DC: National Academy Press.
- Johantgen, M., A. Elixhauser, J. K. Bali, M. Goldfarb, and D. R. Harris. 1998. "Quality Indicators Using Hospital Discharge Data: State and National Applications." *Joint Commission Journal on Quality Improvement* 24 (2): 88-105.
- Karon, S. L., F. Sainfort, and D. R. Zimmerman. 1999. "Stability of Nursing Home Quality Indicators over Time." *Medical Care* 37 (6): 570-9.

- Keyes, M. A. 2000. "CONQUEST 2.0: An Emerging Clinical Performance Measurement Tool." *Journal for Healthcare Quality* 22 (3): 29–36.
- Kohn, L. T., J. Corrigan, M. S. Donaldson, and Institute of Medicine, Committee on Quality of Health Care in America. 2000. *To Err Is Human: Building a Safer Health System*. Washington, DC: National Academy Press.
- Kovner, C., and P. J. Gergen. 1998. "Nurse Staffing Levels and Adverse Events Following Surgery in U.S. Hospitals." *Image the Journal of Nursing Scholarship* 30 (4): 315–21.
- Kuykendall, D. H., C. M. Ashton, M. L. Johnson, and J. M. Geraci. 1995. "Identifying Complications and Low Provider Adherence to Normative Practices Using Administrative Data." *Health Services Research* 30 (4): 531–54.
- Lawthers, A. G., E. P. McCarthy, R. B. Davis, L. E. Peterson, R. H. Palmer, and L. I. Iezzoni. 2000. "Identification of In-Hospital Complications from Claims Data: Is It Valid?" *Medical Care* 38 (8): 785–95.
- Lichtig, L. K., R. A. Knauf, and D. K. Milholland. 1999. "Some Impacts of Nursing on Acute Care Hospital Outcomes." *Journal of Nursing Administration* 29 (2): 25–33.
- Mattke, S., J. Needleman, P. Buerhaus, M. Stewart, and K. Zelevinsky. 2002. "Constructing Measures of Adverse Patient Outcomes Sensitive to Nurse Staffing Using Hospital Administrative Data Sets." Boston, MA: Harvard School of Public Health.
- Medstat Group Research and Policy Division. 2000. *Comparison Analysis for the HCUP Nationwide Inpatient Sample, Release 6 (Calendar Year 1997)*, p. 56. Santa Barbara, CA: Medstat Group Research and Policy Division.
- Needleman, J., P. Buerhaus, S. Mattke, M. Stewart, and K. Zelevinsky. 2002. "Nurse-Staffing Levels and Quality of Care in Hospitals." *New England Journal of Medicine* 346 (22): 1415–22.
- . 2001. *Nurse Staffing and Patient Outcomes in Hospitals*. Boston, MA: Harvard School of Public Health.
- Network. 2000. *Nurse Staffing and Patient Outcomes in the Inpatient Hospital Setting*, pp. 1–76. Baltimore, MD: American Nurses Association.
- Palmer, R. H., A. G. Lawthers, N. J. Banks, L. E. Peterson, G. L. Caputo, and S. M. Sokoloff. 1996. *Conquest 1.0 Overview of Final Report and User's Guide*. Boston, MA: Harvard School of Public Health.
- Radany, M. H., and H. S. Luft. 1993. "Estimating Hospital Admission Patterns Using Medicare Data." *Social Science and Medicine* 37 (12): 1431–9.
- Romano, P. S., L. L. Roos, H. S. Luft, J. G. Jollis, and K. Doliszny. 1994. "A Comparison of Administrative versus Clinical Data: Coronary Artery Bypass Surgery as an Example. Ischemic Heart Disease Patient Outcomes Research Team." *Journal of Clinical Epidemiology* 47 (3): 249–60.
- Romano, P. S., A. Zach, H. S. Luft, J. Rainwater, L. L. Remy, and D. Campa. 1995. "The California Hospital Outcomes Project: Using Administrative Data to Compare Hospital Performance." *Joint Commission Journal on Quality Improvement* 21 (12): 668–82.
- Silber, J., P. Rosenbaum, and R. Ross. 1995. "Comparing the Contributions of Groups of Predictors: Which Outcomes Vary with Hospital Rather Than Patient Characteristics?" *Journal of the American Statistical Association* 90 (429): 7–18.

- Silber, J. H., and P. R. Rosenbaum. 1997. "A Spurious Correlation between Hospital Mortality and Complication Rates." *Medical Care* 35 (10): os77-92.
- Silber, J. H., S. V. Williams, H. Krakauer, and J. Sanford Schwartz. 1992. "Hospital and Patient Characteristics Associated with Death after Surgery: A Study of Adverse Occurrence and Failure to Rescue." *Medical Care* 30 (7): 615-29.
- Stata Corporation. 1999. *STATA Reference Manual: Release 6*. College Station, TX: Stata Corporation.
- U.S. Department of Health and Human Services Agency for Healthcare Research and Policy. 2001. "CONQUEST: Overview." Rockville, MD: Agency for Health Care Policy and Research. [Accessed: April 25 2002]. Available from <http://www.ahrq.gov/qual/conquest/conqovr1.htm>.
- Wan, T. T. H., and R. K. Shukla. 1987. "Contextual and Organizational Correlates of the Quality of Hospital Nursing Care." *Quality Review Bulletin* 13 (2): 61-5.
- Weingart, S. N., L. I. Iezzoni, R. B. Davis, H. R. Palmer, M. Cahalane, M. B. Hamel, K. Mukamal, R. S. Phillips, D. T. Davies, and N. J. Banks. 2000. "Use of Administrative Data to Find Substandard Care: Validation of the Complications Screening Program." *Medical Care* 38 (8): 796-806.

Appendices (Available online only: <http://www.blackwellpublishing.com/products/journals/suppmat/HESR/HESR02200/HESR02200sm.htm>)

Appendix T.1: Regression of Outcomes on Nursing and Other Variables, Medical Pool, 11-State All-Patient, 11-State Medicare, MedPAR Samples
Table A1, Table A2, Table A3

Appendix T.2: Regression of Outcomes on Nursing and Other Variables, Surgical Pool, 11-State All-Patient, 11-State Medicare, MedPAR Samples

Appendix T.3: Regression of Selected Outcomes, 11-State Medicare Sample with AHA Staffing Data and without Procedure Date

SUPPLEMENT

Table A1: Regression of Outcomes on Nursing and Other Variables, Medical Pool, 11-State All-Patient, 11-State Medicare, MedPAR Samples

	UTI			Pressure Ulcer			Pneumonia			DVT		
	11-State All Patient											
	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z
LICENSED Hours per Patient Day	0.998	0.004	0.683	0.997	0.008	0.670	0.999	0.006	0.817	1.009	0.009	0.337
AIDE Hours per Patient Day	0.998	0.007	0.733	1.020	0.013	0.114	1.001	0.008	0.939	1.002	0.014	0.858
RN Hours/LICENSED Hours	0.489	0.060	0.000	0.765	0.157	0.192	0.606	0.093	0.001	1.383	0.298	0.132
New York	0.977	0.026	0.395	0.897	0.042	0.021	0.998	0.031	0.944	0.884	0.044	0.013
Massachusetts	1.014	0.032	0.661	1.071	0.063	0.240	1.012	0.073	0.868	0.900	0.068	0.161
Maryland	1.015	0.031	0.629	0.985	0.051	0.774	1.080	0.051	0.103	0.911	0.057	0.135
Virginia	0.976	0.036	0.500	1.057	0.061	0.332	1.033	0.044	0.452	1.018	0.067	0.783
West Virginia	0.991	0.054	0.873	1.107	0.093	0.225	0.993	0.061	0.908	1.149	0.098	0.102
South Carolina	1.062	0.056	0.247	1.319	0.111	0.001	1.088	0.065	0.158	1.013	0.072	0.852
Wisconsin	1.064	0.037	0.072	1.177	0.076	0.012	1.027	0.042	0.510	0.999	0.077	0.993
Missouri	0.988	0.031	0.706	1.069	0.062	0.256	1.074	0.045	0.088	1.005	0.072	0.945
Arizona	0.994	0.048	0.905	0.949	0.089	0.576	1.051	0.060	0.382	0.993	0.074	0.928
Nevada	0.988	0.078	0.874	1.284	0.262	0.220	1.070	0.075	0.331	0.968	0.112	0.780
Major Teaching Hospital	1.093	0.039	0.013	1.104	0.053	0.037	1.204	0.062	0.000	1.145	0.082	0.059
Other Teaching Hospital	1.058	0.022	0.007	0.998	0.035	0.952	1.033	0.026	0.198	0.990	0.041	0.811
Large Metropolitan	1.065	0.023	0.003	1.242	0.045	0.000	1.001	0.027	0.966	1.076	0.047	0.095
Non-Metropolitan	0.961	0.029	0.187	1.115	0.063	0.054	0.978	0.037	0.563	0.966	0.059	0.566
Less Than 100 Beds	0.998	0.025	0.949	0.974	0.048	0.596	1.084	0.034	0.010	0.887	0.047	0.023
250-499 Beds	0.994	0.020	0.765	1.059	0.039	0.119	0.982	0.026	0.489	1.057	0.041	0.145
500 or More	1.033	0.037	0.371	1.021	0.053	0.691	0.940	0.040	0.148	1.285	0.112	0.004

(continued)

Table A1: Continued

	UTI			Pressure Ulcer			Pneumonia			DVT		
	11-State All Patient			11-State All Patient			11-State All Patient			11-State All Patient		
	IRR	Std. Err.	P > z	IRR	Std. Err.	P > z	IRR	Std. Err.	P > z	IRR	Std. Err.	P > z
Number of Obs	799.000			799.000			799.000			799.000		
Wald chi2(20)	64.080			74.810			43.760			116.330		
Prob > chi2	0.000			0.000			0.002			0.000		
Pseudo R2	0.008			0.012			0.008			0.016		
11-State Medicare												
LICENSED Hours per Patient Day	1.000	0.004	0.989	0.991	0.008	0.259	1.001	0.007	0.883	1.004	0.010	0.668
AIDE Hours per Patient Day	0.994	0.007	0.381	1.021	0.014	0.126	0.999	0.009	0.884	1.001	0.016	0.958
RN Hours/LICENSED Hours	0.537	0.065	0.000	0.706	0.158	0.121	0.586	0.100	0.002	1.128	0.278	0.624
New York	0.966	0.026	0.193	0.908	0.046	0.059	0.987	0.033	0.683	0.877	0.048	0.016
Massachusetts	1.009	0.032	0.774	1.010	0.068	0.884	0.982	0.077	0.818	0.909	0.072	0.229
Maryland	1.027	0.032	0.386	1.036	0.058	0.530	1.079	0.056	0.142	0.929	0.067	0.307
Virginia	0.980	0.035	0.580	1.074	0.066	0.249	1.013	0.046	0.775	1.020	0.073	0.780
West Virginia	0.999	0.054	0.985	1.116	0.094	0.195	1.035	0.067	0.599	1.105	0.113	0.332
South Carolina	1.020	0.049	0.680	1.321	0.122	0.002	1.031	0.065	0.630	1.004	0.087	0.968
Wisconsin	1.087	0.038	0.017	1.147	0.079	0.047	1.006	0.044	0.895	1.010	0.089	0.907
Missouri	0.994	0.030	0.831	1.108	0.070	0.106	1.050	0.046	0.263	0.990	0.075	0.894
Arizona	0.944	0.047	0.246	0.963	0.104	0.727	0.976	0.062	0.703	0.967	0.088	0.715
Nevada	0.974	0.077	0.736	1.253	0.266	0.289	1.019	0.094	0.837	1.030	0.127	0.813
Major Teaching Hospital	1.133	0.040	0.000	1.149	0.061	0.009	1.219	0.065	0.000	1.123	0.083	0.115
Other Teaching Hospital	1.064	0.022	0.003	0.974	0.038	0.497	1.020	0.028	0.463	0.979	0.044	0.640
Large Metropolitan	1.052	0.022	0.015	1.251	0.050	0.000	1.010	0.030	0.747	1.090	0.054	0.082
Non-Metropolitan	0.948	0.028	0.065	1.110	0.066	0.081	0.971	0.039	0.468	0.977	0.069	0.739

Less Than 100 Beds	1.001	0.025	0.952	0.956	0.050	0.391	1.083	0.036	0.017	0.850	0.051	0.007
250-499 Beds	0.992	0.020	0.686	1.089	0.044	0.033	0.992	0.029	0.777	1.108	0.046	0.013
500 or More	1.016	0.035	0.646	1.032	0.058	0.570	0.942	0.042	0.176	1.298	0.120	0.005
Number of Obs	799,000			797,000			799,000			799,000		
Wald $\chi^2(20)$	66.500			78.370			37.630			98.940		
Prob > χ^2	0.000			0.000			0.010			0.000		
Pseudo R ²	0.008			0.013			0.007			0.016		

National MedPAR

LICENSED Hours per Patient Day	0.996	0.002	0.025	0.994	0.003	0.073	0.999	0.003	0.814	1.000	0.004	0.940
RN Hours/LICENSED Hours	0.759	0.047	0.000	0.892	0.099	0.305	0.833	0.067	0.024	1.270	0.147	0.038
Alabama	1.049	0.035	0.152	1.271	0.069	0.000	0.986	0.045	0.756	1.011	0.072	0.874
Alaska	0.962	0.093	0.691	1.102	0.078	0.171	0.725	0.113	0.040	0.899	0.188	0.610
Arizona	1.057	0.047	0.210	1.027	0.084	0.741	1.005	0.051	0.924	0.990	0.072	0.890
Arkansas	1.069	0.047	0.127	1.373	0.105	0.000	1.012	0.060	0.842	1.066	0.111	0.540
Colorado	1.003	0.038	0.929	1.154	0.109	0.128	0.932	0.052	0.213	0.962	0.078	0.629
Connecticut	0.993	0.046	0.874	1.115	0.101	0.229	0.993	0.050	0.886	0.941	0.082	0.483
Delaware	1.024	0.078	0.759	0.917	0.148	0.593	1.060	0.103	0.553	0.767	0.170	0.231
District of Columbia	0.954	0.062	0.474	0.883	0.072	0.129	1.037	0.102	0.714	0.895	0.121	0.414
Florida	1.039	0.025	0.114	1.099	0.046	0.023	1.014	0.034	0.680	0.963	0.046	0.431
Georgia	1.012	0.028	0.660	1.181	0.061	0.001	0.997	0.040	0.951	0.987	0.061	0.830
Hawaii	0.981	0.040	0.642	1.222	0.106	0.021	0.936	0.105	0.555	1.066	0.116	0.559
Idaho	1.199	0.080	0.007	1.604	0.216	0.000	0.943	0.085	0.516	0.912	0.175	0.632
Illinois	1.007	0.026	0.802	1.011	0.053	0.835	1.006	0.040	0.883	0.881	0.052	0.031
Indiana	1.034	0.036	0.338	1.201	0.072	0.002	0.975	0.044	0.574	1.014	0.082	0.867
Iowa	1.053	0.040	0.174	1.218	0.116	0.039	0.973	0.056	0.640	1.022	0.102	0.825
Kansas	1.053	0.042	0.190	1.184	0.112	0.073	0.951	0.057	0.402	1.032	0.106	0.763
Kentucky	1.056	0.036	0.108	1.232	0.076	0.001	0.946	0.045	0.238	0.991	0.059	0.883
Louisiana	1.020	0.038	0.591	1.090	0.055	0.091	0.945	0.040	0.176	1.056	0.066	0.379
Maine	1.120	0.061	0.037	1.302	0.167	0.040	0.991	0.060	0.888	1.303	0.171	0.043
Maryland	1.013	0.032	0.672	1.046	0.054	0.388	0.995	0.050	0.922	0.893	0.066	0.127

(continued)

Table A1: Continued

	UTI			Pressure Ulcer			Pneumonia			DVT		
	11-State All Patient											
	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z
Massachusetts	0.980	0.032	0.536	1.098	0.058	0.078	0.953	0.038	0.219	0.853	0.057	0.018
Michigan	0.961	0.029	0.179	0.936	0.047	0.191	0.951	0.034	0.153	0.820	0.046	0.000
Minnesota	1.014	0.038	0.715	1.053	0.095	0.568	0.936	0.043	0.152	0.967	0.071	0.652
Mississippi	1.048	0.037	0.185	1.259	0.085	0.001	0.913	0.056	0.139	1.115	0.104	0.247
Missouri	1.000	0.029	0.994	1.102	0.065	0.101	1.018	0.042	0.667	0.946	0.065	0.421
Montana	1.041	0.082	0.614	1.117	0.108	0.253	0.957	0.088	0.633	1.209	0.144	0.113
Nebraska	1.099	0.069	0.133	1.344	0.152	0.009	0.948	0.079	0.521	1.054	0.092	0.549
Nevada	1.026	0.056	0.633	1.063	0.136	0.635	0.998	0.064	0.975	0.947	0.154	0.736
New Hampshire	1.093	0.053	0.065	1.258	0.265	0.275	0.976	0.078	0.764	0.855	0.146	0.358
New Jersey	1.051	0.032	0.104	1.091	0.057	0.097	1.075	0.045	0.085	0.933	0.049	0.189
New Mexico	1.032	0.054	0.547	1.228	0.118	0.032	0.985	0.063	0.820	0.991	0.089	0.923
New York	0.976	0.024	0.329	0.910	0.039	0.029	0.979	0.030	0.488	0.841	0.043	0.001
North Carolina	1.016	0.030	0.605	1.128	0.062	0.030	0.993	0.068	0.922	0.910	0.054	0.110
North Dakota	1.130	0.072	0.055	1.248	0.081	0.001	0.999	0.108	0.990	1.185	0.115	0.082
Ohio	0.997	0.025	0.912	1.057	0.053	0.264	0.971	0.035	0.417	0.907	0.046	0.055
Oklahoma	1.049	0.046	0.273	1.265	0.104	0.004	0.928	0.050	0.171	1.048	0.069	0.474
Oregon	1.019	0.053	0.790	1.213	0.107	0.029	0.964	0.056	0.523	1.063	0.114	0.565
Pennsylvania	0.988	0.026	0.653	1.032	0.045	0.478	1.001	0.031	0.983	0.911	0.047	0.068
Rhode Island	0.864	0.058	0.029	0.891	0.101	0.308	0.859	0.056	0.020	0.796	0.076	0.017
South Carolina	1.031	0.044	0.466	1.352	0.093	0.000	0.974	0.045	0.567	1.035	0.079	0.653
South Dakota	1.040	0.081	0.611	1.259	0.137	0.033	0.992	0.173	0.964	1.062	0.153	0.678
Tennessee	1.048	0.034	0.152	1.138	0.075	0.050	0.995	0.043	0.901	1.064	0.087	0.446
Texas	1.028	0.028	0.302	1.124	0.047	0.005	0.939	0.027	0.031	1.014	0.050	0.771

Utah	1.015	0.089	0.868	1.085	0.149	0.551	0.885	0.060	0.071	0.958	0.109	0.706
Vermont	0.989	0.053	0.836	1.214	0.237	0.320	0.902	0.114	0.413	1.071	0.150	0.627
Virginia	1.018	0.036	0.609	1.162	0.062	0.005	1.001	0.044	0.980	0.989	0.060	0.854
Washington	1.035	0.040	0.380	1.142	0.083	0.068	0.964	0.045	0.437	0.999	0.085	0.993
West Virginia	1.034	0.052	0.504	1.357	0.116	0.000	0.942	0.054	0.295	1.080	0.094	0.376
Wisconsin	1.039	0.033	0.226	1.192	0.075	0.005	0.969	0.039	0.442	0.973	0.077	0.731
Wyoming	1.166	0.141	0.205	1.567	0.162	0.000	0.950	0.170	0.776	1.237	0.116	0.024
Major Teaching Hospital	1.177	0.021	0.000	1.385	0.043	0.000	1.134	0.027	0.000	1.208	0.048	0.000
Other Teaching Hospital	1.039	0.012	0.001	1.084	0.021	0.000	0.985	0.014	0.291	0.982	0.021	0.403
Large Metropolitan	1.047	0.013	0.000	1.181	0.024	0.000	1.024	0.016	0.135	1.066	0.025	0.007
Non-Metropolitan	0.941	0.013	0.000	0.936	0.024	0.009	1.007	0.020	0.728	0.932	0.026	0.011
Less Than 100 Beds	1.058	0.014	0.000	0.999	0.027	0.980	1.098	0.021	0.000	0.882	0.025	0.000
250-499 Beds	0.978	0.011	0.053	0.989	0.019	0.570	1.011	0.015	0.447	1.158	0.026	0.000
500 or More	0.969	0.017	0.079	0.958	0.027	0.130	0.965	0.021	0.108	1.245	0.050	0.000
Number of Obs	3,356,000		3,314,000				3,355,000			3,357,000		
Wald chi2(20)	193.360		317.060				118.650			430.220		
Prob > chi2	0.000		0.000				0.000			0.000		
Pseudo R2	0.005		0.015				0.004			0.019		

(continued)

Table A1: Continued

	Mortality			Failure to Rescue			GI Bleeding			CNS		
	11-State All-Patient											
	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z
LICENSED Hours per Patient Day	1.000	0.004	0.980	1.003	0.004	0.525	0.988	0.007	0.075	1.013	0.012	0.252
AIDE Hours per Patient Day	1.010	0.006	0.104	1.015	0.007	0.020	0.999	0.011	0.902	1.028	0.019	0.151
RN Hours/LICENSED Hours	0.900	0.091	0.294	0.802	0.084	0.034	0.658	0.126	0.029	1.744	0.518	0.061
New York	0.994	0.021	0.781	0.977	0.022	0.309	1.053	0.047	0.244	1.033	0.069	0.623
Massachusetts	1.027	0.032	0.387	1.014	0.035	0.698	1.079	0.061	0.176	1.023	0.084	0.778
Maryland	1.020	0.026	0.432	1.031	0.028	0.262	1.026	0.047	0.579	0.941	0.105	0.584
Virginia	1.018	0.032	0.562	0.999	0.030	0.978	1.033	0.060	0.577	1.032	0.094	0.732
West Virginia	0.980	0.050	0.695	1.010	0.073	0.893	1.131	0.087	0.112	1.045	0.155	0.769
South Carolina	0.924	0.038	0.055	0.982	0.041	0.673	1.153	0.086	0.056	0.866	0.108	0.248
Wisconsin	1.033	0.037	0.359	1.041	0.042	0.315	1.201	0.074	0.003	0.944	0.075	0.465
Missouri	1.048	0.026	0.066	1.012	0.032	0.712	1.135	0.062	0.020	0.971	0.086	0.743
Arizona	1.090	0.057	0.103	1.046	0.051	0.353	1.164	0.078	0.023	0.877	0.082	0.162
Nevada	0.938	0.051	0.241	1.017	0.034	0.619	0.982	0.133	0.894	0.823	0.101	0.113
Major Teaching Hospital	1.013	0.029	0.655	1.063	0.029	0.024	0.987	0.053	0.800	0.862	0.068	0.059
Other Teaching Hospital	1.007	0.018	0.700	1.005	0.019	0.810	1.053	0.035	0.117	0.955	0.057	0.435
Large Metropolitan	0.959	0.017	0.021	1.009	0.021	0.669	1.068	0.040	0.078	0.966	0.056	0.555
Non-Metropolitan	0.938	0.021	0.004	0.989	0.027	0.682	0.938	0.045	0.183	1.217	0.096	0.012
Less Than 100 Beds	0.951	0.018	0.006	0.948	0.024	0.037	0.988	0.042	0.769	0.737	0.052	0.000
250-499 Beds	1.021	0.019	0.267	1.036	0.020	0.065	1.040	0.032	0.204	1.081	0.054	0.122
500 or More	1.038	0.028	0.168	1.066	0.026	0.008	0.941	0.052	0.272	0.960	0.074	0.594
Number of Obs	799,000			799,000			798,000			799,000		
Wald chi2(20)	44.490			59.440			36.070			45.740		

Prob > chi2	0.001	0.000	0.015	0.001							
Pseudo R2	0.005	0.008	0.005	0.009							
71-State Medicare											
LICENSED Hours per Patient Day	0.998	0.004	0.610	1.003	0.005	0.582	0.007	0.033	1.016	0.013	0.220
AIDE Hours per Patient Day	1.011	0.006	0.074	1.014	0.007	0.036	0.997	0.012	0.784	0.021	0.165
RN Hours/LICENSED Hours	0.857	0.082	0.107	0.811	0.089	0.056	0.684	0.134	0.052	1.898	0.049
New York	1.000	0.021	0.998	0.987	0.025	0.592	1.054	0.048	0.247	1.048	0.507
Massachusetts	1.016	0.032	0.619	1.007	0.037	0.844	1.053	0.061	0.372	1.020	0.098
Maryland	1.029	0.026	0.265	1.033	0.031	0.271	1.015	0.046	0.748	0.935	0.111
Virginia	0.989	0.028	0.684	0.991	0.030	0.777	1.037	0.061	0.539	1.017	0.087
West Virginia	1.014	0.048	0.767	1.019	0.075	0.796	1.148	0.097	0.103	1.050	0.164
South Carolina	0.902	0.039	0.017	0.961	0.042	0.355	1.083	0.089	0.334	0.878	0.124
Wisconsin	1.017	0.032	0.583	1.029	0.039	0.451	1.171	0.072	0.010	0.967	0.082
Missouri	1.031	0.027	0.249	1.002	0.032	0.951	1.124	0.063	0.037	0.980	0.095
Arizona	1.034	0.047	0.460	1.054	0.056	0.323	1.094	0.084	0.239	0.814	0.096
Nevada	0.885	0.049	0.028	0.946	0.037	0.154	0.957	0.133	0.752	0.866	0.135
Major Teaching Hospital	0.972	0.027	0.296	1.045	0.031	0.141	1.036	0.057	0.524	0.850	0.074
Other Teaching Hospital	0.990	0.018	0.579	0.995	0.019	0.800	1.050	0.035	0.141	0.924	0.061
Large Metropolitan	0.928	0.017	0.000	0.967	0.021	0.127	1.057	0.041	0.154	0.961	0.060
Non-Metropolitan	0.943	0.022	0.011	0.995	0.028	0.855	0.935	0.046	0.176	1.235	0.103
Less Than 100 Beds	0.962	0.018	0.037	0.952	0.025	0.065	0.968	0.043	0.463	0.765	0.060
250-499 Beds	1.038	0.019	0.036	1.040	0.021	0.049	1.049	0.034	0.140	1.088	0.060
500 or More	1.050	0.027	0.053	1.064	0.027	0.016	0.930	0.053	0.203	0.946	0.082
Number of Obs											
Wald chi2(20)	799,000			791,000			798,000			799,000	
Prob > chi2	52.230			39.840			35.760			40.430	
Pseudo R2	0.000			0.005			0.016			0.004	
	0.006			0.006			0.005			0.009	

(continued)

Table A1: Continued

	UTI			Pressure Ulcer			Pneumonia			DVT		
	11-State All Patient											
	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z
National MedPAR												
LICENSED Hours per Patient Day	1.002	0.002	0.314	1.001	0.002	0.674	0.994	0.003	0.050	1.003	0.005	0.538
RN Hours/LICENSED Hours	0.985	0.047	0.752	0.900	0.052	0.068	0.957	0.096	0.659	1.858	0.325	0.000
Alabama	0.964	0.025	0.153	0.987	0.031	0.673	1.100	0.067	0.117	0.993	0.091	0.940
Alaska	1.074	0.149	0.607	1.035	0.111	0.750	0.946	0.100	0.599	1.422	0.290	0.084
Arizona	0.986	0.031	0.640	1.003	0.041	0.942	1.047	0.065	0.458	0.956	0.098	0.664
Arkansas	0.975	0.034	0.469	0.998	0.038	0.960	1.026	0.057	0.645	1.068	0.133	0.596
Colorado	1.002	0.032	0.939	1.029	0.040	0.457	1.012	0.100	0.905	0.973	0.127	0.833
Connecticut	0.998	0.033	0.941	0.996	0.040	0.913	1.032	0.058	0.580	0.941	0.099	0.559
Delaware	0.895	0.026	0.000	0.903	0.059	0.121	1.163	0.076	0.020	1.040	0.172	0.813
District of Columbia	1.051	0.055	0.340	1.024	0.072	0.742	1.014	0.116	0.904	0.871	0.168	0.474
Florida	0.965	0.017	0.048	0.977	0.024	0.345	1.013	0.040	0.738	0.976	0.065	0.710
Georgia	1.003	0.026	0.916	1.008	0.034	0.803	1.030	0.053	0.568	1.042	0.095	0.653
Hawaii	0.992	0.049	0.874	1.021	0.058	0.713	0.973	0.111	0.812	0.905	0.206	0.660
Idaho	0.987	0.045	0.776	1.043	0.080	0.578	1.083	0.124	0.483	1.130	0.212	0.515
Illinois	1.002	0.022	0.927	1.007	0.025	0.793	0.997	0.042	0.937	0.910	0.067	0.200
Indiana	0.987	0.027	0.631	0.995	0.034	0.884	1.033	0.047	0.474	1.035	0.090	0.695
Iowa	0.998	0.037	0.947	1.046	0.052	0.366	1.039	0.070	0.572	1.041	0.129	0.746
Kansas	1.029	0.046	0.513	1.060	0.050	0.216	1.066	0.074	0.355	1.103	0.130	0.406
Kentucky	0.990	0.030	0.732	1.014	0.041	0.733	1.034	0.054	0.524	1.017	0.095	0.860
Louisiana	0.924	0.025	0.004	0.932	0.033	0.049	1.006	0.051	0.907	1.023	0.082	0.778
Maine	1.036	0.037	0.314	1.013	0.061	0.825	1.111	0.105	0.266	1.199	0.179	0.223

Maryland	1.002	0.034	0.951	1.015	0.037	0.679	0.997	0.045	0.950	0.962	0.114	0.745
Massachusetts	0.985	0.027	0.598	1.019	0.036	0.592	1.012	0.057	0.837	1.001	0.097	0.990
Michigan	0.986	0.022	0.541	1.000	0.028	0.988	0.979	0.046	0.650	0.991	0.076	0.909
Minnesota	1.022	0.029	0.434	1.024	0.035	0.487	1.093	0.080	0.225	1.026	0.104	0.799
Mississippi	0.962	0.034	0.274	0.978	0.040	0.594	1.083	0.101	0.393	1.113	0.163	0.466
Missouri	1.035	0.027	0.188	1.014	0.033	0.675	1.058	0.057	0.291	1.041	0.093	0.654
Montana	1.011	0.056	0.845	1.040	0.094	0.661	1.025	0.100	0.799	1.024	0.323	0.939
Nebraska	0.987	0.038	0.731	0.975	0.061	0.682	1.126	0.119	0.261	0.976	0.183	0.895
Nevada	0.938	0.050	0.231	0.950	0.050	0.329	0.911	0.099	0.390	0.958	0.125	0.742
New Hampshire	1.033	0.044	0.441	1.057	0.061	0.335	0.988	0.103	0.907	0.867	0.152	0.416
New Jersey	1.020	0.024	0.396	1.009	0.028	0.756	1.037	0.055	0.492	0.928	0.074	0.354
New Mexico	0.998	0.056	0.971	1.021	0.069	0.754	1.073	0.084	0.372	0.873	0.152	0.436
New York	0.974	0.020	0.182	0.991	0.022	0.691	0.985	0.039	0.706	1.016	0.070	0.821
North Carolina	0.950	0.026	0.060	0.976	0.031	0.435	0.994	0.049	0.905	1.072	0.102	0.464
North Dakota	0.973	0.056	0.628	1.045	0.064	0.468	1.062	0.135	0.638	1.250	0.314	0.374
Ohio	0.993	0.019	0.726	1.006	0.024	0.785	1.017	0.039	0.659	0.930	0.065	0.299
Oklahoma	0.947	0.030	0.082	0.965	0.039	0.374	1.043	0.063	0.482	1.018	0.174	0.915
Oregon	1.003	0.038	0.945	1.034	0.050	0.492	1.016	0.085	0.846	1.110	0.136	0.392
Pennsylvania	1.018	0.020	0.343	1.017	0.023	0.446	0.990	0.036	0.784	1.006	0.071	0.928
Rhode Island	1.019	0.028	0.494	1.016	0.052	0.757	0.971	0.105	0.787	0.923	0.103	0.472
South Carolina	0.936	0.038	0.106	0.978	0.038	0.570	1.028	0.081	0.725	0.987	0.115	0.908
South Dakota	1.003	0.040	0.938	1.104	0.089	0.220	1.074	0.107	0.473	1.059	0.208	0.771
Tennessee	0.955	0.027	0.105	0.962	0.031	0.221	1.040	0.053	0.436	1.004	0.092	0.963
Texas	0.944	0.019	0.003	0.968	0.023	0.166	1.017	0.043	0.697	1.066	0.071	0.336
Utah	1.008	0.048	0.870	1.062	0.081	0.431	1.054	0.104	0.592	1.051	0.144	0.719
Vermont	1.008	0.057	0.890	0.988	0.083	0.884	1.088	0.177	0.606	1.060	0.338	0.855
Virginia	0.991	0.026	0.717	1.009	0.031	0.771	0.999	0.053	0.984	1.006	0.092	0.945
Washington	0.993	0.030	0.828	0.996	0.039	0.910	1.013	0.074	0.858	0.976	0.090	0.792
West Virginia	0.976	0.039	0.550	0.987	0.048	0.786	1.049	0.067	0.456	1.007	0.124	0.956
Wisconsin	0.997	0.027	0.912	1.034	0.036	0.340	1.088	0.057	0.110	0.961	0.077	0.620
Wyoming	1.134	0.073	0.052	1.134	0.120	0.236	0.970	0.132	0.825	1.200	0.274	0.424
Major Teaching Hospital	0.962	0.016	0.017	1.013	0.018	0.451	1.005	0.031	0.869	0.858	0.042	0.002

(continued)

Table A1: Continued

	UTI			Pressure Ulcer			Pneumonia			DVT		
	11-State All Patient											
	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z
Other Teaching Hospital	0.975	0.008	0.002	0.998	0.010	0.877	1.009	0.017	0.609	0.946	0.028	0.059
Large Metropolitan	0.939	0.009	0.000	0.961	0.011	0.000	1.039	0.019	0.041	1.003	0.032	0.918
Non-Metropolitan	0.967	0.011	0.003	0.979	0.014	0.135	1.007	0.022	0.740	0.978	0.039	0.585
Less Than 100 Beds	0.947	0.011	0.000	0.942	0.014	0.000	0.987	0.023	0.559	0.890	0.036	0.004
250-499 Beds	1.045	0.009	0.000	1.036	0.011	0.001	1.028	0.018	0.111	1.061	0.033	0.054
500 or More	1.068	0.016	0.000	1.064	0.017	0.000	0.935	0.027	0.019	1.023	0.049	0.628
Number of Obs	3,357,000			3,336,000			3,357,000			3,354,000		
Wald chi2(20)	194.360			100.920			39.820			81.890		
Prob > chi2	0.000			0.001			0.974			0.026		
Pseudo R2	0.006			0.005			0.002			0.004		

Table A1b

	Sepsis			Shock/Cardiac Arrest		
	11-State All Patient					
	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z
LICENSED Hours per Patient Day	0.993	0.007	0.312	0.996	0.012	0.708
AIDE Hours per Patient Day	1.007	0.013	0.608	1.015	0.017	0.384
RN Hours/LICENSED Hours	1.394	0.279	0.097	0.486	0.143	0.014
New York	0.908	0.038	0.021	0.953	0.055	0.407
Massachusetts	0.969	0.061	0.622	1.020	0.139	0.885
Maryland	0.938	0.050	0.229	1.036	0.069	0.597
Virginia	0.964	0.067	0.604	0.976	0.093	0.796
West Virginia	1.074	0.105	0.462	0.988	0.140	0.930
South Carolina	1.107	0.077	0.143	1.032	0.093	0.728
Wisconsin	1.008	0.061	0.896	1.128	0.085	0.110
Missouri	1.036	0.052	0.479	1.058	0.083	0.475
Arizona	1.082	0.074	0.249	1.197	0.131	0.100
Nevada	1.061	0.120	0.604	1.179	0.136	0.152
Major Teaching Hospital	1.207	0.057	0.000	1.182	0.084	0.019
Other Teaching Hospital	1.042	0.034	0.211	0.999	0.048	0.976
Large Metropolitan	1.075	0.036	0.028	1.133	0.058	0.014
Non-Metropolitan	0.928	0.046	0.132	1.059	0.070	0.383
Less Than 100 Beds	0.839	0.037	0.000	0.949	0.062	0.425
250-499 Beds	1.071	0.035	0.037	1.083	0.052	0.096
500 or More	1.100	0.052	0.043	1.003	0.072	0.966

Table A1: Continued

	Sepsis		Shock/Cardiac Arrest			
	11-State All Patient					
	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z
Number of Obs	799,000			798,000		
Wald chi2(20)	166.150			33.510		
Prob > chi2	0.000			0.030		
Pseudo R2	0.022			0.006		
11-State Medicare						
LICENSED Hours per Patient Day	0.989	0.008	0.170	0.995	0.011	0.651
AIDE Hours per Patient Day	1.012	0.014	0.392	1.026	0.018	0.159
RN Hours/LICENSED Hours	1.105	0.233	0.636	0.403	0.114	0.001
New York	0.922	0.041	0.064	0.926	0.057	0.210
Massachusetts	1.043	0.071	0.531	1.078	0.163	0.621
Maryland	1.004	0.058	0.944	1.016	0.074	0.828
Virginia	0.943	0.067	0.410	0.899	0.084	0.251
West Virginia	1.254	0.130	0.030	0.970	0.156	0.851
South Carolina	1.108	0.085	0.183	0.972	0.088	0.754
Wisconsin	1.007	0.070	0.917	1.089	0.089	0.295
Missouri	1.096	0.062	0.104	1.016	0.089	0.853
Arizona	1.049	0.082	0.543	1.216	0.143	0.096
Nevada	1.017	0.157	0.913	0.877	0.113	0.307
Major Teaching Hospital	1.246	0.064	0.000	1.197	0.096	0.024
Other Teaching Hospital	1.069	0.039	0.065	0.966	0.049	0.498
Large Metropolitan	1.065	0.037	0.072	1.057	0.056	0.295

Non-Metropolitan	0.908	0.051	0.082	1.100	0.077	0.169
Less Than 100 Beds	0.833	0.041	0.000	0.967	0.060	0.583
250-499 Beds	1.092	0.039	0.014	1.171	0.058	0.001
500 or More	1.130	0.058	0.017	1.042	0.084	0.608

Number of Obs	799,000	798,000
Wald chi2(20)	157.220	45.610
Prob > chi2	0.000	0.001
Pseudo R2	0.025	0.009

National MedPAR

LICENSED Hours per Patient Day	0.994	0.003	0.094	1.001	0.004	0.868
RN Hours/LICENSED Hours	1.237	0.137	0.056	0.663	0.093	0.004
Alabama	1.134	0.070	0.041	0.931	0.070	0.342
Alaska	1.248	0.262	0.291	1.051	0.278	0.850
Arizona	1.011	0.069	0.868	1.035	0.093	0.707
Arkansas	1.162	0.094	0.064	1.007	0.097	0.941
Colorado	1.000	0.068	0.995	1.011	0.100	0.914
Connecticut	0.988	0.080	0.880	0.982	0.101	0.863
Delaware	0.897	0.108	0.369	0.899	0.205	0.639
District of Columbia	0.882	0.082	0.176	1.108	0.250	0.649
Florida	0.981	0.036	0.592	0.962	0.054	0.496
Georgia	1.030	0.053	0.568	1.003	0.066	0.959
Hawaii	1.109	0.134	0.389	0.928	0.135	0.606
Idaho	1.207	0.154	0.139	1.124	0.205	0.520
Illinois	0.971	0.042	0.494	1.007	0.057	0.906
Indiana	1.016	0.056	0.773	0.961	0.074	0.609
Iowa	1.022	0.069	0.749	1.056	0.093	0.536
Kansas	1.211	0.103	0.025	0.985	0.112	0.896
Kentucky	1.043	0.068	0.515	0.990	0.088	0.908
Louisiana	1.036	0.055	0.501	0.961	0.069	0.578
Maine	1.236	0.108	0.015	1.090	0.164	0.567

(continued)

Table A1: Continued

	Sepsis			Shock/Cardiac Arrest		
	11-State All Patient					
	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z
Maryland	0.965	0.058	0.552	0.999	0.075	0.988
Massachusetts	0.942	0.051	0.269	0.957	0.076	0.583
Michigan	0.875	0.040	0.004	0.959	0.062	0.517
Minnesota	0.976	0.074	0.749	0.924	0.061	0.229
Mississippi	1.124	0.090	0.144	0.967	0.091	0.718
Missouri	0.987	0.053	0.814	1.034	0.078	0.661
Montana	1.206	0.127	0.076	1.028	0.141	0.839
Nebraska	1.199	0.146	0.136	0.966	0.115	0.772
Nevada	0.894	0.072	0.164	0.933	0.138	0.638
New Hampshire	1.249	0.131	0.034	1.054	0.169	0.743
New Jersey	1.003	0.056	0.961	1.042	0.074	0.559
New Mexico	1.243	0.103	0.008	0.978	0.161	0.894
New York	0.868	0.033	0.000	0.971	0.048	0.551
North Carolina	0.955	0.051	0.387	0.981	0.064	0.764
North Dakota	1.109	0.111	0.303	0.994	0.165	0.973
Ohio	0.982	0.043	0.677	0.942	0.050	0.255
Oklahoma	1.031	0.088	0.721	1.011	0.110	0.920
Oregon	1.131	0.103	0.174	1.064	0.109	0.543
Pennsylvania	0.978	0.040	0.576	0.995	0.053	0.920
Rhode Island	0.789	0.097	0.054	0.919	0.086	0.369
South Carolina	1.045	0.065	0.477	0.917	0.072	0.265
South Dakota	1.237	0.151	0.081	1.274	0.227	0.173
Tennessee	1.037	0.067	0.567	0.903	0.067	0.169

Texas	1.019	0.043	0.651	0.969	0.047	0.509
Utah	0.967	0.091	0.724	0.954	0.149	0.761
Vermont	1.165	0.140	0.203	0.923	0.141	0.599
Virginia	1.051	0.059	0.383	0.964	0.071	0.622
Washington	1.041	0.073	0.567	0.997	0.096	0.974
West Virginia	1.117	0.110	0.265	0.976	0.095	0.803
Wisconsin	1.061	0.065	0.333	1.037	0.078	0.624
Wyoming	1.650	0.411	0.044	1.238	0.360	0.464
Major Teaching Hospital	1.231	0.035	0.000	1.107	0.045	0.012
Other Teaching Hospital	1.038	0.019	0.037	0.988	0.023	0.618
Large Metropolitan	1.067	0.020	0.001	1.002	0.025	0.933
Non-Metropolitan	0.868	0.022	0.000	0.951	0.029	0.103
Less Than 100 Beds	0.876	0.024	0.000	0.981	0.032	0.555
250-499 Beds	1.129	0.021	0.000	1.050	0.025	0.044
500 or More	1.207	0.031	0.000	1.033	0.041	0.415
Number of Obs	3,351,000			3,355,000		
Wald chi2(20)	644.570			37.790		
Prob > chi2	0.000			0.986		
Pseudo R2	0.027			0.002		

Table A1c: Continued

	Length of Stay Medical		
	71-state		
	Coeff.	Robust Std. Err.	P > t
LICENSED Hours per Patient Day	-0.094	0.019	0.00
AIDE Hours per Patient Day	0.066	0.027	0.015
RN Hours/LICENSED Hours	-1.410	0.435	0.001
New York	0.156	0.123	0.204
Massachusetts	0.095	0.100	0.341
Maryland	0.065	0.085	0.443
Virginia	0.479	0.119	0.000
West Virginia	0.584	0.262	0.026
South Carolina	0.298	0.104	0.004
Wisconsin	0.109	0.115	0.345
Missouri	0.267	0.133	0.044
Arizona	-0.259	0.149	0.081
Nevada	-0.255	0.317	0.422
Major Teaching Hospital	0.250	0.112	0.026
Other Teaching Hospital	-0.022	0.071	0.759
Large Metropolitan	0.167	0.074	0.024
Non-Metropolitan	-0.334	0.090	0.000
Less Than 100 Beds	-0.241	0.089	0.007
250-499 Beds	0.181	0.071	0.010
500 or More	0.237	0.115	0.039
e2losmed	0.873	0.057	0.000
Constant	2.175	0.561	0.000
Number of Obs	797,000		
F(21, 775)	55.310		

Prob > F	0.000		
R-squared	0.690		
Root MSE	0.828		
Medicare			
LICENSED Hours per Patient Day	-0.141	0.024	0.000
AIDE Hours per Patient Day	0.097	0.037	0.009
RN Hours/LICENSED Hours	-2.176	0.585	0.000
New York	0.316	0.178	0.076
Massachusetts	-0.416	0.140	0.003
Maryland	-0.158	0.133	0.234
Virginia	0.356	0.151	0.018
West Virginia	0.572	0.246	0.020
South Carolina	0.160	0.159	0.315
Wisconsin	-0.031	0.130	0.810
Missouri	0.170	0.168	0.311
Arizona	-0.972	0.234	0.000
Nevada	-0.563	0.361	0.118
Major Teaching Hospital	0.573	0.199	0.004
Other Teaching Hospital	0.057	0.100	0.565
Large Metropolitan	0.279	0.096	0.004
Non-Metropolitan	-0.424	0.120	0.000
Less Than 100 Beds	-0.466	0.113	0.000
250-499 Beds	0.230	0.099	0.020
500 or More	0.112	0.188	0.550
e2losmed	0.800	0.065	0.000
Constant	3.955	0.704	0.000
Number of Obs	797,000		
F(21, 775)	53.210		

(continued)

Table A1c: Continued

	Length of Stay Medical		
	11-state		
	Coef.	Robust Std. Err.	P > t
Prob > F	0.000		
R-squared	0.636		
Root MSE	1.129		
	Medpar		
LICENSED Hours per Patient Day	-0.054	0.010	0.000
RN Hours/LICENSED Hours	-0.818	0.248	0.001
Alabama	-0.033	0.143	0.815
Alaska	-0.166	0.415	0.689
Arizona	-0.267	0.123	0.030
Arkansas	0.105	0.167	0.528
Colorado	-0.083	0.149	0.578
Connecticut	-0.048	0.253	0.850
Delaware	-1.030	0.904	0.255
District of Columbia	-0.467	0.397	0.239
Florida	-0.290	0.109	0.008
Georgia	0.196	0.218	0.368
Hawaii	-0.513	0.483	0.289
Idaho	0.398	0.216	0.065
Illinois	-0.082	0.112	0.460
Indiana	-0.059	0.119	0.623
Iowa	0.397	0.164	0.016
Kansas	0.233	0.189	0.217

Kentucky	-0.069	0.138	0.619
Louisiana	-0.504	0.174	0.004
Maine	0.349	0.206	0.089
Maryland	-0.439	0.138	0.002
Massachusetts	-1.174	0.184	0.000
Michigan	-0.150	0.124	0.226
Minnesota	-0.309	0.131	0.018
Mississippi	0.312	0.179	0.081
Missouri	0.167	0.137	0.223
Montana	0.404	0.247	0.102
Nebraska	-0.176	0.177	0.320
Nevada	-0.801	0.177	0.000
New Hampshire	-0.133	0.199	0.506
New Jersey	-0.272	0.252	0.280
New Mexico	0.160	0.148	0.280
New York	-0.662	0.238	0.005
North Carolina	-0.055	0.130	0.674
North Dakota	-0.193	0.195	0.324
Ohio	0.031	0.112	0.784
Oklahoma	-0.218	0.171	0.201
Oregon	0.335	0.134	0.012
Pennsylvania	-0.205	0.143	0.153
Rhode Island	-0.597	0.267	0.026
South Carolina	-0.272	0.157	0.083
South Dakota	0.599	0.205	0.004
Tennessee	-0.033	0.185	0.858
Texas	-0.261	0.218	0.232
Utah	0.078	0.190	0.681
Vermont	0.187	0.241	0.440
Virginia	-0.029	0.131	0.824

(continued)

Table A1c: Continued

	Length of Stay Medical		
	11-state		
	Coef.	Robust Std. Err.	P > t
Washington	-0.536	0.111	0.000
West Virginia	-0.177	0.132	0.180
Wisconsin	0.158	0.108	0.146
Wyoming	0.592	0.221	0.007
Major Teaching Hospital	0.340	0.100	0.001
Other Teaching Hospital	-0.031	0.047	0.516
Large Metropolitan	0.177	0.063	0.005
Non-Metropolitan	-0.249	0.077	0.001
Less Than 100 Beds	-0.281	0.078	0.000
250-499 Beds	0.214	0.048	0.000
500 or More	0.315	0.102	0.002
e2losmed	0.940	0.049	0.000
Constant	1.296	0.382	0.001
Number of Obs	3,354.000		
F(21, 775)	70.020		
Prob > F	0.000		
R-squared	0.535		
Root MSE	1.242		

Table A2: Regression of Outcomes on Nursing and Other Variables, Surgical Pool, 11-State All-Patient, 11-State Medicare, MedPAR Samples

	UTI			Pressure Ulcer			Pneumonia			DVT		
	11-State All Patient											
	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z
LICENSED Hours per Patient Day	1.006	0.008	0.480	0.981	0.011	0.081	1.018	0.012	0.141	1.032	0.014	0.019
AIDE Hours per Patient Day	1.000	0.012	0.984	1.034	0.020	0.085	1.003	0.018	0.873	1.029	0.027	0.283
RN Hours/LICENSED Hours	0.589	0.119	0.009	0.828	0.299	0.600	0.522	0.164	0.038	1.687	0.625	0.158
New York		0.040	0.055	0.974	0.061	0.674	0.947	0.067	0.439	0.817	0.075	0.028
Massachusetts	0.956	0.056	0.448	1.145	0.154	0.314	0.800	0.082	0.030	0.741	0.102	0.029
Maryland	0.914	0.063	0.194	0.978	0.078	0.786	1.017	0.089	0.847	0.890	0.106	0.327
Virginia	0.885	0.056	0.053	0.987	0.097	0.892	0.957	0.075	0.573	0.855	0.088	0.130
West Virginia	0.908	0.077	0.254	1.009	0.136	0.946	1.061	0.115	0.585	1.053	0.166	0.746
South Carolina	0.941	0.071	0.422	1.060	0.150	0.683	1.004	0.124	0.973	1.047	0.130	0.711
Wisconsin	0.944	0.062	0.381	1.026	0.111	0.812	1.054	0.106	0.603	0.903	0.093	0.325
Missouri	0.912	0.057	0.145	1.009	0.102	0.932	1.063	0.098	0.504	0.879	0.090	0.210
Arizona	0.953	0.075	0.541	1.067	0.123	0.574	0.902	0.084	0.270	0.780	0.133	0.144
Nevada	1.070	0.091	0.427	1.192	0.229	0.360	1.173	0.176	0.288	1.172	0.220	0.396
Major Teaching Hospital	1.160	0.066	0.010	1.019	0.069	0.780	1.341	0.100	0.000	1.420	0.214	0.020
Other Teaching Hospital	1.044	0.039	0.247	1.050	0.055	0.351	1.058	0.057	0.291	1.060	0.060	0.305
Large Metropolitan	1.038	0.038	0.306	1.084	0.060	0.147	1.104	0.061	0.072	1.151	0.072	0.025
Non-Metropolitan	1.061	0.053	0.239	1.071	0.099	0.457	0.985	0.081	0.853	1.240	0.108	0.013
Less Than 100 Beds	1.088	0.048	0.056	0.913	0.090	0.355	1.024	0.069	0.727	0.784	0.068	0.005
250-499 Beds	1.013	0.039	0.738	1.057	0.059	0.322	1.066	0.054	0.210	1.102	0.066	0.108
500 or More	1.019	0.057	0.738	0.970	0.076	0.699	0.987	0.078	0.865	1.208	0.128	0.074

(continued)

Table A2: Continued

	UTI			Pressure Ulcer			Pneumonia			DVT		
	11-State All Patient			11-State Medicare			11-State Medicare			11-State Medicare		
	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z
Number of Obs	795.000			788.000			796.000			796.000		
Wald chi2(20)	34.090			14.810			37.750			77.110		
Prob > chi2	0.026			0.787			0.010			0.000		
Pseudo R2	0.005			0.005			0.008			0.028		
LICENSED Hours per Patient Day	1.003	0.008	0.656	0.967	0.012	0.009	1.015	0.013	0.268	1.020	0.015	0.183
AIDE Hours per Patient Day	1.003	0.012	0.795	1.042	0.023	0.064	1.009	0.020	0.672	0.998	0.024	0.920
RN Hours/LICENSED Hours	0.675	0.142	0.062	0.811	0.345	0.624	0.356	0.121	0.002	1.265	0.520	0.566
New York	0.929	0.042	0.105	0.990	0.069	0.884	0.932	0.067	0.328	0.848	0.075	0.062
Massachusetts	0.930	0.058	0.247	1.134	0.181	0.431	0.694	0.080	0.001	0.686	0.092	0.005
Maryland	0.912	0.061	0.167	1.042	0.105	0.680	0.990	0.088	0.910	0.872	0.099	0.227
Virginia	0.921	0.057	0.184	0.952	0.107	0.661	0.965	0.082	0.671	0.853	0.102	0.181
West Virginia	0.943	0.077	0.472	1.061	0.143	0.659	0.976	0.108	0.825	0.963	0.176	0.838
South Carolina	0.961	0.073	0.606	1.123	0.155	0.402	0.951	0.120	0.687	1.123	0.154	0.398
Wisconsin	0.990	0.066	0.874	1.091	0.127	0.453	1.004	0.109	0.974	1.020	0.101	0.839
Missouri	0.904	0.059	0.118	1.009	0.120	0.940	0.991	0.098	0.924	0.909	0.096	0.363
Arizona	0.929	0.082	0.406	1.213	0.136	0.086	0.866	0.084	0.138	0.803	0.155	0.257
Nevada	1.048	0.085	0.561	1.447	0.322	0.097	1.051	0.124	0.674	1.177	0.215	0.371
Major Teaching Hospital	1.201	0.069	0.001	1.054	0.087	0.524	1.336	0.113	0.001	1.377	0.140	0.002
Other Teaching Hospital	1.087	0.041	0.028	1.102	0.070	0.125	1.043	0.060	0.467	1.045	0.067	0.490
Large Metropolitan	1.026	0.036	0.476	1.111	0.068	0.086	1.135	0.065	0.026	1.223	0.092	0.008

Non-Metropolitan	1.020	0.051	0.694	1.161	0.117	0.138	0.970	0.086	0.736	1.297	0.128	0.008
Less Than 100 Beds	1.134	0.049	0.004	0.924	0.101	0.473	1.066	0.077	0.377	0.876	0.086	0.176
250-499 Beds	0.990	0.039	0.804	1.054	0.067	0.407	1.025	0.057	0.664	1.078	0.072	0.258
500 or More	0.952	0.050	0.356	1.082	0.098	0.381	0.926	0.075	0.341	1.221	0.110	0.027
Number of Obs	789,000			781,000			793,000			794,000		
Wald chi2(20)	33.650			23.610			38.750			56.920		
Prob> chi2	0.029			0.260			0.007			0.000		
Pseudo R2	0.006			0.009			0.009			0.022		

National MedPAR

LICENSED Hours per Patient Day	0.991	0.003	0.004	0.986	0.004	0.001	0.989	0.003	0.001	0.995	0.005	0.326
RN Hours/LICENSED Hours	0.877	0.084	0.169	0.902	0.111	0.404	0.936	0.101	0.540	1.516	0.239	0.008
Alabama	1.047	0.052	0.356	1.172	0.073	0.011	1.088	0.069	0.183	1.065	0.089	0.450
Alaska	0.937	0.186	0.743	1.349	0.182	0.026	0.612	0.123	0.015	1.205	0.335	0.501
Arizona	1.043	0.066	0.513	1.049	0.091	0.582	0.974	0.066	0.703	0.911	0.108	0.431
Arkansas	1.086	0.067	0.178	1.182	0.107	0.064	1.064	0.082	0.419	1.052	0.127	0.678
Colorado	0.982	0.065	0.778	1.025	0.080	0.750	0.990	0.058	0.866	0.950	0.122	0.692
Connecticut	0.971	0.074	0.703	1.109	0.115	0.323	1.003	0.088	0.977	1.048	0.125	0.697
Delaware	0.924	0.096	0.448	1.237	0.051	0.000	1.212	0.339	0.492	0.776	0.104	0.059
District of Columbia	0.964	0.085	0.676	0.879	0.090	0.206	1.083	0.172	0.617	0.875	0.131	0.372
Florida	0.992	0.033	0.801	1.056	0.049	0.246	0.989	0.040	0.790	0.997	0.059	0.961
Georgia	1.007	0.046	0.879	1.124	0.067	0.051	1.067	0.057	0.220	1.052	0.086	0.534
Hawaii	0.992	0.053	0.886	1.127	0.128	0.293	0.952	0.080	0.557	1.069	0.216	0.741
Idaho	1.054	0.093	0.554	1.074	0.223	0.730	1.117	0.171	0.472	1.076	0.244	0.748
Illinois	0.986	0.039	0.712	1.013	0.051	0.802	0.990	0.043	0.807	0.897	0.057	0.088
Indiana	0.988	0.059	0.836	1.066	0.064	0.289	1.017	0.066	0.789	1.030	0.097	0.756
Iowa	1.001	0.076	0.993	1.090	0.095	0.321	1.101	0.131	0.417	1.060	0.138	0.654
Kansas	0.999	0.063	0.992	1.193	0.142	0.138	0.981	0.081	0.814	1.174	0.128	0.142
Kentucky	1.009	0.047	0.843	1.154	0.088	0.059	1.066	0.065	0.295	1.014	0.087	0.871
Louisiana	0.972	0.052	0.594	1.053	0.066	0.408	1.057	0.062	0.340	1.060	0.091	0.494
Maine	1.052	0.106	0.613	1.163	0.192	0.360	0.995	0.086	0.957	1.113	0.199	0.551

(continued)

Table A2: Continued

	UTI			Pressure Ulcer			Pneumonia			DVT		
	11-State All Patient											
	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z
Maryland	0.970	0.052	0.565	0.993	0.055	0.894	0.996	0.059	0.943	0.906	0.076	0.242
Massachusetts	0.945	0.050	0.286	0.992	0.075	0.914	0.940	0.058	0.316	0.869	0.075	0.104
Michigan	0.894	0.038	0.008	0.987	0.052	0.804	0.964	0.053	0.506	0.859	0.065	0.046
Minnesota	0.947	0.057	0.364	1.085	0.087	0.309	0.879	0.064	0.077	0.977	0.082	0.784
Mississippi	1.086	0.066	0.177	1.189	0.084	0.014	1.100	0.096	0.275	1.074	0.110	0.484
Missouri	0.955	0.049	0.377	1.044	0.086	0.596	1.026	0.057	0.643	0.882	0.070	0.113
Montana	1.025	0.110	0.816	1.099	0.159	0.511	1.006	0.109	0.953	1.367	0.355	0.228
Nebraska	1.027	0.089	0.762	1.176	0.113	0.093	1.007	0.104	0.948	1.160	0.248	0.488
Nevada	1.037	0.078	0.628	1.232	0.218	0.238	1.028	0.086	0.740	1.054	0.176	0.752
New Hampshire	1.009	0.089	0.915	1.071	0.170	0.668	1.010	0.151	0.948	1.067	0.186	0.709
New Jersey	0.965	0.042	0.403	1.002	0.049	0.965	1.047	0.057	0.403	0.882	0.068	0.102
New Mexico	1.032	0.079	0.676	1.216	0.196	0.226	1.022	0.115	0.848	1.070	0.207	0.725
New York	0.936	0.031	0.050	0.905	0.042	0.031	0.965	0.039	0.386	0.799	0.047	0.000
North Carolina	0.997	0.045	0.954	1.115	0.065	0.064	1.040	0.062	0.507	0.989	0.078	0.883
North Dakota	1.011	0.075	0.883	1.196	0.152	0.160	0.952	0.089	0.597	1.198	0.306	0.479
Ohio	0.952	0.037	0.204	1.059	0.052	0.244	0.975	0.041	0.538	0.869	0.057	0.033
Oklahoma	1.047	0.073	0.509	1.183	0.125	0.110	1.049	0.096	0.602	1.095	0.101	0.326
Oregon	1.011	0.070	0.870	1.112	0.096	0.219	1.001	0.091	0.990	1.038	0.121	0.748
Pennsylvania	0.925	0.037	0.054	0.987	0.049	0.784	1.022	0.045	0.614	0.926	0.061	0.248
Rhode Island	0.859	0.081	0.107	0.978	0.145	0.879	0.848	0.098	0.151	0.873	0.141	0.399
South Carolina	0.970	0.060	0.626	1.138	0.085	0.084	1.019	0.068	0.781	1.032	0.097	0.736
South Dakota	0.977	0.099	0.820	1.211	0.160	0.146	1.073	0.211	0.720	0.979	0.235	0.931
Tennessee	1.043	0.056	0.430	1.104	0.069	0.111	1.057	0.070	0.405	1.014	0.085	0.867

Texas	1.031	0.038	0.410	1.094	0.053	0.063	1.048	0.042	0.242	1.002	0.064	0.977
Utah	0.901	0.109	0.390	1.038	0.096	0.689	0.971	0.084	0.735	1.001	0.191	0.994
Vermont	0.914	0.093	0.379	1.116	0.168	0.465	0.860	0.198	0.513	0.836	0.218	0.493
Virginia	0.969	0.046	0.501	1.065	0.058	0.247	1.039	0.052	0.443	0.980	0.085	0.811
Washington	0.988	0.067	0.857	1.050	0.109	0.637	0.962	0.083	0.656	1.010	0.156	0.951
West Virginia	0.924	0.070	0.302	1.150	0.097	0.098	1.110	0.083	0.163	1.104	0.108	0.309
Wisconsin	0.972	0.052	0.594	1.095	0.071	0.161	1.079	0.085	0.337	0.986	0.073	0.853
Wyoming	0.912	0.187	0.652	1.325	0.205	0.069	0.841	0.140	0.300	1.064	0.197	0.737
Major Teaching Hospital	1.216	0.032	0.000	1.223	0.039	0.000	1.135	0.034	0.000	1.217	0.054	0.000
Other Teaching Hospital	1.072	0.018	0.000	1.081	0.022	0.000	1.030	0.020	0.126	0.959	0.026	0.121
Large Metropolitan	1.038	0.018	0.029	1.184	0.026	0.000	1.087	0.022	0.000	1.107	0.031	0.000
Non-Metropolitan	0.957	0.019	0.032	0.984	0.029	0.587	1.011	0.027	0.677	0.981	0.037	0.616
Less Than 100 Beds	1.098	0.023	0.000	1.101	0.037	0.004	1.074	0.030	0.011	0.908	0.040	0.028
250-499 Beds	0.968	0.016	0.052	0.963	0.020	0.074	0.945	0.019	0.004	1.140	0.032	0.000
500 or More	0.940	0.023	0.011	0.907	0.026	0.001	0.876	0.024	0.000	1.213	0.047	0.000
Number of Obs	3,288,000			3,217,000			3,293,000			3,297,000		
Wald $\chi^2(20)$	118,960			202,510			102,930			231,480		
Prob > χ^2	0.000			0.000			0.000			0.000		
Pseudo R ²	0.005			0.011			0.005			0.016		

Table A2a

	Mortality			Failure to Rescue			GI Bleeding			CNS		
	11-State All Patient											
	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z
LICENSED Hours per Patient Day	1.000	0.007	0.992	0.982	0.008	0.022	0.989	0.013	0.380	1.033	0.017	0.051
AIDE Hours per Patient Day	1.008	0.012	0.496	1.017	0.014	0.194	1.007	0.020	0.707	1.034	0.026	0.180
RN Hours/LICENSED Hours	1.124	0.202	0.517	0.715	0.149	0.107	0.528	0.191	0.077	2.098	0.968	0.108
New York	0.903	0.035	0.009	0.945	0.044	0.224	1.103	0.079	0.170	0.946	0.095	0.581
Massachusetts	0.909	0.061	0.157	1.014	0.133	0.916	1.160	0.113	0.127	1.055	0.114	0.618
Maryland	0.948	0.052	0.335	0.999	0.068	0.984	1.037	0.091	0.675	0.912	0.173	0.628
Virginia	0.894	0.051	0.048	1.021	0.063	0.735	1.004	0.107	0.970	0.950	0.132	0.711
West Virginia	1.007	0.070	0.923	0.963	0.076	0.633	1.036	0.136	0.790	1.086	0.207	0.666
South Carolina	0.953	0.073	0.533	1.008	0.065	0.903	1.110	0.138	0.403	0.903	0.153	0.546
Wisconsin	0.981	0.051	0.707	0.999	0.072	0.993	1.110	0.099	0.245	0.822	0.094	0.087
Missouri	0.992	0.049	0.867	0.976	0.059	0.689	1.037	0.082	0.647	1.000	0.117	0.999
Arizona	0.934	0.074	0.383	1.050	0.089	0.563	1.025	0.150	0.864	0.879	0.129	0.380
Nevada	1.081	0.085	0.320	0.989	0.086	0.902	1.053	0.167	0.742	0.772	0.206	0.332
Major Teaching Hospital	1.167	0.054	0.001	1.031	0.052	0.541	0.981	0.083	0.821	0.990	0.102	0.923
Other Teaching Hospital	1.022	0.031	0.479	1.011	0.035	0.758	1.079	0.056	0.144	0.928	0.075	0.358
Large Metropolitan	0.986	0.030	0.634	0.978	0.036	0.540	1.101	0.061	0.080	1.021	0.090	0.815
Non-Metropolitan	0.977	0.048	0.629	0.929	0.055	0.213	1.000	0.085	0.997	1.134	0.127	0.264
Less Than 100 Beds	0.946	0.046	0.255	0.938	0.055	0.275	0.946	0.077	0.492	0.765	0.090	0.023
250-499 Beds	1.110	0.035	0.001	1.008	0.036	0.835	1.083	0.057	0.129	1.172	0.088	0.035
500 or More	1.163	0.050	0.000	1.097	0.057	0.071	0.848	0.069	0.044	1.080	0.124	0.500

Number of Obs	796.000	785.000	797.000	796.000								
Wald chi2(20)	75.080	17.990	30.650	28.930								
Prob > chi2	0.000	0.588	0.060	0.089								
Pseudo R2	0.015	0.006	0.008	0.010								
11-State Medicare												
LICENSED Hours per Patient Day	0.993	0.008	0.403	0.978	0.009	0.013	0.991	0.014	0.517	1.033	0.020	0.106
AIDE Hours per Patient Day	1.001	0.013	0.955	1.014	0.016	0.369	0.999	0.024	0.962	1.014	0.032	0.647
RN Hours/LICENSED Hours	0.929	0.189	0.718	0.698	0.168	0.135	0.404	0.171	0.032	2.063	1.095	0.172
New York	0.942	0.042	0.179	0.948	0.046	0.264	1.126	0.092	0.147	1.062	0.126	0.615
Massachusetts	0.854	0.071	0.057	1.028	0.130	0.826	1.063	0.126	0.608	1.087	0.145	0.533
Maryland	0.938	0.051	0.239	1.012	0.068	0.857	0.979	0.095	0.830	0.932	0.203	0.747
Virginia	0.924	0.053	0.172	1.069	0.069	0.301	1.118	0.135	0.352	1.034	0.174	0.842
West Virginia	0.932	0.067	0.321	0.878	0.083	0.166	0.981	0.138	0.891	0.970	0.235	0.901
South Carolina	0.980	0.078	0.794	1.010	0.083	0.902	1.145	0.161	0.336	0.999	0.226	0.998
Wisconsin	0.969	0.055	0.575	1.001	0.082	0.995	1.069	0.105	0.497	0.899	0.116	0.409
Missouri	0.975	0.055	0.656	0.991	0.067	0.889	1.079	0.097	0.401	1.035	0.144	0.807
Arizona	0.934	0.075	0.392	1.075	0.094	0.407	1.013	0.184	0.944	0.855	0.143	0.346
Nevada	1.058	0.084	0.474	1.035	0.118	0.760	1.084	0.247	0.722	0.801	0.260	0.495
Major Teaching Hospital	1.143	0.059	0.010	1.014	0.053	0.798	0.962	0.096	0.699	1.019	0.134	0.884
Other Teaching Hospital	1.016	0.032	0.610	1.024	0.043	0.580	1.106	0.067	0.099	0.919	0.086	0.365
Large Metropolitan	0.977	0.035	0.518	0.961	0.043	0.365	1.163	0.073	0.017	1.000	0.102	0.999
Non-Metropolitan	0.990	0.051	0.839	0.927	0.057	0.221	1.035	0.099	0.721	1.103	0.146	0.456
Less Than 100 Beds	1.016	0.053	0.760	0.947	0.058	0.378	1.009	0.090	0.921	0.859	0.119	0.273
250-499 Beds	1.097	0.037	0.007	1.029	0.044	0.503	1.062	0.065	0.330	1.077	0.094	0.393
500 or More	1.064	0.050	0.190	1.095	0.062	0.108	0.816	0.079	0.035	1.021	0.141	0.878
Number of Obs	794.000		767.000				794.000			794.000		
Wald chi2(20)	27.560		19.180				33.200			12.980		
Prob > chi2	0.120		0.510				0.032			0.878		
Pseudo R2	0.007		0.006				0.010			0.004		

Table A2b

	Mortality			Failure to Rescue			GI Bleeding			CNS		
				National MedPAR								
	IRR	Robust Std. Err.	P>z	IRR	Robust Std. Err.	P>z	IRR	Robust Std. Err.	P>z	IRR	Robust Std. Err.	P>z
LICENSED Hours per Patient Day	0.999	0.002	0.660	0.999	0.003	0.763	0.987	0.004	0.001	0.991	0.007	0.189
RN Hours/LICENSED Hours	0.873	0.069	0.088	0.813	0.066	0.011	0.769	0.109	0.063	1.628	0.381	0.037
Alabama	0.950	0.039	0.217	0.973	0.039	0.495	1.047	0.081	0.550	0.996	0.115	0.969
Alaska	0.989	0.175	0.948	0.986	0.255	0.958	1.007	0.376	0.985	1.129	0.430	0.750
Arizona	0.999	0.042	0.986	1.021	0.039	0.587	1.019	0.095	0.839	0.883	0.107	0.307
Arkansas	0.977	0.056	0.688	0.977	0.061	0.709	1.069	0.101	0.485	0.959	0.208	0.848
Colorado	0.986	0.056	0.806	0.994	0.067	0.925	1.001	0.108	0.993	1.009	0.168	0.958
Connecticut	1.002	0.050	0.964	1.001	0.039	0.981	1.089	0.099	0.346	0.878	0.111	0.302
Delaware	0.897	0.054	0.072	0.948	0.061	0.402	1.257	0.133	0.030	0.911	0.317	0.788
District of Columbia	0.959	0.095	0.671	0.997	0.084	0.968	1.019	0.166	0.909	0.825	0.217	0.465
Florida	0.957	0.026	0.098	0.979	0.030	0.492	1.005	0.054	0.923	0.978	0.076	0.775
Georgia	0.969	0.037	0.408	1.000	0.041	0.998	1.060	0.072	0.390	0.966	0.117	0.773
Hawaii	0.991	0.076	0.904	0.981	0.071	0.793	0.931	0.147	0.651	1.157	0.353	0.632
Idaho	1.026	0.083	0.755	1.044	0.107	0.675	1.091	0.153	0.532	1.026	0.293	0.929
Illinois	0.979	0.033	0.522	1.019	0.038	0.604	1.048	0.055	0.373	0.971	0.096	0.766
Indiana	0.987	0.038	0.729	1.013	0.050	0.798	1.071	0.087	0.395	0.981	0.119	0.875
Iowa	0.952	0.056	0.402	1.008	0.050	0.866	1.039	0.100	0.696	0.936	0.195	0.753
Kansas	0.990	0.071	0.884	1.001	0.080	0.986	0.979	0.089	0.818	0.962	0.157	0.812
Kentucky	0.967	0.048	0.502	1.006	0.041	0.881	1.009	0.080	0.907	0.913	0.119	0.484
Louisiana	0.948	0.039	0.196	0.961	0.049	0.428	0.988	0.071	0.864	1.079	0.123	0.506
Maine	1.036	0.097	0.704	1.003	0.112	0.979	1.132	0.114	0.219	1.248	0.248	0.266
Maryland	0.986	0.050	0.780	1.024	0.059	0.686	1.031	0.072	0.661	0.891	0.144	0.476

Massachusetts	0.988	0.045	0.793	0.981	0.046	0.681	1.056	0.085	0.497	1.004	0.116	0.971
Michigan	0.947	0.035	0.136	0.992	0.033	0.812	1.013	0.063	0.839	0.935	0.098	0.521
Minnesota	1.036	0.067	0.580	1.017	0.071	0.804	1.001	0.091	0.989	1.101	0.131	0.421
Mississippi	0.975	0.045	0.584	0.992	0.066	0.907	1.075	0.128	0.545	0.983	0.192	0.932
Missouri	1.013	0.040	0.743	1.016	0.052	0.753	1.044	0.079	0.566	0.959	0.108	0.712
Montana	1.039	0.106	0.706	1.046	0.099	0.636	1.039	0.245	0.872	0.852	0.329	0.677
Nebraska	0.938	0.078	0.439	0.940	0.108	0.595	0.999	0.156	0.993	0.851	0.186	0.458
Nevada	0.969	0.073	0.675	0.955	0.064	0.489	0.976	0.140	0.866	1.047	0.256	0.850
New Hampshire	0.994	0.078	0.941	1.017	0.088	0.847	1.038	0.157	0.807	0.967	0.191	0.865
New Jersey	0.994	0.038	0.866	0.992	0.036	0.820	1.035	0.067	0.593	0.916	0.096	0.403
New Mexico	1.016	0.085	0.853	1.022	0.157	0.889	0.955	0.113	0.699	1.099	0.257	0.686
New York	0.972	0.029	0.344	1.004	0.029	0.893	0.985	0.054	0.777	0.888	0.070	0.131
North Carolina	0.970	0.034	0.383	1.003	0.037	0.930	1.075	0.083	0.350	1.029	0.137	0.827
North Dakota	0.970	0.067	0.660	0.989	0.070	0.879	1.034	0.160	0.827	1.078	0.310	0.794
Ohio	0.956	0.029	0.128	0.989	0.033	0.740	1.048	0.063	0.429	0.953	0.092	0.618
Oklahoma	0.943	0.054	0.304	0.978	0.051	0.673	1.037	0.087	0.667	0.807	0.215	0.420
Oregon	1.010	0.055	0.854	1.044	0.082	0.581	1.070	0.115	0.533	0.960	0.123	0.751
Pennsylvania	0.976	0.030	0.423	0.996	0.030	0.885	1.010	0.052	0.852	0.926	0.079	0.367
Rhode Island	0.924	0.096	0.448	1.015	0.102	0.885	0.910	0.143	0.549	0.802	0.170	0.298
South Carolina	0.926	0.043	0.101	0.970	0.039	0.459	1.011	0.086	0.899	0.988	0.164	0.943
South Dakota	0.993	0.068	0.922	0.996	0.066	0.952	1.190	0.223	0.354	0.999	0.234	0.998
Tennessee	0.955	0.038	0.257	0.985	0.039	0.709	1.066	0.076	0.372	1.002	0.110	0.986
Texas	0.959	0.027	0.140	0.985	0.031	0.624	1.023	0.053	0.662	0.989	0.088	0.900
Utah	0.975	0.059	0.679	1.036	0.082	0.653	1.039	0.134	0.768	1.136	0.226	0.522
Vermont	0.919	0.116	0.502	1.031	0.097	0.747	1.106	0.171	0.515	1.024	0.406	0.952
Virginia	0.960	0.039	0.316	0.991	0.041	0.825	0.999	0.082	0.990	0.972	0.119	0.815
Washington	0.977	0.062	0.716	1.017	0.048	0.723	0.998	0.097	0.980	0.923	0.128	0.563
West Virginia	0.935	0.046	0.177	0.976	0.048	0.615	1.064	0.102	0.521	1.037	0.202	0.853
Wisconsin	0.989	0.044	0.805	1.006	0.047	0.902	1.069	0.083	0.394	0.882	0.108	0.308
Wyoming	1.047	0.141	0.732	1.081	0.226	0.710	1.090	0.218	0.667	0.842	0.457	0.752

(continued)

Table A2b: Continued

	Mortality			Failure to Rescue			GI Bleeding			CNS		
	National MedPAR											
	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z
Major Teaching Hospital	1.049	0.022	0.021	1.031	0.021	0.126	0.975	0.040	0.549	0.957	0.061	0.486
Other Teaching Hospital	1.020	0.013	0.134	1.030	0.014	0.033	1.022	0.024	0.353	0.950	0.037	0.196
Large Metropolitan	0.967	0.013	0.016	0.959	0.014	0.004	1.045	0.026	0.084	1.006	0.043	0.892
Non-Metropolitan	0.957	0.017	0.014	0.967	0.020	0.108	0.979	0.032	0.519	0.992	0.055	0.881
Less Than 100 Beds	0.954	0.021	0.034	0.963	0.025	0.144	1.048	0.037	0.183	0.831	0.049	0.002
250-499 Beds	1.069	0.014	0.000	1.017	0.015	0.255	1.020	0.024	0.397	0.996	0.040	0.917
500 or More	1.075	0.019	0.000	1.029	0.019	0.126	0.874	0.032	0.000	1.043	0.068	0.516
Number of Obs	3,297.000			3,184.000			3,297.000			3,294.000		
Wald chi2(20)	101.000			37.570			58.680			45.420		
Prob > chi2	0.001			0.987			0.487			0.903		
Pseudo R2	0.005			0.002			0.003			0.004		
11-State All Patient												
LICENSED Hours per Patient Day	1.006	0.011	0.579	0.998	0.013	0.896	0.997	0.010	0.742	1.000	0.012	1.000
AIDE Hours per Patient Day	0.997	0.017	0.847	0.990	0.023	0.674	1.016	0.017	0.331	1.014	0.019	0.456
RN Hours/LICENSED Hours	1.107	0.325	0.728	0.595	0.205	0.132	1.327	0.407	0.356	1.202	0.366	0.545
New York	0.894	0.055	0.066	0.853	0.068	0.045	0.919	0.055	0.154	0.964	0.063	0.579
Massachusetts	0.865	0.106	0.236	0.912	0.167	0.615	1.052	0.082	0.519	0.917	0.094	0.401
Maryland	0.986	0.081	0.864	0.953	0.097	0.639	0.945	0.069	0.439	1.009	0.105	0.933
Virginia	0.891	0.079	0.191	0.830	0.085	0.070	0.952	0.083	0.574	0.961	0.107	0.721
West Virginia	1.090	0.136	0.489	0.824	0.126	0.204	1.077	0.168	0.633	1.243	0.201	0.178
South Carolina	1.155	0.147	0.260	0.950	0.132	0.712	1.009	0.113	0.936	1.091	0.122	0.434

Wisconsin	1.029	0.085	0.732	1.003	0.115	0.976	0.995	0.080	0.948	1.010	0.083	0.899
Missouri	0.958	0.092	0.658	0.935	0.112	0.575	1.004	0.089	0.968	1.060	0.069	0.369
Arizona	1.050	0.142	0.721	1.067	0.162	0.671	1.132	0.121	0.245	0.889	0.105	0.320
Nevada	1.110	0.104	0.263	1.028	0.184	0.876	1.180	0.190	0.305	1.321	0.202	0.068
Major Teaching Hospital	1.192	0.095	0.028	1.131	0.106	0.190	1.160	0.071	0.015	0.904	0.072	0.953
Other Teaching Hospital	1.045	0.051	0.364	1.055	0.065	0.387	1.019	0.049	0.696	0.976	0.055	0.666
Large Metropolitan	1.202	0.060	0.000	1.030	0.066	0.642	1.045	0.052	0.368	1.115	0.067	0.069
Non-Metropolitan	1.078	0.087	0.349	1.092	0.113	0.398	1.178	0.085	0.023	0.775	0.063	0.002
Less Than 100 Beds	0.932	0.067	0.324	0.914	0.083	0.325	0.870	0.058	0.037	0.852	0.061	0.025
250-499 Beds	1.059	0.055	0.268	1.038	0.061	0.532	1.096	0.052	0.057	1.125	0.063	0.035
500 or More	1.099	0.082	0.204	0.981	0.094	0.843	1.093	0.076	0.198	1.093	0.082	0.238

Number of Obs	796.000	796.000	796.000	796.000
Wald chi2(20)	54.190	13.400	38.040	91.450
Prob> chi2	0.000	0.860	0.009	0.000
Pseudo R2	0.012	0.004	0.009	0.017

11-State Medicare

LICENSED Hours per Patient Day	0.986	0.012	0.247	1.002	0.014	0.883	1.010	0.012	0.417	0.994	0.012	0.630
AIDE Hours per Patient Day	1.005	0.020	0.786	1.006	0.026	0.830	1.000	0.021	0.995	1.019	0.020	0.356
RN Hours/LICENSED Hours	0.859	0.286	0.649	0.420	0.161	0.023	0.929	0.351	0.845	0.892	0.284	0.719
New York	0.856	0.061	0.030	0.885	0.083	0.194	1.022	0.072	0.760	0.988	0.067	0.856
Massachusetts	0.776	0.110	0.073	0.907	0.183	0.628	0.929	0.086	0.428	0.867	0.101	0.221
Maryland	0.959	0.089	0.651	1.022	0.112	0.843	1.037	0.097	0.702	1.045	0.122	0.707
Virginia	0.893	0.081	0.213	0.864	0.099	0.204	0.947	0.101	0.608	0.944	0.101	0.586
West Virginia	1.012	0.142	0.929	0.689	0.117	0.028	0.914	0.216	0.704	1.120	0.195	0.517
South Carolina	1.123	0.158	0.411	1.015	0.146	0.918	0.968	0.150	0.832	1.164	0.145	0.221
Wisconsin	0.991	0.099	0.930	1.006	0.123	0.958	1.069	0.102	0.485	1.017	0.096	0.857
Missouri	0.970	0.103	0.774	0.919	0.113	0.491	0.970	0.100	0.769	1.058	0.075	0.428
Arizona	1.033	0.122	0.782	1.060	0.170	0.716	1.098	0.142	0.471	0.894	0.125	0.426
Nevada	1.058	0.146	0.683	1.148	0.189	0.402	0.912	0.188	0.653	1.074	0.111	0.491

(continued)

Table A2b: Continued

	Mortality			Failure to Rescue			GI Bleeding			CNS		
	National MedPAR			National MedPAR			National MedPAR			National MedPAR		
	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z	IRR	Robust Std. Err.	P > z
Major Teaching Hospital	1.347	0.140	0.004	1.118	0.132	0.346	1.187	0.097	0.037	1.015	0.087	0.862
Other Teaching Hospital	1.029	0.061	0.631	1.061	0.076	0.408	1.000	0.060	0.997	0.982	0.058	0.754
Large Metropolitan	1.173	0.068	0.006	1.005	0.072	0.945	0.979	0.057	0.710	1.080	0.069	0.230
Non-Metropolitan	1.031	0.094	0.742	1.111	0.125	0.349	1.193	0.108	0.051	0.740	0.065	0.001
Less Than 100 Beds	0.881	0.079	0.155	0.970	0.098	0.766	0.908	0.078	0.260	0.905	0.072	0.212
250-499 Beds	1.013	0.058	0.827	1.066	0.073	0.348	1.090	0.064	0.144	1.149	0.067	0.018
500 or More	0.985	0.087	0.867	0.951	0.106	0.649	1.048	0.092	0.592	1.072	0.088	0.395
Number of Obs	791.000			794.000			794.000			794.000		
Wald chi2(20)	37.290			16.350			21.530			62.520		
Prob> chi2	0.011			0.695			0.367			0.000		
Pseudo R2	0.012			0.006			0.006			0.016		
National MedPAR												
LICENSED Hours per Patient Day	0.985	0.003	0.000	0.995	0.005	0.313	1.007	0.004	0.120	0.995	0.003	0.108
RN Hours/LICENSED Hours	1.099	0.126	0.410	0.589	0.086	0.000	1.908	0.292	0.000	1.206	0.124	0.068
Alabama	1.055	0.072	0.436	0.942	0.081	0.488	1.138	0.107	0.168	0.995	0.057	0.928
Alaska	1.055	0.387	0.883	0.890	0.330	0.753	0.620	0.144	0.040	1.003	0.090	0.974
Arizona	1.046	0.078	0.544	0.980	0.087	0.819	1.074	0.098	0.435	1.043	0.064	0.495
Arkansas	1.077	0.086	0.351	0.908	0.100	0.382	1.163	0.146	0.230	1.120	0.084	0.130
Colorado	1.022	0.073	0.761	1.011	0.120	0.924	0.998	0.099	0.981	0.993	0.098	0.941
Connecticut	1.039	0.083	0.629	0.992	0.087	0.923	1.000	0.084	0.998	1.037	0.063	0.546
Delaware	0.983	0.050	0.737	0.986	0.192	0.942	0.774	0.197	0.315	1.120	0.156	0.416

District of Columbia	1.033	0.130	0.797	1.151	0.324	0.617	0.936	0.113	0.583	1.021	0.124	0.865
Florida	0.994	0.043	0.884	0.968	0.051	0.530	0.995	0.060	0.929	0.993	0.037	0.855
Georgia	1.013	0.061	0.823	0.971	0.070	0.686	1.022	0.087	0.800	1.036	0.053	0.495
Hawaii	1.078	0.131	0.536	0.992	0.132	0.952	1.006	0.143	0.964	0.992	0.058	0.896
Idaho	1.172	0.136	0.172	1.060	0.188	0.744	1.047	0.129	0.707	1.180	0.158	0.218
Illinois	0.970	0.047	0.528	1.021	0.064	0.745	0.955	0.064	0.493	0.984	0.039	0.685
Indiana	0.995	0.069	0.946	0.985	0.086	0.863	0.898	0.081	0.232	1.016	0.052	0.753
Iowa	1.013	0.068	0.843	1.020	0.116	0.861	0.918	0.099	0.426	1.088	0.077	0.235
Kansas	1.136	0.096	0.130	0.998	0.137	0.988	0.922	0.076	0.323	1.075	0.088	0.380
Kentucky	1.056	0.060	0.344	0.960	0.064	0.543	0.926	0.082	0.385	1.063	0.067	0.335
Louisiana	1.024	0.062	0.696	0.925	0.073	0.323	1.132	0.097	0.147	1.029	0.050	0.550
Maine	1.140	0.119	0.211	0.926	0.150	0.636	1.005	0.132	0.971	1.206	0.132	0.087
Maryland	0.969	0.065	0.634	1.010	0.084	0.905	0.962	0.075	0.622	1.002	0.075	0.981
Massachusetts	0.962	0.064	0.561	1.000	0.090	0.998	0.998	0.079	0.984	0.966	0.063	0.593
Michigan	0.919	0.048	0.111	0.986	0.069	0.841	0.949	0.062	0.421	0.994	0.043	0.892
Minnesota	0.967	0.066	0.625	0.978	0.078	0.777	0.896	0.074	0.182	0.994	0.072	0.931
Mississippi	1.026	0.078	0.736	0.928	0.112	0.535	1.038	0.098	0.690	1.129	0.085	0.107
Missouri	0.983	0.064	0.788	1.025	0.087	0.771	0.964	0.078	0.649	1.062	0.054	0.235
Montana	1.021	0.183	0.906	0.883	0.092	0.234	0.997	0.155	0.984	1.261	0.131	0.026
Nebraska	0.993	0.103	0.945	0.911	0.127	0.506	1.109	0.139	0.408	1.088	0.127	0.468
Nevada	1.013	0.093	0.889	0.957	0.116	0.718	1.005	0.114	0.963	1.042	0.088	0.625
New Hampshire	1.083	0.179	0.628	1.117	0.177	0.483	0.974	0.140	0.855	1.048	0.088	0.580
New Jersey	0.973	0.054	0.615	1.035	0.077	0.645	1.005	0.082	0.946	0.943	0.041	0.176
New Mexico	1.087	0.115	0.430	0.943	0.178	0.754	0.967	0.128	0.799	1.095	0.101	0.326
New York	0.894	0.039	0.010	0.997	0.052	0.949	0.915	0.046	0.077	0.985	0.035	0.679
North Carolina	0.979	0.054	0.698	1.024	0.079	0.760	0.947	0.061	0.396	1.007	0.055	0.896
North Dakota	1.079	0.153	0.589	0.896	0.158	0.536	1.015	0.163	0.927	1.050	0.103	0.622
Ohio	0.978	0.048	0.645	0.998	0.061	0.980	0.931	0.057	0.241	0.992	0.043	0.860
Oklahoma	1.019	0.088	0.828	0.951	0.095	0.611	1.066	0.129	0.598	1.053	0.081	0.498
Oregon	1.064	0.100	0.508	1.015	0.110	0.893	0.978	0.119	0.853	1.072	0.093	0.420
Pennsylvania	0.992	0.044	0.850	0.987	0.059	0.822	0.945	0.057	0.345	0.977	0.037	0.542

(continued)

Table A2b: Continued

	Mortality			Failure to Rescue			GI Bleeding			CNS		
	National MedPAR											
	Robust			Robust			Robust			Robust		
	IRR	Std. Err.	P > z	IRR	Std. Err.	P > z	IRR	Std. Err.	P > z	IRR	Std. Err.	P > z
Rhode Island	0.843	0.085	0.089	0.987	0.195	0.948	0.941	0.157	0.716	0.947	0.087	0.558
South Carolina	1.035	0.084	0.675	0.976	0.103	0.818	1.034	0.106	0.741	1.072	0.073	0.307
South Dakota	1.106	0.171	0.514	1.017	0.216	0.937	1.071	0.201	0.713	1.148	0.149	0.288
Tennessee	0.997	0.068	0.970	0.997	0.072	0.971	1.086	0.088	0.311	1.056	0.054	0.292
Texas	1.030	0.045	0.488	0.975	0.051	0.625	1.048	0.056	0.387	1.004	0.037	0.915
Utah	1.047	0.087	0.578	0.965	0.136	0.799	0.952	0.131	0.722	0.988	0.102	0.909
Vermont	1.068	0.121	0.562	0.912	0.196	0.668	0.838	0.158	0.348	1.124	0.141	0.349
Virginia	0.994	0.059	0.925	0.983	0.069	0.811	0.967	0.078	0.676	1.003	0.067	0.965
Washington	0.991	0.074	0.903	0.990	0.103	0.927	1.006	0.095	0.953	1.049	0.096	0.604
West Virginia	1.034	0.102	0.732	0.892	0.100	0.308	0.948	0.102	0.620	1.091	0.096	0.325
Wisconsin	1.014	0.071	0.844	1.051	0.089	0.555	0.942	0.073	0.439	0.974	0.054	0.630
Wyoming	1.125	0.301	0.659	1.173	0.293	0.522	1.066	0.387	0.860	1.062	0.135	0.636
Major Teaching Hospital	1.122	0.035	0.000	1.035	0.040	0.373	1.113	0.043	0.006	1.000	0.026	0.992
Other Teaching Hospital	1.036	0.020	0.073	0.990	0.025	0.701	1.036	0.027	0.172	1.031	0.018	0.090
Large Metropolitan	1.093	0.022	0.000	0.985	0.026	0.562	1.008	0.027	0.760	1.030	0.020	0.122
Non-Metropolitan	0.941	0.026	0.028	0.969	0.035	0.394	1.041	0.037	0.255	0.821	0.021	0.000
Less Than 100 Beds	0.961	0.031	0.223	0.964	0.041	0.381	1.060	0.043	0.144	0.925	0.027	0.008
250-499 Beds	0.982	0.019	0.350	0.991	0.025	0.708	1.042	0.027	0.119	1.033	0.018	0.064
500 or More	1.014	0.027	0.601	0.956	0.036	0.225	1.116	0.043	0.004	0.992	0.025	0.751
Number of Obs	3,289,000			3,295,000			3,297,000			3,294,000		
Wald chi2(20)	136.040			27.430			85.520			195.710		

Prob> chi2	0.000	1.000	0.014	0.000
Pseudo R2	0.008	0.002	0.005	0.012

Table A2c				
Metabolic Derangement				
11-State All Patient				
	IRR	Robust Std. Err.	P > z	
LICENSED Hours per Patient Day	0.979	0.012	0.091	
AIDE Hours per Patient Day	1.017	0.020	0.409	
RN Hours/LICENSED Hours	0.492	0.162	0.031	
New York	0.994	0.067	0.932	
Massachusetts	1.141	0.118	0.204	
Maryland	0.937	0.085	0.474	
Virginia	1.056	0.120	0.631	
West Virginia	1.082	0.098	0.384	
South Carolina	1.293	0.201	0.099	
Wisconsin	1.103	0.095	0.252	
Missouri	1.045	0.088	0.604	
Arizona	1.114	0.152	0.431	
Nevada	1.460	0.161	0.001	
Major Teaching Hospital	0.959	0.085	0.639	
Other Teaching Hospital	0.979	0.051	0.693	
Large Metropolitan	1.192	0.069	0.002	
Non-Metropolitan	0.978	0.074	0.766	
Less Than 100 Beds	0.992	0.063	0.894	
250–499 Beds	1.034	0.060	0.564	
500 or More	0.992	0.088	0.925	

(continued)

Table A2c: Continued

Metabolic Derangement			
11-State All Patient			
	IRR	Robust Std. Err.	P > z
Number of Obs	797,000		
Wald chi2(20)	28.370		
Prob > chi2	0.101		
Pseudo R2	0.004		
11-State Medicare			
LICENSED Hours per Patient Day	0.985	0.011	0.160
AIDE Hours per Patient Day	1.007	0.018	0.702
RN Hours/LICENSED Hours	0.538	0.161	0.039
New York	1.068	0.067	0.294
Massachusetts	1.026	0.106	0.802
Maryland	0.922	0.074	0.314
Virginia	1.086	0.112	0.426
West Virginia	1.061	0.092	0.497
South Carolina	1.253	0.181	0.118
Wisconsin	1.095	0.092	0.280
Missouri	1.116	0.090	0.173
Arizona	1.058	0.137	0.661
Nevada	1.271	0.104	0.003
Major Teaching Hospital	1.038	0.083	0.642
Other Teaching Hospital	1.035	0.052	0.492

Large Metropolitan	1.098	0.058	0.079
Non-Metropolitan	0.949	0.068	0.464
Less Than 100 Beds	1.022	0.063	0.724
250–499 Beds	1.023	0.055	0.671
500 or More	0.899	0.069	0.167

Number of Obs	790,000
Wald chi2(20)	24,650
Prob > chi2	0.215
Pseudo R2	0.004

National MedPAR

LICENSED Hours per Patient Day	0.994	0.004	0.134
RN Hours/LICENSED Hours	1.045	0.122	0.706
Alabama	1.022	0.071	0.757
Alaska	0.947	0.171	0.761
Arizona	0.948	0.060	0.396
Arkansas	1.021	0.081	0.791
Colorado	0.989	0.074	0.885
Connecticut	1.108	0.098	0.247
Delaware	1.040	0.110	0.711
District of Columbia	1.031	0.163	0.849
Florida	1.037	0.047	0.425
Georgia	1.043	0.056	0.428
Hawaii	1.024	0.160	0.879
Idaho	1.110	0.186	0.535
Illinois	1.004	0.049	0.933
Indiana	1.009	0.064	0.884
Iowa	0.886	0.076	0.158
Kansas	1.084	0.079	0.265
Kentucky	1.031	0.072	0.659

(continued)

Table A2c: Continued

Metabolic Derangement			
		11-State All Patient	
	IRR	Robust Std. Err.	P > z
Louisiana	1.058	0.062	0.335
Maine	1.031	0.119	0.795
Maryland	0.931	0.060	0.267
Massachusetts	0.992	0.063	0.894
Michigan	1.010	0.066	0.880
Minnesota	0.990	0.100	0.921
Mississippi	1.138	0.100	0.142
Missouri	1.024	0.065	0.707
Montana	0.945	0.115	0.641
Nebraska	0.978	0.110	0.843
Nevada	1.088	0.080	0.248
New Hampshire	0.908	0.129	0.497
New Jersey	1.009	0.062	0.882
New Mexico	1.086	0.103	0.379
New York	0.946	0.040	0.192
North Carolina	1.000	0.073	0.998
North Dakota	1.019	0.148	0.896
Ohio	1.001	0.054	0.990
Oklahoma	1.009	0.072	0.902
Oregon	1.116	0.119	0.306
Pennsylvania	0.953	0.050	0.365
Rhode Island	1.109	0.163	0.481

South Carolina	1.063	0.098	0.508
South Dakota	0.972	0.148	0.853
Tennessee	0.988	0.055	0.824
Texas	1.023	0.043	0.592
Utah	0.945	0.090	0.556
Vermont	0.935	0.201	0.756
Virginia	0.958	0.062	0.510
Washington	0.992	0.055	0.887
West Virginia	1.039	0.087	0.647
Wisconsin	0.984	0.064	0.799
Wyoming	1.011	0.201	0.958
Major Teaching Hospital	1.057	0.035	0.097
Other Teaching Hospital	0.998	0.021	0.937
Large Metropolitan	1.074	0.023	0.001
Non-Metropolitan	1.017	0.028	0.537
Less Than 100 Beds	1.035	0.027	0.193
250–499 Beds	0.958	0.020	0.040
500 or More	0.916	0.030	0.007
Number of Obs	3,283,000		
Wald $\chi^2(20)$	50.480		
Prob > χ^2	0.778		
Pseudo R ²	0.002		

(continued)

Table A2d

Length of Stay			
11-State All Patient			
	Coef.	Robust Std. Err.	P > t
LICENSED Hours per Patient Day	−0.015	0.015	0.312
AIDE Hours per Patient Day	0.017	0.023	0.461
RN Hours/LICENSED Hours	−0.553	0.435	0.204
New York	0.022	0.072	0.758
Massachusetts	−0.086	0.064	0.182
Maryland	−0.008	0.079	0.924
Virginia	0.075	0.098	0.441
West Virginia	−0.691	0.599	0.249
South Carolina	0.042	0.080	0.601
Wisconsin	0.178	0.070	0.011
Missouri	0.040	0.094	0.674
Arizona	0.088	0.112	0.434
Nevada	0.416	0.138	0.003
Major Teaching Hospital	0.293	0.079	0.000
Other Teaching Hospital	−0.019	0.053	0.723
Large Metropolitan	0.152	0.067	0.024
Non-Metropolitan	0.022	0.085	0.796
Less Than 100 Beds	−0.136	0.080	0.087
250–499 Beds	0.131	0.064	0.040
500 or More	0.046	0.083	0.577
e2losmaj	1.008	0.052	0.000
Constant	0.353	0.384	0.358

Number of Obs	796,000		
F(21, 775)	85.660		
Prob > F	0.000		
R-squared	0.646		
Root MSE	0.809		
<i>11-State Medicare</i>			
LICENSED Hours per Patient Day	− 0.010	0.030	0.733
AIDE Hours per Patient Day	− 0.019	0.039	0.625
RN Hours/LICENSED Hours	− 0.785	0.565	0.165
New York	− 0.141	0.383	0.712
Massachusetts	− 0.443	0.173	0.010
Maryland	− 0.187	0.124	0.133
Virginia	− 0.123	0.198	0.536
West Virginia	− 1.487	0.861	0.085
South Carolina	− 0.245	0.218	0.262
Wisconsin	0.012	0.137	0.928
Missouri	0.062	0.189	0.742
Arizona	0.039	0.197	0.844
Nevada	− 0.082	0.407	0.840
Major Teaching Hospital	0.632	0.252	0.012
Other Teaching Hospital	0.091	0.093	0.332
Large Metropolitan	0.154	0.082	0.061
Non-Metropolitan	0.035	0.105	0.740
Less Than 100 Beds	− 0.296	0.092	0.001
250–499 Beds	0.100	0.115	0.381
500 or More	− 0.190	0.186	0.308
e2losmaj	1.118	0.220	0.000
Constant	0.215	1.381	0.876

(continued)

Table A2d: Continued

Length of Stay			
11-State All Patient			
	Coef.	Robust Std. Err.	P > t
Number of Obs	793,000		
F(21, 775)	39,440		
Prob > F	0.000		
R-squared	0.630		
Root MSE	1.072		
National MedPAR			
LICENSED Hours per Patient Day			
RN Hours/LICENSED Hours			
Alabama	-0.033	0.016	0.042
Alaska	-0.063	0.313	0.839
Arizona	-0.109	0.173	0.530
Arkansas	-0.262	0.850	0.758
Colorado	-0.167	0.135	0.214
Connecticut	0.042	0.233	0.856
Delaware	-0.252	0.163	0.122
District of Columbia	0.110	0.223	0.621
Florida	-0.731	0.203	0.000
Georgia	0.477	1.059	0.653
Hawaii	-0.368	0.120	0.002
Idaho	-0.137	0.176	0.434
Illinois	-0.643	0.951	0.499
	0.131	0.239	0.585
	-0.226	0.140	0.106

Indiana	- 0.038	0.128	0.765
Iowa	- 0.005	0.163	0.973
Kansas	0.363	0.215	0.092
Kentucky	- 0.162	0.220	0.461
Louisiana	- 0.165	0.205	0.420
Maine	0.329	0.191	0.084
Maryland	- 0.294	0.148	0.047
Massachusetts	- 0.206	0.160	0.197
Michigan	- 0.383	0.141	0.007
Minnesota	- 0.081	0.149	0.585
Mississippi	- 0.394	0.263	0.134
Missouri	0.183	0.226	0.417
Montana	0.412	0.219	0.060
Nebraska	0.083	0.232	0.721
Nevada	- 0.321	0.206	0.119
New Hampshire	0.528	0.323	0.102
New Jersey	0.295	0.375	0.432
New Mexico	- 0.238	0.343	0.488
New York	- 0.459	0.326	0.159
North Carolina	- 0.403	0.173	0.020
North Dakota	- 0.958	0.670	0.153
Ohio	- 0.133	0.145	0.358
Oklahoma	0.078	0.214	0.715
Oregon	0.139	0.142	0.325
Pennsylvania	- 0.165	0.150	0.272
Rhode Island	- 0.685	0.235	0.004
South Carolina	- 0.562	0.236	0.017
South Dakota	0.335	0.232	0.150
Tennessee	- 0.475	0.186	0.011
Texas	- 0.196	0.129	0.130

(continued)

Table A2d: Continued

Length of Stay			
71-State All Patient			
	Coef.	Robust Std. Err.	P > t
Utah	-0.174	0.177	0.325
Vermont	0.031	0.352	0.931
Virginia	-0.093	0.188	0.622
Washington	-0.013	0.141	0.928
West Virginia	-0.209	0.247	0.396
Wisconsin	0.118	0.137	0.388
Wyoming	0.262	0.389	0.501
Major Teaching Hospital	0.582	0.162	0.000
Other Teaching Hospital	0.042	0.062	0.494
Large Metropolitan	0.106	0.068	0.116
Non-Metropolitan	-0.141	0.067	0.036
Less Than 100 Beds	-0.477	0.065	0.000
250-499 Beds	0.315	0.075	0.000
500 or More	0.266	0.127	0.037
e2losmaj	1.037	0.058	0.000
Constant	0.066	0.575	0.908
Number of Obs	396,000		
F(21, 775)	68.380		
Prob > F	0.000		
R-squared	0.708		
Root MSE	1.467		

Table A3: Regressions of Selected Outcomes, 11-State Medicare Sample with AHA Staffing Data and without Procedure Date

	Pneumonia			Sepsis			Metabolic Derangement		
	IRR	Robust Std. Err.	P> z	IRR	Robust Std. Err.	P> z	IRR	Robust Std. Err.	P> z
LICENSED Hours per Patient Day	0.995	0.008	0.490	1.001	0.007	0.858	0.995	0.007	0.515
RN Hours/LICENSED Hours	0.434	0.108	0.001	0.579	0.144	0.028	0.506	0.121	0.004
New York	0.923	0.046	0.109	0.944	0.050	0.271	0.975	0.051	0.625
Massachusetts	0.893	0.065	0.122	0.909	0.063	0.165	1.070	0.077	0.352
Maryland	0.990	0.060	0.873	1.010	0.062	0.877	0.916	0.060	0.180
Virginia	0.974	0.060	0.667	0.844	0.060	0.017	0.982	0.074	0.810
West Virginia	1.018	0.112	0.874	0.913	0.134	0.534	0.984	0.078	0.837
South Carolina	1.026	0.105	0.800	1.137	0.132	0.269	1.104	0.129	0.398
Wisconsin	1.045	0.087	0.599	1.028	0.076	0.711	1.069	0.073	0.324
Missouri	0.984	0.067	0.815	0.896	0.064	0.127	1.062	0.071	0.367
Arizona	0.917	0.098	0.421	0.929	0.099	0.491	0.963	0.120	0.763
Nevada	0.842	0.100	0.146	0.896	0.124	0.430	1.058	0.071	0.400
Major Teaching Hospital	1.316	0.085	0.000	1.173	0.077	0.015	1.053	0.065	0.404
Other Teaching Hospital	1.061	0.043	0.142	1.027	0.043	0.523	1.015	0.041	0.706
Large Metropolitan	1.109	0.046	0.013	1.120	0.046	0.006	1.083	0.047	0.068
Non-Metropolitan	0.960	0.059	0.509	0.940	0.061	0.342	0.967	0.056	0.565
Less Than 100 Beds	1.061	0.054	0.242	0.877	0.051	0.025	1.017	0.049	0.723
250–499 Beds	0.997	0.040	0.937	1.013	0.042	0.758	1.016	0.045	0.713
500 or More	0.902	0.055	0.094	1.011	0.062	0.856	0.909	0.058	0.136
Number of Obs	849,000			849,000			846,000		
Wald chi2(20)	47.360			58.730			23.180		
Prob > chi2	0.000			0.000			0.230		
Pseudo R2	0.009			0.012			0.004		

	Length of Stay		
	Coefficient	Robust Std. Err.	P > t
LICENSED Hours per Patient Day	-0.030	0.021	0.156
RN Hours/LICENSED Hours	-1.079	0.772	0.162
New York	-0.169	0.627	0.787
Massachusetts	-0.911	0.248	0.000
Maryland	-0.543	0.229	0.018
Virginia	-0.122	0.229	0.595
West Virginia	-2.780	0.690	0.000
South Carolina	-0.298	0.306	0.330
Wisconsin	0.169	0.168	0.315
Missouri	0.020	0.262	0.939
Arizona	-0.032	0.299	0.915
Nevada	-0.498	0.250	0.047
Major Teaching Hospital	1.105	0.339	0.001
Other Teaching Hospital	0.235	0.136	0.085
Large Metropolitan	0.369	0.144	0.011
Non-Metropolitan	-0.033	0.147	0.821
Less Than 100 Beds	-0.482	0.128	0.000
250-499 Beds	0.228	0.144	0.115
500 or More	-0.134	0.268	0.616
e2losmaj	1.029	0.165	0.000
_cons	0.875	1.422	0.539
Number of Obs	763.000		
F(21, 775)	63.370		
Prob > F	0.000		
R-squared	0.786		
Root MSE	1.487		