Impact of Public Reimbursement

The Effect of Cuts in Medicare Reimbursement on Hospital Mortality

Meena Seshamani, J. Sanford Schwartz, and Kevin G. Volpp

Objective. To determine if patients treated at hospitals under different levels of financial strain from the Balanced Budget Act (BBA) of 1997 had differential changes in 30-day mortality, and whether vulnerable patient populations such as the uninsured were disproportionately affected.

Data Source. Hospital discharge data from all general acute care hospitals in Pennsylvania from 1997 to 2001.

Study Design. A multivariate regression analysis was performed retrospectively on 30-day mortality rates, using hospital discharge data, hospital financial data, and death certificate information from Pennsylvania.

Data Collection. We used 370,017 hospital episodes with one of four conditions identified by the Agency for Healthcare Research and Quality as inpatient quality indicators were extracted.

Principal Findings. The average magnitude of Medicare payment reduction on overall net revenues was estimated at 1.8 percent for hospitals with low BBA impact and 3.6 percent for hospitals with a high impact in 1998, worsening to 2 and 4.8 percent, respectively, by 2001. Operating margins decreased significantly over the time period for all hospitals ($p < .05$). While unadjusted mortality rates demonstrated a disproportionate rise in mortality for patients from high impact hospitals from 1997 to 2000, adjusted analyses show no consistent, significant difference in the rate of change in mortality between high-impact and low-impact hospitals ($p = .04-.94$). Similarly, uninsured patients did not experience greater increases in mortality in high-impact hospitals relative to low-impact hospitals.

Conclusions. An analysis of hospitalizations in the Commonwealth of Pennsylvania did not find an adverse impact of increased financial strain from the BBA on patient mortality either among all patients or among the uninsured.

Key Words. Medicare, Balanced Budget Act, financial strain, hospital, quality of care

The Balanced Budget Act (BBA) of 1997 was introduced as a cost-saving measure that significantly cut Medicare reimbursements to hospitals, physi-

cians, home health agencies, and skilled nursing facilities, with planned net spending reductions of \$116.4 billion from 1998 to 2002 (Rivers and Tsai 2002). For hospitals, the rate of increase in prospective payment system (PPS) payments was slowed across all diagnosis-related groups (DRGs), disproportionate share payments were reduced, and indirect medical education payments were reduced. As a result of significant protests from the American Hospital Association (AHA), Congress passed the Balanced Budget Refinement Act (BBRA) in 1999 to restore \$8.4 billion and subsequently passed the Benefits and Improvement Protection Act (BIPA) in 2000 to restore a further \$11.5 billion of the original \$116 billion reductions.

As Medicare patients comprise roughly 40 percent of all hospitalized patients, reductions in Medicare payments have a significant impact on revenues for patient care services. Data from the Medicare Payment Advisory Commission (MedPAC) estimate that overall Medicare margins decreased from 10.3 percent in 1996 to 1.7 percent in 2002 (MedPAC 2004). During this time frame, the AHA cited "service closures and cutbacks as hospitals and other health care facilities attempt[ed] to wrestle with the BBA's dramatic reductions" (American Hospital Association 2003a,b). Private payer payment-to-cost ratios also decreased from 1997 to 1999 and remained flat in 2000–2001, putting added financial stress on hospitals (MedPAC 2005). As hospitals face financial stress, they may either maintain current service levels and accept lower profits or decrease operating expenses to preserve profits. Data from MedPAC indicate that nationwide, hospital costs per discharge rose at a slower rate than Medicare payments per discharge, suggesting that hospitals may have spent less on patient care during this time period in an effort to preserve their operating margins.

Attempts to decrease operating expenses can potentially translate to curtailed services to patients, in forms such as decreased quantity and quality of nursing staff, reduced efforts to train and improve staff performance, less investment in infrastructure, and decreased levels of service. The response of a hospital to financial stress will likely depend not only on the size of the shock,

Address correspondence to Kevin Volpp, M.D., Ph.D., 1232 Blockley Hall, 423 Guardian Drive, Philadelphia, PA. Meena Seshamani, M.D., Ph.D. is with the Department of Otolaryngology-Head and Neck Surgery, Johns Hopkins University School of Medicine, Baltimore, MD. J. Sanford Schwartz, M.D., is with the Department of General Internal Medicine, University of Pennsylvania School of Medicine, Department of Health Care Systems, the Wharton School, Philadelphia, PA. Kevin G. Volpp, M.D., Ph.D., is with the Philadelphia Veterans Affairs Medical Center, Department of Health Care Systems, University of Pennsylvania School of Medicine, the Wharton School, Philadelphia.

but also on the baseline financial health of the hospital and level of hospital competition in the area. The effect that such changes in service provision may have on patient outcomes will depend on the illness severity of the patient population, as sicker patients have less physiologic reserve to withstand changes in their care.

There is evidence from a number of different contexts that exogenous financial shocks may decrease the quantity of hospital services provided and affect the health outcomes of patients. A decrease in PPS reimbursement from 1985 to 1994 was found to increase 30-day mortality of acute myocardial infarction (AMI) patients (Shen 2003). Reductions in Medicaid reimbursements in California in the 1980s affected the number of services per admission, particularly in Medicaid-dependent hospitals, and services were reduced more significantly for Medicaid than privately insured patients (Dranove and White 1998). Price-competitive market reforms in New Jersey in the early 1990s were associated with rises in inpatient mortality rates for uninsured AMI patients, with concomitant decreases in the rates of revascularization and cardiac catheterization (Volpp et al. 2003). Similarly, the enactment of legislation in California to permit selective contracting for insurance companies (thereby allowing them to preferentially send patients to hospitals where they obtained lower prices) decreased the quantity of services provided to the uninsured (Gruber 1994). Along with exogenous financial shocks, baseline financial health may also affect quality of care; a study of acute care hospitals in New York found that the hospitals with the lowest inpatient operating costs and lowest fund balances had the highest likelihood of negligent medical injury (Burstin et al. 1993). It is crucial to determine whether the national policies that cut hospital Medicare reimbursement in 1997 adversely affected patient care, as policy makers continue to consider new cost-containment measures.

We used hospital discharge data from Pennsylvania from 1997 to 2001 to examine whether quality of care worsened disproportionately in hospitals under more financial strain from the BBA. We examined 30-day mortality rates for a set of conditions chosen by the Agency for Healthcare Research and Quality (AHRQ) as important indicators of inpatient quality: hip fracture, stroke, acute myocardial infarction, and gastrointestinal hemorrhage. We additionally focused on whether outcomes for the uninsured worsened to a greater degree than other patients, as cost-saving reforms such as the BBA could be a mechanism contributing to larger disparities in health outcomes. Finally, we analyzed in turn whether the BBA affected length of stay, nurse staffing, or number of uninsured treated.

CONCEPTUAL FRAMEWORK

We think about the potential hospital responses to net revenue reductions from BBA by framing this based on the concept that hospitals derive utility from profits, uncompensated care provision, and provision of quality (Newhouse 1970; Sloan and Steinwald 1980; Gruber 1994). Reductions in net revenues, therefore, may lead to reductions in both quality of care for all patients and the quantity and quality of services provided to the uninsured. Hospitals with larger relative reductions in net revenues from the BBA thus would be expected to either reduce quality of care, operating margins, or the quantity and quality of services provided to the uninsured. As hospital price-cost margins can be used to finance hospital objectives which are not revenue producing such as uncompensated care or quality enhancements above the profit-maximizing level, increased pressure on margins reduces the resources available for hospitals to use for these purposes.

The change in net revenues is the most important factor to focus on in considering changes in hospital outcomes over time, which reflect hospitals' decisions regarding tradeoffs between larger profits and better quality of care. However, an important modifying factor is each hospital's baseline financial health, as hospitals that have larger reserves will be less likely to experience quality reductions in the face of exogenous revenue shocks. Increased pressure on hospital margins also suggests that the change in outcomes in the transition to price competition will be worse among uninsured patients than among insured patients, as funding for their care, in the absence of explicit subsidies, is provided from hospital margins (Gruber 1994).

METHODS

This project was approved by the University of Pennsylvania Institutional Review Board.

Data

The Pennsylvania Health Care Cost Containment Council (PHC4) provided data on all discharges from hospitals in the Commonwealth of Pennsylvania from 1997 to 2001, with information on patient age, gender, diagnoses, and procedures. We obtained data on hospital characteristics from two datasets: the Medicare Cost Reports and the AHA annual survey. We used guidelines established by the AHRQ to identify patients with one of the four conditions

listed above, which were chosen by AHRQ for their face validity, construct validity, precision, and minimal bias (AHRQ 2002). We used mortality rates within 30 days of hospital admission, which is a better outcome measure than in-hospital mortality because it eliminates any potential bias because of length of stay differences across hospitals and over time (Jencks et al. 1988; Garnick, DeLong, and Luft 1995; Cutler, McClellan, and Newhouse 2000). Thirty-day mortality was calculated by linking acute care inpatient discharge records from the PHC4 with death certificate records from the Pennsylvania Department of Health.

Calculation of the BBA Impact

We used a simulator constructed by the AHA for hospitals to calculate the financial impact of the BBA, BBRA, and BIPA (American Hospital Association 2002). Using financial information from the 1997 Medicare Cost reports, the simulator applies different trend factors to simulate hospital Medicare reimbursements without the BBA (i.e., under inflation), under BBA, under BBRA, and under BIPA. The Medicare reimbursements included inpatient payments (Diagnosis Related Group, Disproportionate Share payments, and Indirect Medical Education) as well as other payments such as outpatient services and PPS-exempt services. Subtracting the projected reimbursement with inflation alone from the projected reimbursement under the BBA, BBRA, and BIPA provides a prediction of the financial impact from these legislative acts from FY 1998 to FY 2001 for each hospital. Table 1 provides an illustration of the magnitude of the trend factors used and the way in which impact from the BBA, BBRA, and BIPA were calculated based on relative changes in DRG payments. We then scaled this financial impact by the proportion of revenue each hospital derived from Medicare in the baseline year of 1997. We

Table 1: Relative Changes in DRG Payments for a Sole-Community Hospital under BBA, BBRA, and BIPA Using a Baseline of FY 1997

	<i>FY 1997</i>	<i>FY 1998</i>	<i>FY 1999</i>	<i>FY 2000</i>	<i>FY 2001</i>
Inflation alone	1.000	1.027	1.052	1.083	1.114
BBA	1.000	0.999	0.995	1.007	1.024
BBA+BBRA	1.000	0.999	0.995	1.007	1.036
BBA+BBRA+BIPA	1.000	0.999	0.995	1.007	1.038
Net impact (BBA+BBRA+BIPA – inflation)	0	– 0.028	– 0.057	– 0.076	– 0.076

DRG, diagnosis-related groups; BBA, Balanced Budget Act; BBRA, Balanced Budget Refinement Act; BIPA, Benefits and Improvement Protection Act.

used an average BBA impact for each hospital over the 4 years 1998–2001 and divided hospitals into high-impact hospitals (with the highest quartile of impact), low-impact hospitals (with the lowest quartile of BBA impact), and middle impact (Table 2).

Using a predicted impact measure was preferable to other financial indicators such as operating margin or net revenue because the simulated BBA impact provides an exogenous marker of financial stress. Other financial indicators would be affected by changes in hospital practice and therefore would be endogenous. Using operating margin in particular is not desirable as it is affected not only by changes in net revenues but also by changes in operating costs. As discussed above, a hospital's response to financial shock could include decreasing resources provided for patient care, thereby preserving hospital margins. Thus, the endogeneity of the operating margin variable would preclude its use as an independent proxy for financial stress. The AHA simulator was provided to all AHA-member hospitals for administrators to use in calculating the potential effects of BBA on net revenues. However, as discussed above, baseline financial health could certainly compound a hospital's response to a financial shock. Therefore, baseline operating margin and endowment from 1997 were included in the regression model, both as independent predictors and through interactions with the BBA impact group.

Adjustment for Patient and Hospital Characteristics

The PHC4 data contains the unique MediQual Atlas™ Admission Severity, which is a score of 0–4 that translates across diagnostic groups, describing the risk of in-hospital mortality as derived from 250 key clinical findings on admission such as blood pressure, serum sodium, and hematocrit (Iezzoni 1997). Adding these scores to standard administrative data has been shown to increase discriminatory ability substantially in predicting hospital mortality (Iezzoni et al. 1992). We constructed risk-adjustment models controlling for age, sex, diagnostic category, and MediQual severity score.

Based on literature examining the link between hospital characteristics and quality of care (Kuhn et al. 1991; Keeler et al. 1992; Silber et al. 1992; Taylor, Whellan, and Sloan 1999; Aiken et al. 2002; Ayanian and Weissman 2002; Sheikh and Bullock 2001), we included five hospital characteristics that may influence health outcomes: bed size, nursing staff (the ratio of total nursing staff—registered nurses [RNs] and licensed practical nurses [LPNs]—to occupied beds), teaching status (having an Accreditation Council of Graduate Medical Education accredited residency program, and/or affiliation with the

Council of Teaching Hospitals), urban/rural setting, and availability of technology (presence of any of three technologies: open heart surgery, magnetic resonance imaging, and cardiac intensive care unit). We also adjusted for the proportion of managed care discharges from each hospital, and hospital competition as measured by area Herfindahl–Hirschman indices.

Data Sample

The initial dataset contained 575,915 episodes from 194 general acute care hospitals from 1997 to 2001. Data cleanup entailed removing patients with missing data ($n = 2,031$), patients who were not Pennsylvania residents because we could not link their hospital episode with death certificate data ($n = 25,904$), patients transferring from long-term care facilities because they may be more likely to have advanced directives and or DNR orders that would affect their course of treatment ($n = 23,757$), and patients under age 18 ($n = 1,050$). We then removed patients from hospitals that had missing AHA data (nine hospitals, $n = 7,393$), missing financial data (22 hospitals, $n = 77,691$), or other data errors such as reporting no uninsured patients (18 hospitals, $n = 26,451$). We then removed patients from general acute care hospitals that merged, closed, opened, or changed to a specialty hospital (12 hospitals, $n = 38,402$). If a patient transferred to a second hospital and died on the day of transfer, the death was assigned to the first hospital, and the episode from the second hospital was eliminated to avoid double counting; similarly, if a patient died more than 1 day after transfer, the death was assigned to the second hospital, and the episode from the first hospital was eliminated ($n = 3,218$). The final dataset had 370,017 patients from 133 hospitals.

Statistical Analyses

We first examined the degree to which the BBA affected net revenues. We then examined mortality rate trends among hospitals with different average BBA impact levels for the different AHRQ conditions. To confirm stability of the baseline pre-BBA year (1997), we compared the degree to which mortality rates changed in the different impact groups from 1996 to 1997. However, the 1996 data were not included in adjusted analyses because of high rates of missing MediQual risk adjustment scores and other patient characteristics.

We modeled the effect of financial impact from the BBA and BBRA on the likelihood of dying within 30 days of hospitalization using a patient-level probit regression analysis. We hypothesized that the level of hospital financial stress would alter hospital mortality trends over the years of study, which we

modeled using an interaction term between year and BBA impact group, controlling for various patient and hospital characteristics.

$$\begin{aligned} \text{Pr}(\text{death}) = & \alpha + \beta_1 P + \beta_2 H + \sum_{d=1}^3 \delta_d D_d + \beta_3 OM + \sum_{y=1998}^{2001} \psi_y FY_y + \sum_{b=1}^2 \theta_b BBA_b \\ & + \sum_{b=1}^2 \sum_{d=1}^3 \tau_{bd} BBA_b \times D_d + \sum_{b=1}^2 \sum_{y=1998}^{2001} \chi_{by} BBA_b \times FY_y \\ & + \sum_{b=1}^2 \sigma_b BBA_b \times OM \end{aligned}$$

where P is the vector of patient characteristics (age, sex, illness severity), H the hospital characteristics (percentage of discharges from managed care, ratio of nurses to occupied beds, teaching status, and technology index), D the diagnostic condition (baseline hip fracture), OM the operating margin (0 if negative, 1 if positive), FY the fiscal year (baseline 1997), and BBA the BBA impact group (baseline lowest impact group).

We ran models with interactions between the various hospital characteristics and BBA but none were significant, so they were excluded in a backward stepwise fashion from the final model. To confirm robustness of our measure of baseline hospital operating margin, we examined hospitals that had negative versus positive margins, and hospitals with margins below versus above the median. Moreover, we examined hospital fund balance as an alternative measure of baseline financial health, but did not find it to have any significant effect. Hospital bed size was eliminated from analysis because it was highly correlated with the other hospital variables, and urban/rural status and hospital competition proved to be insignificant.

To account for the fact that different conditions may be affected distinctly by changes in hospital care, we included a variable for diagnosis and interacted this with BBA impact group. We also separately analyzed uninsured patients who were under 65 years of age using the same model. Finally, we altered the model to in turn examine whether the BBA affected length of stay, nurse staffing, or number of uninsured treated. We also tested and confirmed that results were robust to assigning all deaths among transferred patients to the index hospitalization.

Despite controlling for numerous hospital characteristics, outcomes may be correlated among patients treated at the same hospital. In a statistical model, this can lead to overestimation of the significance of the factors that affect patient mortality (Shen 2003). To prevent this, we used robust regression

errors clustered on the hospital level (White 1980). To test the robustness of our results, we repeated all analyses with an ordinary least squares (OLS) fixed effects model to control for idiosyncratic hospital effects.

RESULTS

Descriptive Analysis

Table 2 demonstrates the financial impact of the BBA and BBRA on hospitals in Pennsylvania, as estimated by the AHA simulator. Low-impact hospitals (the bottom 25th percentile) were expected to experience a \$2.6 million decrease in their overall Medicare reimbursements in 1998, equal to a 1.8 percent decrease in overall reimbursement. The high-impact group (top 25th percentile) had a \$3.4 million reduction in Medicare reimbursement in 1998, which corresponded to a 3.6 percent overall reimbursement reduction. These reimbursement reductions increased from 1997 to 2000 before decreasing slightly from 2000 to 2001. Operating margins across all three impact groups also worsened over the time period. There was not a significant difference between hospital impact groups at baseline in terms of nursing staff ratios, teaching status, technology, or financial health, but low-impact hospitals had significantly higher managed care penetration at baseline than high-impact hospitals.

The number of hospitalizations remained stable over the years (Table 3). The average age ranged from 71 to 74, with the population aging slightly. The proportion of discharges from the different diagnoses remained relatively stable. The mortality rates were significantly different across the four conditions, with a 14.8 percent 30-day mortality rate for stroke compared with 6.1 percent for gastrointestinal hemorrhage (Appendix 1). Across all impact groups, length of stay decreased.

Examining 30-day mortality rates for all patients from 1997 to 2000, patients at high-impact hospitals experienced a larger rise in unadjusted mortality than patients at low-impact hospitals, causing their mortality curves to converge in 2000 (Figure 1). For uninsured patients under 65 (not shown), the mortality curves jumped by three and four percentage points yearly, with no clear differential pattern between high- and low-impact hospitals. This was likely because of smaller numbers of patients ($n = 2,995$).

Adjusted Analysis

After adjusting for the patient and hospital characteristics discussed above, mortality rates for all patients in high-impact hospitals changed at the same

Table 2: Hospital Characteristics by BBA Impact Group (Discharge-Weighted Averages)

BBA Group	Year	No. Hospital	BBA Impact (\$)	BBRA Impact (\$)	BIPA Impact (\$)	Baseline (%) Revenue from Medicare	Final Impact (% Total Revenue)	Average Operating Margin (%)	Average Endowment per Bed (\$)	(%) Teaching	Average Nurse: Bed Ratio	(%) HMO Discharges	Average Tech Index
Low	1997	33	—	—	—	37.0	—	1.44	278,031	50.1	2.25	25.7	1.79
	1998	33	(2,645,082)	—	—	37.2	−1.8	−3.30	326,271	50.5	2.38	28.3	1.79
	1999	33	(4,073,469)	—	—	37.3	−2.7	−4.36	332,009	50.4	2.45	34.6	1.85
	2000	33	(5,036,764)	445,396	—	37.1	−3.0	−2.13	336,412	50.3	2.31	40.4	1.89
	2001	33	(5,479,028)	1,258,026	794,965	37.1	−2.0	−1.17	346,038	49.6	2.31	37.7	1.88
Middle	1997	67	—	—	—	45.0	—	−0.98	214,276	57.4	2.00	17.7	1.85
	1998	67	(4,004,410)	—	—	45.1	−2.5	−3.52	261,890	57.1	2.00	19.6	1.86
	1999	67	(5,831,217)	—	—	45.1	−3.7	−3.75	257,441	57.0	2.05	28.9	1.95
	2000	67	(7,564,640)	605,310	—	45.3	−4.2	−5.56	289,087	55.7	2.10	37.4	1.90
	2001	67	(9,407,257)	1,698,893	972,122	45.1	−3.8	−4.69	321,696	55.9	2.15	37.3	2.03
High	1997	33	—	—	—	56.3	—	−0.33	205,163	38.8	2.02	13.9	1.57
	1998	33	(3,352,058)	—	—	56.5	−3.6	−2.29	311,612	39.1	2.07	16.1	1.43
	1999	33	(4,552,531)	—	—	56.4	−4.7	−3.36	338,440	39.3	2.01	21.0	1.73
	2000	33	(5,760,014)	335,095	—	56.4	−5.5	−2.69	305,324	39.5	2.11	34.6	1.73
	2001	33	(9,518,238)	1,918,586	959,184	54.4	−4.8	−3.36	312,460	38.9	2.15	35.9	1.87

BBA, Balanced Budget Act; BBRA, Balanced Budget Refinement Act; BIPA, Benefits and Improvement Protection Act.

Table 3: Patient Characteristics by BBA Impact Group

BBA Group	Year	No. Hospital Episodes	All Patients										Uninsured under 65			
			Average Age	% Hip Fx	% Stroke	% AMI	% GI Hem	30-Day Mort (%)	In-Hospital Mortality (%)	Average LOS	% of under 65	30-Day Mortality (%)	In-Hospital Mortality (%)	Average LOS		
Low-impact	1997	18,292	71.7	16.0	29.6	34.6	19.9	10.4	6.9	6.33	3.0	5.5	5.5	6.33	5.5	4.8
	1998	18,806	72.4	15.3	29.0	35.3	20.4	11.2	7.1	5.98	3.3	5.1	4.5	5.98	4.5	4.2
	1999	19,040	72.4	15.9	27.3	35.8	21.0	10.3	6.8	5.75	3.2	5.1	4.5	5.75	4.5	3.7
	2000	19,064	72.4	14.8	26.0	35.8	23.3	10.4	6.5	5.60	3.0	6.8	4.8	5.60	4.8	3.8
Middle-impact	2001	18,272	72.8	15.6	27.0	33.4	24.0	10.7	6.7	5.63	3.7	4.1	3.5	5.63	3.5	3.5
	1997	38,649	71.8	14.1	29.0	36.5	20.4	10.0	6.9	6.57	3.9	6.9	6.4	6.57	6.4	4.9
	1998	39,027	72.0	13.8	28.0	37.0	21.2	10.0	6.7	6.30	4.5	7.7	7.0	6.30	7.0	5.1
	1999	38,080	72.3	14.2	27.4	36.5	21.8	10.8	7.2	6.23	5.1	5.8	5.2	6.23	5.2	4.9
High-impact	2000	39,474	72.5	13.9	26.9	36.9	22.3	10.6	7.0	6.09	4.3	7.7	7.2	6.09	7.2	4.4
	2001	38,495	72.8	13.7	27.5	35.0	23.8	10.6	6.7	5.97	4.1	7.1	6.4	5.97	6.4	4.5
	1997	16,882	73.4	14.5	28.1	35.7	21.8	9.8	6.7	6.51	3.1	6.1	6.1	6.51	6.1	4.2
	1998	16,387	73.7	14.3	27.5	36.5	21.7	9.6	6.4	6.04	3.2	7.4	6.5	6.04	6.5	4.0
	1999	16,469	73.8	13.8	25.7	38.0	22.6	10.5	6.5	5.77	3.8	7.6	5.3	5.77	5.3	4.3
	2000	16,914	74.0	14.0	24.8	37.8	23.4	10.6	6.3	5.64	3.4	6.6	5.7	5.64	5.7	3.5
	2001	16,166	74.3	14.7	24.6	35.0	25.6	10.0	5.8	5.51	4.3	4.8	2.7	5.51	2.7	4.1

BBA, Balanced Budget Act; AMI, acute myocardial infarction; GIHEM, gastrointestinal hemorrhage; LOS, length of stay.

Figure 1. Thirty-Day Mortality Rates over Time by Balanced Budget Act Impact Group

rate as they did for patients in low-impact hospitals (Figure 1). Mortality increased over time for all impact groups, with significant coefficients for both year 2000 (0.16, $p < .01$) and year 2001 (0.09, $p < .01$) (Table 4). However, there were no consistent or significant patterns to the interaction terms between year and BBA impact groups, with coefficients that crossed zero (-0.07 – 0.04) and had p -values of .09–.86. F -tests examining the joint significance of the sum of the interaction terms for the high-impact hospitals and middle impact hospitals also failed to find any significant net effect ($p = .90$ and .59, respectively). There was no significant effect of baseline operating margin on patient mortality ($p = .06$), nor were the interactions between baseline operating margin and BBA impact group significant ($p = .70$ and .77). While diagnostic category was a significant predictor of mortality risk, there were no significant interactions between diagnostic group and BBA impact ($p = .06$ –.78). Similar patterns were observed with uninsured patients.

The probit regression model provided good discriminatory ability, with a pseudo- R^2 of 0.22 (c -statistic 0.81 with logistic regression). An OLS fixed effects model that controlled for idiosyncratic hospital characteristics produced qualitatively similar results with no significant effect of the BBA on 30-day mortality.

Table 4: The Effect of BBA Impact Group on 30-Day Mortality

<i>Variable</i>	<i>Coefficient</i>	<i>SE</i>
Female	− 0.19**	0.05
Age	0.01**	0.00
Stroke	0.19**	0.02
Stroke × middle-impact interaction	0.04	0.03
Stroke × high-impact interaction	0.07	0.04
AMI	− 0.11**	0.02
AMI × middle-impact interaction	0.03	0.03
AMI × high-impact interaction	0.06	0.03
GI hemorrhage	− 0.08**	0.03
GI hem × middle-impact interaction	0.01	0.04
GI hem × high-impact interaction	0.05	0.04
Year1998	0.03	0.03
Year1999	0.00	0.02
Year2000	0.16**	0.03
Year2001	0.09**	0.03
Middle-impact	− 0.013	0.04
High-impact	− 0.08	0.05
Year1998 × middle-impact interaction	− 0.03	0.03
Year1998 × high-impact interaction	− 0.07	0.04
Year1999 × middle-impact interaction	0.04	0.03
Year1999 × high-impact interaction	0.04	0.04
Year2000 × middle-impact interaction	0.01	0.03
Year2000 × high-impact interaction	0.04	0.04
Year2001 × middle-impact interaction	− 0.03	0.03
Year2001 × high-impact interaction	0.01	0.04
Positive operating margin	0.04	0.02
Positive margin × middle-impact interaction	− 0.01	0.03
Positive margin × high-impact interaction	0.01	0.05
Regression diagnostics	$N = 328,778$ Pseudo- $R^2 = 0.22$	

** $p < .01$.

Regressions adjust for MediQual score, HMO penetration, nurse staffing ratio, hospital teaching status, and technology index.

BBA, Balanced Budget Act; AMI, acute myocardial infarction.

We did not find differences in the rate of change between high- and low-impact hospitals in nursing staff ratios ($p = .84$), length of stay for all patients ($p = .77$), length of stay among the uninsured ($p = .28$), or the percentage of uninsured patients with our study conditions treated at each hospital ($p = .41$). We further looked at whether the proportion of LPNs to RNs changed by hospital impact group, but did not find any relationship ($p = .60$).

Operating margins declined significantly over the time period. Among low-impact hospitals, this decrease was about 5.8 percentage points from 1997 to 1999, with subsequent increases resulting in a difference of 2.6 percentage points from 1997 to 2001. Among high-impact hospitals, the decrease from 1997 to 1999 was about 3.0 percentage points and remained in this range until 2001.

DISCUSSION

The results indicate that Medicare reimbursement cuts from the BBA of 1997 did not adversely affect 30-day mortality rates for patients with four common and serious conditions treated in Pennsylvania hospitals. While predicted mortality rates for all conditions from the regression model increased from 1997 to 2001, particularly from 1999 to 2000, this was a function of yearly effects after adjusting for hospital and patient characteristics in the model, and the degree to which this happened was similar for patients in high- and low-impact hospitals. There was no differential change in mortality rates for uninsured patients in high-impact hospitals, and hospitals under increased financial strain from the BBA did not cut nursing staff, decrease patient length of stay, or admit fewer uninsured patients relative to less financially stressed hospitals.

Operating margins decreased at high impact hospitals to a lesser degree than low impact hospitals although the reductions in Medicare reimbursement were much larger. As discussed previously, operating margin is a function of both net revenue and net operating expenses. This implies that high impact hospitals dealt with reimbursement cuts by reducing operating expenses in order to maintain operating margins. Despite this, the analyses presented here did not find an effect on patient mortality. While reducing operating expenses to preserve operating margins may in the short term be a viable strategy, it would seem that this approach might not be sustainable if further cuts in reimbursement ensue.

The lack of an effect of financial strain on patient outcomes in this study may also be a function of the conditions studied. As mentioned previously, acute myocardial infarction, stroke, gastrointestinal hemorrhage, and hip fracture are cited by the AHRQ as good measures of inpatient quality of care. Several of them have defined practice guidelines that reflect prevailing beliefs about standard of care (Eisen, Dominitz, and Faigel 2001; American Heart Association 2003; American College of Cardiology 2004). For example, the American Heart Association advises that patients with ischemic stroke should be given reperfusion therapy within 60 minutes of presentation (American

Heart Association 2003). Moreover, acute myocardial infarction and stroke are “high-profile” conditions that are often cited in studies that examine the effect of health policy on quality of care (Langa and Sussman 1993; Burwen et al. 2003; Shen 2003; Volpp et al. 2003; Schade, Cochran, and Stephens 2004). Therefore, quality of care may be more likely to be maintained for these conditions than for others that do not have such set management algorithms or active monitoring such as the management of postoperative complications (Seshamani et al. 2005).

There may be changes in processes of care not assessed in this study, but we have assessed this for AMI patients and found the BBA did not affect AMI process of care (Volpp et al. 2005). While there were no significant differences in either the rate of change in the nurse to bed ratio or length of stay between hospital impact groups, there could be differential use of procedures or other process measures of care for patients with our study conditions besides AMI. It is also possible that changes in care may have affected quality of life but not mortality rates.

The available datasets do not contain information on reimbursement rates for payers other than Medicare. While we controlled for managed care penetration in analysis, we could not account for the possible financial strain caused by changes in negotiated reimbursements across hospital impact groups. Finally, the data were limited to Pennsylvania, and a larger dataset would provide more power for assessing mortality trends, particularly for subpopulations such as the uninsured. However, focusing on Pennsylvania data alone offered several advantages not found in other administrative datasets, including the MediQual Atlas Admission Severity index where clinical inputs to the severity measure include only conditions present on admission and data used to calculate severity are abstracted from patient medical records. Additionally, restricting the analysis to a single state eliminates the possibility of confounding from contemporaneous state-level policy reforms.

CONCLUSIONS

As health care payers continue to search for ways to curtail health care costs, information on how reimbursement reductions affect quality of care will be exceedingly important. Following passage of the BBA of 1997, hospitals warned that reimbursement cuts would lead to decreased service provision and lower quality of care. Our analyses provide a first look into this possibility and find that reimbursement cuts did not lead to higher 30-day mortality rates

for a set of four common, high mortality conditions within hospitals under increased financial strain from the BBA. However, hospital financial health deteriorated over the time period, calling into question the sustainability of quality patient care in the face of further reimbursement cuts. As cuts in reimbursement continue, it will be an ongoing challenge for hospitals to continue to provide high-quality care using fewer resources.

ACKNOWLEDGMENTS

Funding for the work was provided by the Doris Duke Charitable Foundation. Dr. Volpp is a VA Health Services Research and Development Career Development Awardee and a Doris Duke Foundation Clinical Scientist Development Awardee. The authors would also like to thank Jingsan Zhu for help with analyses. There are no conflicts of interests, nor disclaimers from employer or funder.

REFERENCES

- Agency for Healthcare Research and Quality. 2002. *AHRQ Quality Indicators—Guide to Inpatient Quality Indicators: Quality of Care in Hospitals—Volume, Mortality, and Utilization*. Rockville, MD: Agency for Healthcare Research and Quality.
- Aiken, L. H., S. P. Clarke, D. M. Sloane, J. Sochalski, and J. H. Silber. 2002. "Hospital Nurse Staffing and Patient Mortality, Nurse Burnout, and Job Dissatisfaction." *Journal of the American Medical Association* 288: 1987–93.
- American College of Cardiology. 2004. "ACC/AHA Guidelines for the Management of Patients with ST-Elevation Myocardial Infarction—Executive Summary." *Journal of the American College of Cardiology* 44: 671–719.
- American Heart Association. 2003. *Advanced Cardiac Life Support Provider Manual*. Dallas: American Heart Association.
- American Hospital Association. 1999. "Testimony of the American Hospital Association before the Subcommittee on Health and Environment of the Committee on Commerce of the US House of Representatives on Balanced Budget Act of 1997: Impact on Cost Savings and Patient Care, September 15 1999" [accessed July 29, 2003]. Available at <http://www.hospitalconnect.com/aha/advocacy-grassroots/advocacy/testimony/1999/testimony91599.html>
- . 2000. "Statement of the American Hospital Association before the Commerce Subcommittee on Health and Environment of the United States House of Representatives on the Impact of the Balanced Budget Act of 1997 on Providers and Patients, July 19 2000" [accessed July 29, 2003]. Available at <http://www.hospitalconnect.com/aha/advocacy-grassroots/advocacy/testimony/2000/BBA-Relief70019.html>

- . 2002. "BBA Impact Worksheet." Available at <http://www.aha.org/>
- Ayanian, J. Z., and J. S. Weissman. 2002. "Teaching Hospital and Quality of Care: A Review of the Literature." *Milbank Quarterly* 80 (3): 569–93.
- Burstin, H. R., S. R. Lipsitz, I. S. Udvarehelyi, and T. A. Brennan. 1993. "The Effect of Hospital Financial Characteristics on Quality of Care." *Journal of the American Medical Association* 270 (7): 845–9.
- Burwen, D. R., D. H. Galusha, J. M. Lewis, M. R. Bedinger, M. J. Radford, H. M. Krumholz, and J. M. Foody. 2003. "National and State Trends in Quality of Care for Acute Myocardial Infarction between 1994–1995 and 1998–1999: The Medicare Health Care Quality Improvement Program." *Archives of Internal Medicine* 163 (12): 1430–9.
- Cutler, D. M., M. McClellan, and J. P. Newhouse. 2000. "How Does Managed Care Do It?" *RAND Journal of Economics* 31 (3): 526–48.
- Dranove, D., and W. D. White. 1998. "Medicaid-Dependent Hospitals and Their Patients: How Have They Fared?" *Health Services Research* 33 (2): 163–85.
- Eisen, G. M., J. A. Dominitz, and D. O. Faigel. 2001. "An Annotated Algorithmic Approach to Upper Gastrointestinal Bleeding." *Gastrointestinal Endoscopy* 53 (7): 853–8.
- Garnick, D. W., E. R. DeLong, and H. S. Luft. 1995. "Measuring Hospital Mortality Rates: Are 30-Day Data Enough?" *Health Services Research* 29 (6): 679–95.
- Gruber, J. 1994. "The Effect of Competitive Pressure on Charity: Hospital Responses to Price Shopping in California." *Journal of Health Economics* 38: 183–212.
- Iezzoni, L. I. 1997. "The Risks of Risk Adjustment." *Journal of the American Medical Association* 278 (19): 1600–7.
- Iezzoni, L. I., A. S. Ash, G. A. Coffman, and M. A. Moskowitz. 1992. "Predicting In-Hospital Mortality: A Comparison of Severity Measurement Approaches." *Medical Care* 30 (4): 347–59.
- Jencks, S. F., J. Daley, D. Draper, N. Thomas, G. Lenhart, and J. Walker. 1988. "Interpreting Hospital Mortality Data: The Role of Clinical Risk Adjustment." *Journal of the American Medical Association* 260 (24): 3611–6.
- Keeler, E. B., L. V. Rubenstein, K. L. Kahn, D. Draper, E. R. Harrison, M. J. McGinty, W. H. Rogers, and R. H. Brook. 1992. "Hospital Characteristics and Quality of Care." *Journal of the American Medical Association* 268 (13): 1709–14.
- Kuhn, E. M., A. J. Hartz, M. S. Gottlieb, and A. A. Rimm. 1991. "The Relationship of Hospital Characteristics and the Results of Peer Review in Six Large States." *Medical Care* 29: 1028–38.
- Langa, K. M., and E. J. Sussman. 1993. "The Effect of Cost-Containment Policies on Rates of Coronary Revascularization in California." *New England Journal of Medicine* 329: 1784–9.
- Medicare Payment Advisory Commission. 2004. "A Data Book: Health Care Spending and the Medicare Program" [accessed May 13, 2005]. Available at http://www.medpac.gov/publications/congressional_reports/Jun04DataBookSec7.pdf
- Medicare Payment Advisory Committee. "Report to the Congress: Issues in a Modernized Medicare Program, June 2005" [last accessed on June 17, 2005].

Available at http://www.medpac.gov/publications/congressional_reports/June05_Entire_report.pdf

- Newhouse, J. P. 1970. "Toward a Theory of Nonprofit Institutions: An Economic Model of a Hospital." *American Economic Review* 60 (1): 64–74.
- Rivers, P. A., and K.-L. Tsai. 2002. "The Impact of the Balanced Budget Act of 1997 on Medicare in the USA: The Fallout Continues." *International Journal of Health Care Quality Assurance* 15 (6): 249–54.
- Schade, C. P., B. F. Cochran, and M. K. Stephens. 2004. "Using Statewide Audit and Feedback to Improve Hospital Care in West Virginia." *Joint Commission Journal on Quality and Safety* 30 (3): 143–51.
- Seshamani, M., J. Zhu, and K. G. Volpp. 2005. "Did Postoperative Mortality Increase following Implementation of the Medicare Balanced Budget Act?" *Medical Care*, in press.
- Sheikh, K., and C. Bullock. 2001. "Urban–Rural Differences in the Quality of Care for Medicare Patients with Acute Myocardial Infarction." *Archives of Internal Medicine* 161 (5): 737–43.
- Shen, Y.-C. 2003. "The Effect of Financial Pressure on the Quality of Care in Hospitals." *Journal of Health Economics* 833: 1–27.
- Silber, J. H., S. V. Williams, H. Krakauer, and J. S. Schwartz. 1992. "Hospital and Patient Characteristics Associated with Death after Surgery: A Study of Adverse Occurrence and Failure to Rescue." *Medical Care* 30: 615–29.
- Sloan, F. A., and B. Steinwald. 1980. "Effects of Regulation on Hospital Costs and Input Use." *Journal of Law and Economics* 23 (1): 81–109.
- Taylor, D. H., D. J. Whellan, and F. A. Sloan. 1999. "Effects of Admission to a Teaching Hospital on the Cost and Quality of Care for Medicare Beneficiaries." *New England Journal of Medicine* 340: 293–9.
- Volpp, K. G. M., S. V. Williams, J. Waldfogel, J. H. Silber, J. S. Schwartz, and M. V. Pauly. 2003. "Market Reform in New Jersey and the Effect on Mortality from Acute Myocardial Infarction." *Health Services Research* 38 (2): 515–33.
- Volpp, K. G., T. Konetzka, J. Zhu, L. Parsons, and E. D. Peterson. 2005. "The Effect of Cuts in Medicare Reimbursement on Process and Outcomes of Care for AMI Patients." *Circulation* 112: 2268–75.
- White, H. 1980. "A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity." *Econometrica* 48: 817–38.

SUPPLEMENTARY MATERIAL

The following supplementary material for this article is available online:

APPENDIX 1. Patient Characteristics for Each of the Four Conditions.