Online Appendix

Mandatory patient surveys and hospital resource allocation

OA1. Alternative risk-adjustment methodologies for mortality

OA1.1 Comorbidity control

The disease categories used as controls in our main tests reflected the patient's primary diagnosis. As a robustness check, we now control for the mortality risk stemming from comorbidities. To this end, we use the Stata Elixhauser comorbidity package to convert a patient's disease diagnoses (primary and nonprimary) into comorbidity indicators (Elixhauser et al. 1998). We then follow Van Walraven et al. (2009) to calculate a weighted sum of these indicators to yield a single index. The weighted approach has been shown to perform better in predicting in-hospital death than the originally proposed unweighted index, but we obtain similar results using either.

Table OA1 reports the difference-in-differences analyses (columns (1)–(2)) and parallel trends analyses (columns (3)–(4)) of inpatient mortality in the 2003 setting (Panel A) and in the 2007 setting (Panel B), including the weighted Elixhauser comorbidity index as an additional control. Naturally, the comorbidity index is strongly positively associated with inpatient mortality. The table shows that accounting for comorbidity does not qualitatively change our results.

Table OA1: Empirical results for inpatient mortality controlling for comorbidity.

Panel A: 2003 setting.

	Died ×100			
	2002 vs. 2003		2000-2003	
	(1)	(2)	(3)	(4)
Y2001* × *Maryland			**0.078**	**0.069**
			(1.64)	**(1.37)**
Y2002* × *Maryland			**0.056**	**0.053**
			(1.38)	**(1.27)**
Y2003* × *Maryland	**0.097****	**0.090****	**0.103*****	**0.105*****
	(2.50)	**(2.31)**	**(2.62)**	**(2.69)**
Age	0.050***	0.050***	0.050***	0.050***
	(29.02)	(27.94)	(33.19)	(31.67)
Female	-0.235***	-0.223***	-0.256***	-0.236***
	(-9.27)	(-8.82)	(-11.74)	(-10.63)
Comorbidity Index	0.463***	0.468***	0.491***	0.495***
	(51.53)	(51.67)	(55.27)	(55.47)
Quarter-Year FE	Yes	Yes	Yes	Yes
Hospital FE	Yes	No	Yes	No
Disease FE	Yes	No	Yes	No
Admission Type FE	Yes	No	Yes	No
Payer FE	Yes	Yes	Yes	Yes
Race FE	Yes	Yes	Yes	Yes
Hospital × Disease × Admission Type FE	No	Yes	No	Yes
Observations	3,612,925	3,612,925	7,112,308	7,112,308
Adjusted R^2	0.0693	0.0750	0.0717	0.0770

OLS regression model estimates comparing the probability of dying in Maryland and New Jersey during (2003) versus before ($\leq$ 2002) the Maryland pilot study. Variables are defined in Appendix B. ***, **, and * refer to significance at the 1%, 5%, and 10% levels, respectively, in a two-sided test. t-statistics are in parentheses. Standard errors are clustered by hospital.

Panel B: 2007 setting on the sample of rural patients.

	Died ×100			
	July 2007-March 2008 vs. October 2006-June 2007		July 2004-March 2008	
	(1)	(2)	(3)	(4)
Pre[-2]* × *Acute			**0.154**	**0.259**
			(0.91)	**(1.48)**
Pre[-1]* × *Acute			**0.099**	**0.071**
			(0.70)	**(0.52)**
Post* × *Acute	**0.389****	**0.386****	**0.277***	**0.292****
	(2.31)	**(2.34)**	**(1.97)**	**(2.12)**
Age	0.051***	0.054***	0.052***	0.054***
	(13.21)	(12.81)	(19.97)	(21.35)
Female	-0.145**	-0.156**	-0.120**	-0.128**
	(-2.45)	(-2.39)	(-2.47)	(-2.66)
Comorbidity Index	0.339***	0.336***	0.365***	0.362***
	(23.24)	(21.06)	(31.61)	(29.42)
Month-Year FE	Yes	Yes	Yes	Yes
Hospital FE	Yes	No	Yes	No
Disease FE	Yes	No	Yes	No
Admission Type FE	Yes	No	Yes	No
Payer FE	Yes	Yes	Yes	Yes
Race FE	Yes	Yes	Yes	Yes
Hospital × Disease × Admission Type FE	No	Yes	No	Yes
Observations	207,316	207,316	530,035	530,035
Adjusted R^2	0.0448	0.0549	0.0464	0.0583

OLS regression model estimates comparing the probability of dying in ACHs and CAHs before versus after the 2007 nationwide mandatory adoption. Variables are defined in Appendix B. ***, **, and * refer to significance at the 1%, 5%, and 10% levels, respectively, in a two-sided test. t-statistics are in parentheses. Standard errors are clustered by hospital and month-year.

OA1.2 Excess inpatient mortality at the individual level

Our study evaluates the impact of the HCAHPS mandate on inpatient mortality. To accurately measure this effect, we need to first account for patient characteristics that influence mortality. Risk adjustment helps control for patient factors that may contribute to outcome variations (Daley and Shwartz 1994). There are multiple risk adjustment approaches. One method directly incorporates patient characteristics into regression models, which we use in our main analysis. However, some argue that this approach can overshadow the mandate's effect (Daley and Shwartz 1994). To address this concern, we also implement a two-step method. First, we estimate the effect of patient characteristics on mortality to generate standardized mortality rates. Then we use these adjusted rates in the subsequent analysis, enhancing interpretability by reducing patient-level variability (Daley and Shwartz 1994; Tourangeau and Tu 2003).

Most risk-adjusted mortality measures in the literature focus on hospital-level estimates (Chandra et al. 2016). Since our data are at the patient level, we construct a risk-adjusted mortality measure, following Lenzi and Pildava (2019). Specifically, we use a logistic regression, where the dependent variable is a binary mortality indicator (*DIED*) and independent variables include patient characteristics, such as age, sex, and other factors. While predefined comorbidity sets can be used for risk adjustment (Quan et al. 2005), Lenzi and Pildava (2019) suggests including only significant risk factors to prevent overfitting. Research identifies age, race/ethnicity, and sex as key determinants of mortality (Xu et al. 2022). Accordingly, we regress *DIED* on these factors along with hospital fixed effects.

In the next stage, we use risk-adjusted *DIED* values to re-run our main analysis while maintaining the same fixed effects and controls. Table OA2 presents our results for risk-adjusted inpatient mortality in the 2003 Maryland Pilot Study, which closely match those in Table 12. Results for the 2007 nationwide mandate adoption appear in Table OA3. Overall, our findings remain consistent across both approaches, indicating that they are not driven by specific patient characteristics.

Table OA2: Empirical results for risk-adjusted inpatient mortality in the 2003 setting.

	Risk-adjusted Died ×100			
	2002 vs. 2003		2000-2002 vs. 2003	
	(1)	(2)	(3)	(4)
Y2003* × *Maryland	**0.111*****	**0.109*****	**0.118*****	**0.122*****
	(2.78)	**(2.80)**	**(2.80)**	**(3.04)**
Age	0.006**	0.007***	0.009***	0.009***
	(2.53)	(2.77)	(3.83)	(3.86)
Female	0.148***	0.147***	0.127***	0.130***
	(4.79)	(4.75)	(4.38)	(4.42)
Quarter-Year FE	Yes	Yes	Yes	Yes
Hospital FE	Yes	No	Yes	No
Disease FE	Yes	No	Yes	No
Admission Type FE	Yes	No	Yes	No
Payer FE	Yes	Yes	Yes	Yes
Race FE	Yes	Yes	Yes	Yes
Hospital × Disease × Admission Type FE	No	Yes	No	Yes
Observations	3,612,925	3,612,925	7,112,308	7,112,308
Adjusted R^2	0.0242	0.0303	0.0243	0.0300

OLS regression model estimates comparing the predicted probability of dying in Maryland and New Jersey during (2003) versus before ($\leq$ 2002) the Maryland pilot study. Variables are defined in Appendix B. ***, **, and * refer to significance at the 1%, 5%, and 10% levels, respectively, in a two-sided test. t-statistics are in parentheses. Standard errors are clustered by hospital.

Table OA3: Empirical results for risk-adjusted inpatient mortality in the 2007 setting on the sample of rural patients (PL_UR_CAT4 = 4 before 2006 and PL_NCHS = 6 from 2006).

	Risk-adjusted Died ×100			
	July 2007-March 2008 vs. October 2006-June 2007		July 2007-March 2008 vs. July 2004-June 2007	
	(1)	(2)	(3)	(4)
Post* × *Acute	**0.402****	**0.400****	**0.249****	**0.256****
	(2.50)	**(2.63)**	**(2.11)**	**(2.23)**
Age	0.021***	0.022***	0.022***	0.023***
	(5.10)	(5.15)	(8.05)	(8.79)
Female	0.121*	0.120*	0.148***	0.154***
	(1.95)	(1.80)	(2.88)	(3.02)
Month-Year FE	Yes	Yes	Yes	Yes
Hospital FE	Yes	No	Yes	No
Disease FE	Yes	No	Yes	No
Admission Type FE	Yes	No	Yes	No
Payer FE	Yes	Yes	Yes	Yes
Race FE	Yes	Yes	Yes	Yes
Hospital × Disease × Admission Type FE	No	Yes	No	Yes
Observations	207,316	207,316	530,035	530,035
Adjusted R^2	0.0135	0.0250	0.0123	0.0256

OLS regression model estimates comparing the predicted probability of dying in acute care hospitals and critical access hospitals before versus after the 2007 nationwide mandatory adoption. Variables are defined in Appendix B. ***, **, and * refer to significance at the 1%, 5%, and 10% levels, respectively, in a two-sided test. *t*-statistics are in parentheses. Standard errors are clustered by hospital and month-year.

OA1.3 Risk-adjusted mortality at the hospital service area level

In this appendix, we check the robustness of our results by using risk-adjusted mortality data for Medicare enrollees aggregated at the hospital service area level (instead of patient-level data). We document that, relative to other U.S. states, Maryland experienced higher mortality in 2003.

We collect data on hospital service area mortality rates and the number of Medicare enrollees for the period 2001–2003 from the Dartmouth Atlas of Health Care. Their database lists 3,436 service areas, most consisting of a single hospital, and provides total Medicare mortality rates adjusted by age, sex, and race. The database groups service areas into hospital referral regions.

At the hospital service area level, we estimate the following model:

$$\begin{aligned} Medicare\ Mortality_{j,t} &= \beta_0 + \beta_1 Y2003_t \times Maryland_j \\ &\quad + \beta_2 Enrollees_{j,t} + \delta_t + \kappa_j + \phi_j + \varepsilon_{j,t}. \end{aligned} \tag{1}$$

The outcome variable in (1) is $Medicare\ Mortality$, which is the age, sex, and race adjusted mortality rate for all Medicare enrollees in service area j in year t.[1] $Maryland$ is an indicator variable that equals one if the service area is located in Maryland and zero otherwise. $Y2003$ is an indicator variable that equals one for observations from the year 2003 and zero otherwise. $Enrollees$ is the natural logarithm of the number of Medicare enrollees in the service area. δ denotes year fixed effects and κ denotes state fixed effects. In additional specifications, we also include hospital service area fixed effects and hospital referral region fixed effects, which we denote by ϕ.

In Table OA4, we report the descriptive statistics for the sample of hospital service area-level observations for all U.S. states for the period 2001–2003.

Table OA4: Descriptive Statistics of sample used for the hospital service area-level analysis.

	N	Mean	S.D.	.25	Mdn	.75
Medicare Mortality	6,530	5.35	0.69	4.90	5.35	5.81
Enrollees (ln)	6,530	8.48	1.17	7.62	8.38	9.29
Maryland	6,530	0.01	0.10	0.00	0.00	0.00

The sample covers hospital service areas across the United States in the 2001–2003 period.

In Table OA5, we compare risk-adjusted Medicare mortality rates in 2002 with 2003 in Maryland versus other U.S. states. In columns 1, we estimate a model with year fixed effects; in column 2, with year and state fixed effects; in column 3, with year, state, and hospital referral region fixed effects; and in column 4, with year and hospital service area fixed effects. Note that hospital service area fixed effects subsume state and hospital referral region fixed effects because service areas are nested within both referral regions and states. In all four models,

[1] When an estimate of the mortality rate is imprecise due to a small sample size, it is reported as a negative number. We remove the negative observations from our sample.

we cluster standard errors at the state level. The coefficient of interest is the one associated with the interaction $Y2003 \times Maryland$. The estimates for this coefficient are positive across all columns in Table OA5 and are statistically significant at the 1% or 5% level, with the exception of column 1, suggesting that mandatory adoption resulted in an increase in Medicare mortality rates in treated service areas (Maryland) compared to control service areas (other U.S. states). The economic magnitude is sizeable, regardless of the specification used. For example, compared to the sample average $Medicare\ Mortality$ of 5.35, the treatment effect for Maryland versus other U.S. states is 0.028 or 0.5% in the model with state fixed effects (column 1), while in the model with hospital service area fixed effects, the treatment effect is 0.8% for overall Medicare mortality (column 4).

Table OA5: Empirical results for hospital service area-level risk-adjusted Medicare mortality in the 2003 setting.

	Medicare Mortality			
	(1)	(2)	(3)	(4)
Maryland	0.010			
	(0.16)			
Y2003 × Maryland	**0.028***	**0.033****	**0.035****	**0.043*****
	(1.79)	**(2.15)**	**(2.23)**	**(2.99)**
Enrollees	-0.031	-0.046***	-0.031**	-0.211
	(-0.85)	(-2.71)	(-2.57)	(-0.98)
Year FE	Yes	Yes	Yes	Yes
State FE		Yes	Yes	
HRR FE			Yes	
HSA FE				Yes
Observations	6,530	6,530	6,530	6,530
Adjusted R-squared	0.0029	0.3204	0.3933	0.6005

OLS regression model estimates comparing Medicare mortality in Maryland and other U.S. states before (2002) and during (2003) the HCAHPS three-state pilot study. ***, **, and * refer to significance at the 1%, 5%, and 10% levels, respectively, in a two sided test. t-statistics are in parentheses. Standard errors are clustered by state.

OA2. Survey Instrument about Practitioner Beliefs on Patient Satisfaction and Inpatient Mortality

Instructions. This survey asks about your professional expectations regarding hospital-level patient satisfaction initiatives (such as HCAHPS-style surveys) and inpatient mortality outcomes. All questions are hypothetical and refer to system-level emphasis at the hospital level (e.g., public reporting, performance evaluation, or incentives tied to patient satisfaction), not to any specific hospital, employer, clinician, or patient. There are no right or wrong answers. Please respond based on your professional judgment and experience.

1. **Which option best describes your current professional role?**
   (a) Physician / Doctor
   (b) Nurse or Advanced Practice Nurse
   (c) Hospital administrator or management
   (d) Other: ________________________________

2. **How many years have you worked in healthcare?**
   (a) 0 to 4 years
   (b) 5 to 9 years
   (c) 10 to 19 years
   (d) 20+ years

3. **What is your primary work setting?**
   (a) Inpatient hospital
   (b) Outpatient clinic / ambulatory care
   (c) Long-term care or skilled nursing facility
   (d) Other: ________________________________

4. **In your view, does a patient being satisfied necessarily mean that the patient received the most appropriate or optimal medical care?**
   (a) Yes
   (b) Maybe
   (c) No

5. **In your experience, which of the following factors plays the largest role in determining whether a patient feels satisfied during a hospital stay?**
   (a) Receiving correct and appropriate medical treatment (i.e., care that minimizes the risk of readmissions or future complications)
   (b) Clear communication and positive interactions with doctors and nurses
   (c) Hospital amenities and the overall care environment

6. **How surprising would it be to you if a hospital with very high patient satisfaction scores had worse patient survival outcomes (i.e., higher mortality), while another hospital with lower satisfaction scores had better survival outcomes (i.e., lower mortality)?**
   (a) Not at all
   (b) Slightly surprised
   (c) Very surprised

7. **How familiar are you with hospital patient satisfaction surveys (such as HCAHPS), which are publicly reported and serve as a type of rating system for hospitals, similar to how Yelp provides ratings for businesses?**
   (a) Not familiar at all
   (b) Slightly familiar
   (c) Moderately familiar
   (d) Very familiar
   (e) Extremely familiar

8. **Suppose a hospital places greater emphasis on improving its patient satisfaction scores or ratings (for example, HCAHPS surveys that are publicly reported). What do you expect would happen to patient health outcomes like inpatient mortality?**
   (a) Inpatient mortality would decrease
   (b) Inpatient mortality would show no meaningful change
   (c) Inpatient mortality would increase
   (d) Not sure / depends on context

9. **How surprising would it be to you if a rigorous academic study found that greater hospital-level emphasis on patient satisfaction was associated with higher inpatient mortality?**

(a) Not at all
(b) Somewhat surprising
(c) Very surprising

10. **If there is a link between hospital patient satisfaction efforts and inpatient mortality, what do you think is the main reason? (Please select up to two.)**

    (a) Fewer resources available for direct patient care (such as staffing or equipment)
    (b) Changes in how doctors or nurses make treatment decisions
    (c) Differences in the types of patients admitted or discharged
    (d) There is no real reason – it is just a correlation

11. **If a study found that higher inpatient mortality was linked to hospitals shifting resources, for example, spending more on patient-experience initiatives (such as apps for easier access to doctors or nurses) and less on direct clinical care, how likely does this explanation seem to you?**

    (a) Not likely
    (b) Somewhat likely
    (c) Very likely

12. **Have you previously encountered academic or policy research studying the effects of hospital patient satisfaction initiatives on inpatient mortality?**

    (a) Yes
    (b) Maybe
    (c) No

13. **If yes, please briefly describe the study or research you have encountered (for example, the authors, institution, journal, or main findings, if you recall).**

    (Open-ended response)

    ____
    ____
    ____
    ____

Notes: Question 13 is displayed conditional on responding "Yes" to Question 12 (as implemented in the survey platform).

References

Chandra, A., A. Finkelstein, A. Sacarny, and C. Syverson (2016). Health care exceptionalism? performance and allocation in the us health care sector. *American Economic Review 106*(8), 2110–2144.

Daley, J. and M. Shwartz (1994). Developing risk-adjustment methods. In *Risk Adjustment for Measuring Health Care Outcomes*, 199–238. Ann Arbor, MI: Health Administration Press.

Elixhauser, A., C. Steiner, D. R. Harris, and R. M. Coffey (1998). Comorbidity measures for use with administrative data. *Medical care 36*(1), 8–27.

Lenzi, J. and S. Pildava (2019). Tips for calculating and displaying risk-standardized hospital outcomes in stata. *The Stata Journal 19*(2), 477–496.

Quan, H., V. Sundararajan, P. Halfon, A. Fong, B. Burnand, J.-C. Luthi, L. D. Saunders, C. A. Beck, T. E. Feasby, and W. A. Ghali (2005). Coding algorithms for defining comorbidities in icd-9-cm and icd-10 administrative data. *Medical care 43*(11), 1130–1139.

Tourangeau, A. E. and J. V. Tu (2003). Developing risk-adjusted 30-day hospital mortality rates. *Research in Nursing & Health 26*(6), 483–496.

Van Walraven, C., P. C. Austin, A. Jennings, H. Quan, and A. J. Forster (2009). A modification of the elixhauser comorbidity measures into a point system for hospital death using administrative data. *Medical care 47*(6), 626–633.

Xu, J., S. L. Murphy, K. D. Kochanek, and E. Arias (2022). Mortality in the United States, 2021. NCHS Data Brief No. 456. National Center for Health Statistics, Hyattsville, MD. Available at `https://dx.doi.org/10.15620/cdc:122516`. Accessed April 15, 2023.