PERFORMANCE IMPROVEMENT IN MEDICAL CARE: DO MANDATED REPORTING REQUIREMENTS WORK?

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ABSTRACT OF THE DISSERTATION

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Background

Hospitals have been required to publicly report outcomes of care or costs for many years based on state level mandates. In 2003 the federal government began requiring similar public reporting for hospitals to be reimbursed by Medicare. The goal has been to allow consumer demand to drive quality improvement in patient care and to reduce the cost of care. This dissertation explores the effectiveness of such programs by evaluating inpatient mortality rates and the length of stay (LOS) in acute myocardial infarction and heart failure patients from 1988 through 2006 using publicly reported data and Health Care Utilization Project – Nationwide Inpatient Sample data.

Methods

First, an evaluation was completed to ensure no endogeneity existed with variables associated with the likelihood of implementing the mandated reporting at the state level and the outcomes of interest. A linear probability model was run with several state level factors as independent variables that were potentially associated with mandate implementation. Factors found to be significant in that model were incorporated into subsequent regression models. Second, regression models were developed to identify the association between the state level mandate and the outcomes of interest. Third,

regression models were used to evaluate the association between federal mandates and the outcomes of interest. Linear probability models were used for the probability of dying while in the hospital and Poisson regression models were used for LOS.

Results

Factors that were potentially associated with the implementation of mandates were the state fiscal margin, the average hospital level LOS and the average inpatient mortality rates leading up to the implementation of the mandate. The implementation of state level mandates was associated with a decrease in the probability of dying while an inpatient and a decrease in the inpatient LOS for AMI and HF patients. The implementation of federal mandates was associated with an increase int the probability of dying while an inpatient and an increase in the inpatient LOS for AMI and HF patients. Federal mandates appeared to wash out the positive effect of state mandates in AMI patients.

Conclusion

Mandated hospital reporting can be effective, but it must be done at the most appropriate level of government.

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Chapter 1: Recent History of State and Federal Hospital Mandated Performance Reporting

Under the 2005 Deficit Reduction Act (Section 5001(a)), the Centers for Medicare and Medicaid Services (CMS) began requiring the use of reporting methods to implement a system of payments based on performance – Value Based Purchasing – in 2008. Despite the many challenges and much push back from providers, it is now under way. Initially payments were to be based simply on reporting, and eventually started to be based on outcomes. Past efforts have been made to increase the quality of patient care via reporting mandates, but it is unclear what impact this has truly had on patient care (outcomes) or the cost of care.[1] Several evaluations have demonstrated that reporting does lead to better care[2,3]; however, there is also evidence demonstrating that there is no clear causal pathway between mandated reporting and patient outcomes nor is there clear evidence on how the reporting should occur.[4] To this point a definitive causal pathway has yet to be drawn. Marshall et al. stated it well in a 2003 *Health Affairs* article assessing the status of report cards both in the US and UK:

"Politicians and the media have embraced the idea with enthusiasm, but we summarize below a growing body of evidence to suggest that many consumers, purchasers, health professionals, and, to a lesser extent, provider organizations are either ambivalent, apathetic, or actively antagonistic toward **report card**s. There is still much that we do not

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[1]Epstein AJ. Do cardiac surgery report cards reduce mortality? Assessing the evidence. *Med Care Res Rev*. 2006 Aug;63(4):403-26; Epstein AJ.; Hospital report cards: intent, impact, and illusion. *Am J Med Qual*. 2004 Sep-Oct;19(5):183-92..

[2] Rothberg MB, Morsi E, Benjamin EM, Lindenauer PK. Choosing the Best Hospital: The Limitations of Public Reporting of Hospital Quality. Health Affairs 2008;27(6):1680-87.

[3] Lindenauer PK, Remus D, Roman S, Rothberg MB, Benjamin EM, Ma A, Bratzler, DW. Public Reporting and Pay for Performance in Hospital Quality Improvement. N Engl J Med 2007:356:486-496.

[4] E.L. Hannan et al., "Improving the Outcomes of Coronary Artery Bypass Surgery in New York State," *Journal of the American Medical Association* 271, no. 10 (1994): 761–766; E.D. Peterson et al., "The Effects of New York's Bypass Surgery Provider Profiling on Access to Care and Patient Outcomes in the Elderly," *Journal of the American College of **Card**iology* 32, no. 4 (1998): 993–999.; Guru V, Fremes SE, Naylor CD, Austin PC, Shrive FM, Ghali WA, Tu JV; Cardiac Care Network of Ontario. *Am Heart J*. 2006 Sep;152(3):573-8; Andrew M Ryan, Jan Blustein, Tim Doran, Marilyn D Michelow, Lawrence P Casalino Health Serv Res. 2012 Aug; 47(4): 1418–1436.

know about public **report**ing, and there are major opportunities for collaboration between the two countries for finding the answers."[5]

Quality Reporting at the National Level

The Development of the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) Measures

Spawning from the American College of Surgeons' initial efforts at the beginning of the 20th century to develop standards for hospitals, the Joint Commission on Accreditation of Hospitals' (JCAH) purpose was to provide accreditation to hospitals meeting standards for care. As seen in Figure 1, it has since evolved into an organization that has played an important role in determining the measurement method by which the CMS will pay hospitals for care delivered to patients.

Accreditation was a voluntary effort on behalf of hospitals; however in 1965, congress, under the Social Security Act Amendments (Public Law 89-97), determined that hospitals that were accredited by the JCAH were also in compliance with the "Medicare Conditions of Participation for Hospitals", making them eligible to participate in the Medicare and Medicaid programs.[6] Over time the JCAH developed to include more health care service accreditation including outpatient care and managed care organizations. Additionally, it changed the level of care needed from minimal standards to optimal standards. In 1994, the agency started reporting the performance of hospitals that chose to participate in

[5] Marshall MN, Shekelle PG, Davies HTO, Smith PC. Public reporting on quality in the United States and the The United Kingdom. *Health Affairs.* May/June 2003; 22(3): 134-148.
[6] *A journey through the history of The Joint Commission.* *http://www.jointcommission.org/AboutUs/joint_commission_history.htm*

the JCAHO[7] accreditation. In 1997 the ORYX™ Performance Measurement Initiative program was introduced by JCAHO to measure not only process performance, but also include outcomes- based performance in the evaluation of providers. The next year it was determined that ORYX™ should focus in five areas: acute myocardial infarction, congestive heart failure, pneumonia, pregnancy and related conditions, and surgical procedures and complications. Over the next decade the Joint Commission (as its name later became) worked to establish relationships with national and international health care organizations to ensure health care standards were being improved and that patient safety and quality of care was getting better.

In July of 2003, facilities that did not report to JCAHO outcomes were not allowed to treat Medicare patients (except in emergencies) – in essence creating a tiered system of Medicare hospital providers with high performing JCAHO reporting facilities being preferred Medicare providers, any JCAHO reporting facilities were able to see any Medicare patients, and non-JCAHO reporting facilities able to see emergency patients. Medicare patients were directed to compliant facilities whenever possible. This cutoff any non-compliant facility from reaping the full benefits of treating the full spectrum of Medicare patients.

The Development of Federal Government Quality Reporting

As indicated, in 1965, Congress, via the Social Security Act Amendments (Public Law 89-97) determined that the standards established by JCAH were sufficient to

[7] The abbreviation was changed to JCAHO (Joint Commission on the Accreditation of Health care Organizations)

make hospitals eligible to receive reimbursement from Medicare and Medicaid.[8] These standards were minimum standards. Over time the Health Care Finance Administration (HCFA) (the predecessor to the Centers for Medicare and Medicaid Services or CMS) determined that Peer Review Organizations (PROs) should monitor care given to patients in their programs, and in 1982 the structure to do this monitoring was established by Congressional acts. The following year Congress introduced the Inpatient Prospective Payment System to try to further standardize care by paying a single amount per patient based on their diagnosis and the expected care they should receive with that diagnosis.

Three years later HCFA began publishing mortality rates for hospitals based on the data collected by the PROs. Throughout the late nineteen-eighties and early nineties it was recognized by many health care organizations that it was better to focus on improving the care of all providers rather than punishing poor performing facilities based on retrospective reviews, as was the case with HCFA; therefore, early efforts to produce report cards by HCFA were dropped in 1993.[9] Due to the influence of these organizations, HCFA directed the PROs to focus on not only measuring hospital outcomes of care, but also helping them to improve based on evidence-based guidelines. This became such a focus that in 2002, through the urging of CMS, the PROs changed to become Quality Improvement

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[8] Centers for Medicare and Medicaid Services. *History: Key Milestones in CMS Programs*. http://www.cms.hhs.gov/History/Downloads/CMSProgramKeyMilestones.pdf Accessed 4.2008

[9] Epstein A., Sounding Board: Performance **Report**s on Quality—Prototypes, Problems, and Prospects. *New England Journal of Medicine* 333, no. 1 (1995): 57–61.

Organizations (QIOs). Although patient care processes improved based on the efforts of the PROs, it was difficult to attribute the improvements to the PROs given the similar activities of JCAHO and others.[10] However, with the results of PRO efforts in hand, Congress and the White House determined, through the Medicare Prescription Drug Improvement and Modernization Act of 2003 Section 501(b), that public reporting of performance based on 10 quality indicators would be required for hospitals to receive their annual payment update, also known as the Reporting Hospital Quality Data for Annual Payment Update (RHQDAPU).[11] The indicators aligned closely with those used by the JCAHO.

Health care quality exposed

While major health care improvement initiatives occurred during the latter part of the 20th century and the early part of the 21st century, the Institute of Medicine (IOM) also released two reports indicating that not enough was being done to improve patient care. First, the IOM released *To Err is Human (2000)*, which indicated that up to 98,000 patients die in hospitals every year due to medical errors.[12] The IOM followed up with *Crossing the Quality Chasm* (2001), which documented the divide between the care received by patients and the optimal care that they should receive.[13] Both of the reports were strong indictments of the poor quality of care provided by the health care industry in the United States.

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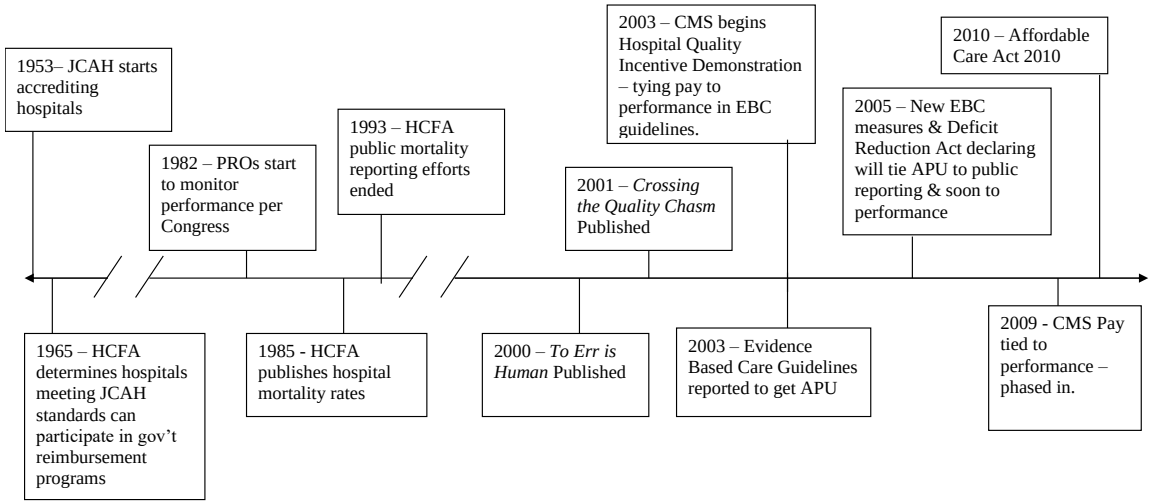
[10] Sprague, L. Contracting for Quality: Medicare's Quality Improvement Organizations *National Health Policy Forum Issue Brief*. 774 June 3, 2002: 1-15.
[11] Text of Section 501(b) of the Medicare Prescription Drug, Improvement and Modernization Act (MMA) 2003 (Public Law No: 108-173)
[12] Kohn LT, Corrigan JM, Donaldson MS, eds. To Err is Human – Building a Safer Health System. National Academy Press. Washington DC: 2000
[13] Committee on Quality of Health Care in America. Crossing the Quality Chasm – A New Health System for the 21st Century. National Academy Press. 2001

Further, the reports undoubtedly contributed to additional efforts by CMS, as outlined in Section 5001(a) of P.L. 109-171, the Deficit Reduction Act (DRA) of 2005, to add new requirements for the RQHDAPU program. The new requirements re-enforced public reporting for hospitals to receive their annual 2% payment update and also required that the payment be tied to performance through "quality measures of process, structure, outcome, patients' perspectives on care, efficiency, and costs of care that relate to services furnished in inpatient settings in hospitals."[14]

More recently we have seen a number of initiatives to cut costs implemented by the federal Department of Health and Human Services (DHHS) and CMS, many of which have targeted payment based on quality of care. The Affordable Care Act 2010 ("Public Law 111-148", 111th congress) established that payment by the CMS for patient care would be in part based on the quality of care received in a facility starting in 2012 and further reductions occurred and were tied to additional hospital acquired conditions in 2014.

[14] Text of Title V, Subtitle A, Section 5001(a) of the Deficit Reduction Act of 2005 (P.L. 109-171) REPORTING HOSPITAL QUALITY DATA FOR ANNUAL PAYMENT UPDATE (RHQDAPU)

Figure 1. Federal reporting initiatives relevant to public reporting of hospital outcomes.



APU – Annual Payment Update; CMS – Centers for Medicare and Medicaid Services; EBC – Evidence Based Care; HCFA – Health Care Finance Administration

Quality reporting at the state level

Contemporaneously, along with JCAHO and CMS, several state health departments decided to begin collecting data for public reporting to ensure standards of care, inform the consumer, and allow patients to compare hospital performance (see Table 1.1 below).

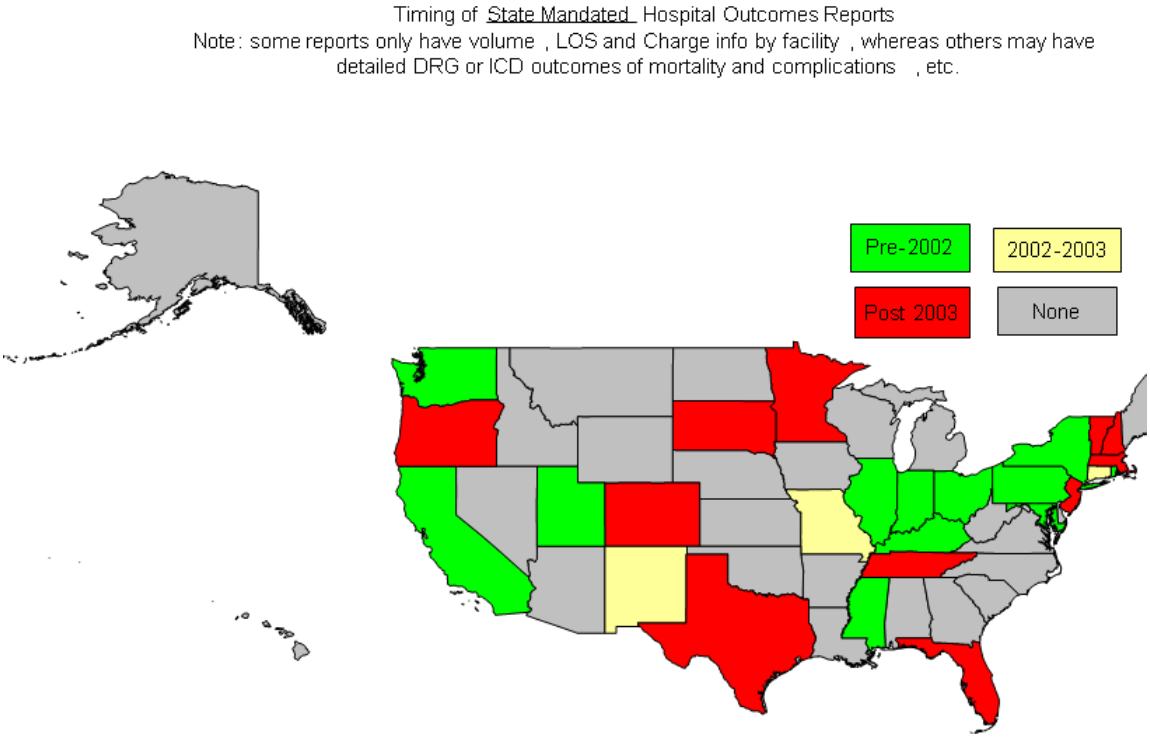
Table 1.1. States mandating public reporting of hospital performance

State	Year of Mandate	Comments
California	1991	1991 - additional measures added over time
Washington	1991	1991- cost & volume, length of stay (LOS) by hospital; 1998 by hospital & diagnosis-related group (DRG)
Utah	1993	1993 - length of stay, volume and charges
New York	1994	began collecting data in 1979, reports began in 1994
Illinois	1995	1995-2000 efficiency reports
Indiana	1996	1996 first reported, next report was 1999
Mississippi	1996	1996, report efficiency and utilization measures
Pennsylvania	1997	1997 began reports
Rhode Island	1998	1998
Kentucky	1999	1999 efficiency, costs
Maryland	2001	current report started in 2001 released in 2002
Ohio	2001	2001 (infant and maternal began) 2002 bone marrow transplant, open heart surg. & cardiac cath. began
Missouri	2002	only one year (2002), Missouri Hospital Association 2004 (voluntary)
New Mexico	2002	2002-2006
Connecticut	2003	2002 signed into law, 2003 first report
New Jersey	2004	performance reports start in 2004 (used 2003 data)
Tennessee	2004	state 2004, efficiency measures
Florida	2005	2004 legislation, 2005 actual reports
Massachusetts	2005	started reports in 2005 (data from 2003 & 2002)
Minnesota	2005	2005 started
Oregon	2005	2005 started
South Dakota	2005	2005 Efficiency measures
Texas	2005	2005 started
Vermont	2005	2005 first report (2004 data)
Colorado	2007	2001 voluntary 2007 mandated

Pennsylvania, New York and California were some of the first states to begin such efforts in the early 1990's. However, only fourteen states mandated reporting prior to the JCAHO CMS harmonization of measures in July 2003, but several have begun reporting since that time. States that did report outcomes often did so in a fashion that was not easily used by consumers to aid in the decision of which facility to go to for health care services and may have led to public disinterest in report cards.[15] However, some states did make efforts to create so called "report cards" on hospitals that simplified outcome measures to an easily read scale that could help consumers identify which facilities generally performed well. Figure 2 depicts those states that began reporting prior to the CMS/JCAHO harmonization of measures for the Reporting Hospital Quality Data for Annual Payment Update (RHQDAPU). As can be seen, there is little consistency in each region of the US or in adjoining states as to the timing of state mandated hospital outcome reporting.

[15] Ireson CI, Ford MA, Hower JM, Schwartz RW. Outcome report cards: a necessity in the health care market. *Arch Surg*. 2002 Jan;137(1):46-51.

Figure 2 Pre-post 2003 state mandates



Despite efforts to create transparency, the variety of measure types (i.e., structure, process, outcomes) and definitions of measurements associated with the measure types has led to patient, payer and provider confusion and potentially increased health care costs.[16] Along with the confusion around measurement type, methodological issues have been challenged,[17] which further contributes to the lack of clarity about the true effect of state mandated reporting.

Due to the disparities in state mandated hospital-level reporting, little national attention has been paid to the effects of state reporting as a whole, and more focus has been on the recent national reporting efforts. This focus on national efforts has occurred despite some evidence suggesting that health care outcomes in states that have adopted mandated hospital reporting have yielded improvements within the state.[18] Part of the neglect may be due to the paucity of evidence to suggest that improvements in mandatory-reporting states are greater than those found in states that have not adopted such mandates. In addition, with the contemporaneous federal reporting requirements, evaluating the effect of state mandates can be difficult.

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[16] Kelly A, Thompson JP, Tuttle D, Benesch C, Holloway RG. Public reporting of quality data for stroke: is it measuring quality?*Stroke.* 2008 Sep 4. [Epub ahead of print]

[17] Shahian DM, Normand SL, Torchiana DF, Lewis SM, Pastore JO, Kuntz RE, Dreyer PI. Cardiac surgery report cards: comprehensive review and statistical critique. *Ann Thorac Surg.* 2001 Dec;72(6):2155-68.

[18] Hannan E.L.et al., "Improving the Outcomes of Coronary Artery Bypass Surgery in New York State," *Journal of the American Medical Association* 271, no. 10 (1994): 761–766; and Peterson E.D. et al., "The Effects of New York's Bypass Surgery Provider Profiling on Access to Care and Patient Outcomes in the Elderly," *Journal of the American College of* ***Card****iology* 32, no. 4 (1998): 993–999.

Given the continuing efforts of CMS to improve patient quality and safety, and the mandated reporting requirements by CMS, it is relevant to explore the effect on outcomes caused by national and state level mandated reporting. The experience of these efforts should be used to inform patients and providers of the impact they might expect with the CMS value-based purchasing mandates. In addition, a critical decision will need to be made by state agencies as to whether it is cost effective to continue their reporting efforts because they assess all patients or if they should shift to supplement CMS federal reporting and payment efforts with additional measurements.

To that end, the focus of this dissertation will be on hospital level reporting mandates at both the state and federal levels, and whether there have been demonstrative improvements in health care quality and efficiency due to their implementation.

Chapter 2: Determining Factors That Influence State Mandated Hospital Performance Public Reporting

As noted above, to better anticipate the effects of current value-based purchasing mandates it is important to assess the impact of reporting requirements on patient outcomes for specific diseases. An ideal way to examine whether this relationship is indeed causal would be to randomly assign reporting requirements to some states and not others, and then compare the change in outcomes between the two groups of states pre- and post- reporting requirements. Unfortunately, such an experimental approach is not feasible and the best one can do is to study the impact of reporting requirements based on observational data (as described below).

To help ensure that a causal relationship is being estimated from observational data, one must be certain that states have not purposefully adopted rules in response to their (prior) experience with the outcome of interest, or with regard to factors that are associated with both the policy variable and outcomes of interest. Such endogeneity can compromise the assertion that the estimated relationship is causal and result in biased estimates of the impact of the policy intervention. Assessing whether specific factors are associated with the implementation of policy and using those factors in empirical models of the effect of reporting requirements can mitigate the bias and threat to causality from policy endogeneity. At the same time, examining the factors that are associated with policy implementation will also provide information on differences in the policy environment across states that do/do not adopt reporting requirements.

To identify the determinants of state implementation of mandatory hospital-level health outcomes reporting, this study will follow similar methodology used by Stream (1999) to evaluate the impetus behind state mandating of health insurance market reforms. Stream's methodology used external factors capturing the state's political, economic, and regulatory characteristics to predict the adoption of the policy mandate. A similar framework is applied here to determine how much such factors can explain the adoption of state report card mandates. Although this study examined a different topic than Stream, both studies reflected regulatory interventions in the health care market and thus, they relied on a similar set of explanatory factors. The goal of this approach was to attempt to identify a set of variables that affected legislative implementation and then if statistically significant, include those variables in subsequent models used to evaluate the effect of mandatory hospital-level health outcomes reporting on patient level outcomes. To that end the objective of this evaluation is to assess the determinants of a state's decision to impose a mandatory or voluntary reporting requirement. In this study the null hypotheses would be that there are no external influences prompting states to implement mandated hospital-level health outcomes reporting. Under this hypothesis, state reporting requirements can be treated as being randomly distributed across states, thus mitigating concerns that "policy endogeneity" will preclude identifying a causal relationship between the presence of reporting requirements and the outcomes of interest.

Methods

Data

This portion of the study utilized multiple exogenous independent variables to explain the likelihood that a state would implement mandated report card adoption prior to the 2003 RQDAPU implementation. Data were collected from several publicly available sources as described in the model section of this chapter. Since the model used the state/year as the unit of analysis, all variables were obtained at the state level.

The independent variables include state-level controls reflecting which parties control state executive and legislative branches of government, state fiscal health, hospital industry political influence, and sizes of state Medicare and Medicaid covered populations. Additionally, variables are included that reflect hospital reporting requirements and indicators showing whether adjacent states have mandatory hospital reporting requirements.

Model

A linear probability regression model was used to evaluate the likelihood that a state had adopted hospital-level health outcomes reporting, and the probability that the adoption is attributable to each of the independent variables in this model. Although it is typical to use a non-linear model (such as logit or probit) for binary outcomes, use of a linear probability regression model provides easily interpretable parameter estimates of the effect of the independent factors on the dependent variable. The model can be represented by the following:

$y_i = \alpha + \beta_1 x_{1it} + \beta_2 x_{2it} + \ldots + \beta_k x_{kit} + e_{it}$

where the x variables (1 through k) represents the explanatory variables in the model and the β's represent the corresponding coefficients.

The y_i refers to a state i having adopted state mandated hospital reporting requirements by the year 2003 (value of one, zero otherwise), and is predicted by independent variables x_{it} that are relevant for year 't' (the year of adoption by specific states) for state 'i', and e_{it} represents the error term.

The independent variables used to predict the outcome include the following: *Party control of state government* addresses the effect of political influence on the implementation of health care policy. Past research has demonstrated that such an effect exists (Berry and Berry 1992). The health care industry has typically been supported by both parties, although specific party support depends upon the sector of the industry. The for-profit (market driven) hospital industry has long held the support of the Republican party; however, health care unions, and urban safety net hospitals have traditionally been aligned with the Democratic party. The data for this variable were taken from publicly available data from the Council of State Governments (The Book of States 2007, Lexington, KY)

The Republican Party has been more sympathetic to letting market forces determine industry changes and historically has been supportive of value-based purchasing; however, hospital performance reporting may appear to be unfair to their hospital constituency due to the potential for narrowly defined and questionable measures used to determine a hospital's overall performance. Democrats have traditionally supported the consumer's right to quality of care information and would be expected to provide greater support for the mandated hospital-level health outcomes reporting from the perspective that it provides consumers with more information that can be used in making hospital-choice decisions.

Stream used both the influence of the legislative and executive branches in the state to measure political influence in the state's decision to implement small group insurance market reform. Likewise, this study used a similar method to examine a state's decision to mandate hospital performance reporting. There were two such variables used in the model specified above, the first indicating the party of the executive branch, with the second indicating the party of the legislative branch. These variables are defined for the 2003 calendar year for non-mandate adopting states and for the fiscal year prior to adoption for states implementing mandated reporting.

The argument Stream made for the *fiscal health of the state* is that a state in better fiscal health is more likely to be able to afford to enforce stringent policy

mandates. His evaluation confirmed that hypothesis. This study measured the fiscal health of the state using a similar methodology by including both the revenues and state expenditures in the model. However, in this study the mean difference between revenues and expenditures in the five years prior to 2003 was used as the measure of margin for non-adopters, and the difference five years prior to the adopting year was used as the measure of margin for adopters.

The number of hospitals in a state may have influence on the political will of state legislators to develop policies that may adversely affect an institution that provides a large number of jobs for a state and is politically active during the campaign season. Most hospitals were opposed to the implementation of performance reporting systems because of the potential for negative publicity. In addition, many facilities have felt the measures used in public reports narrowly define the overall care given by the hospital. Although many of the early adopters of state level hospital performance reporting were states with a large number of hospitals, they were also states with large populations.

Because the population is not evenly distributed across states and the size of each state varies considerably, it was not appropriate to use a measure of the number of hospitals in a state for this variable. The reason was because states with smaller populations may, in fact, have had more facilities than states with larger populations. For example, New Jersey which is densely populated may have had a few large facilities, but South Dakota, which is sparsely populated,

may have a large number of small facilities. Therefore, a measure of *the number of hospital beds per 1000 people in the state* was used to capture hospital density. For non-adopting states, this figure was constructed for 2003 while for states adopting legislation, the measure was constructed for the year prior to adoption. State population was obtained using census data and the number of beds was obtained from national inpatient sample of the Healthcare Cost and Utilization Project (HCUP) data[19], which is used for subsequent analyses in this dissertation.

One area that governments can be directly affected by changes in health care is government-related health insurance programs. State governments tend to have more control over Children's Health Insurance Plan (CHIP)[20] and Medicaid programs due to their shared responsibility with the Federal Government in funding and running the programs. The Medicare program is directly run and funded by the Federal government. There are regional and market adjustments made to payments through Medicare, which could affect local and regional businesses that influence state regulatory requirements; however, the policy setting occurs at the national level.

[19] https://www.hcup-us.ahrq.gov/

[20] Per the Benefits.Gov website: "The Children's Health Insurance Program (CHIP) is a partnership between the federal and state governments that provides low-cost health coverage to children in families that earn too much money to qualify for Medicaid. In some states, CHIP covers pregnant women. Each state offers CHIP coverage, and works closely with its state Medicaid program. CHIP benefits are different in each state. But all states provide comprehensive coverage, like routine check-ups, immunizations, doctor visits, and prescriptions."

The demographic group that typically used government-run health insurance programs during the study period were the elderly and disabled (Medicare); poor families, children, and pregnant women (Medicaid or CHIP). The most relevant to states are the Medicaid and CHIP programs which are administered by the states. One way to determine the impact these programs may have had on state policy regarding quality reporting was to assess the size of the populations in each state that were enrolled in these government-run insurance programs. To that end, a variable was included in the model to represent the commonly captured government insurance programs described above: Medicare and Medicaid.[21] Each variable was a measure of the number of hospital discharges per 1000 inpatients enrolled in the specified insurance type over the five years prior to 2003 or the adopting year for states.

The *diffusion explanation* posits that state-level policy adoption is influenced by regional factors, such as policies generated in neighboring states. This theory assumes that politically, an entire region may favor similar policies and a similar political will exists in neighboring states. Several studies, cited by Stream, have identified the influence of neighboring states on policy adoption and the business case for creating policies that contribute to a competitive environment between states.[22] Diffusion was measured in this study using a variable to indicate that an

[21] Although it is recognized that the Veterans Health Administration is a government run-health plan, it is also run very differently. The VA health system is more of a closed system in that much of the care is given at facilities run directly at by the VHA. Therefore, it would be considered a single hospital system with the ability to implement mandated controls with greater ease than non- government run systems.
[22] Walker JL. The diffusion of innovations among the American states. *American Political Science Review* 63 1969:880-899.; Berry FS, and Berry WD. State lottery adoptions as policy innovations. *American Political Science Review.* 84 1990:395-413; Judd RJ, Greenwood WT, and Becker FW, eds. 1988. *Small*

adjacent state had mandated hospital-level health outcomes reporting in the prior year.

Policies may be developed to improve health outcomes, but they may also be implemented because there is a feeling that health outcomes are poor enough to require a government intervention (i.e., reverse causality). To that end, it was necessary to control for whether the outcome that the policy was targeting was actually trending in a direction that may have influenced or required a policy intervention. The outcome measures that were included in this model were hospital-level inpatient mortality and hospital-level inpatient length of stay (LOS). Inpatient mortality is seen by many as a primary indicator of quality of care in health care facilities and LOS is a proxy for cost of care and has been used for many years as a measure of efficiency in health care facilities. Both of these measures were evaluated using mean values based on the five years leading up to the 2003 RHQDAPU implementation or the five years leading up to the year of adoption for states adopting the reporting mandate. The mean hospital-level mortality and LOS across all hospitals found in the HCUP data in a given state over the five years were included as independent variables.

Results

Figure 2 (shown earlier) indicated the 12 states that implemented mandated public reporting of hospital outcomes prior to 2003. Note three states

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Business in a Regulated Economy: Issues and Policy Implications. Westport, CT: Quorum books.; Grant, DS. The political economy of new business formation across the American states: 1970-1985. *Social Science Quarterly.* 77 1996: 28-42.; Riley II CA.1995 Small business, big politics: What entrepreneurs need to know to use their growing political power. Princeton, NJ: Peterson's/Pacesetter Books.

implemented mandated reporting in 2002 and 2003 that were included in the control group of non-state mandated reporting states (Connecticut, Missouri, and New Mexico.)

There were a total of 12 independent variable used in the model to predict mandated outcomes (Table 2.1). There was data available for all variables in only 33 states. There were more states with Republican governors and there were more states with Republican legislative branches. The range for the average five- year margin was from $309 million to $51,204 million, reflecting a large difference in the size of state budgets and states themselves. There was from 1.3 to 3.8 beds per 1000 people in the state which again reflects the diversity of states in this analysis. Surprisingly the average length of stay over the five years prior to implementing the mandate or 2003 ranged from approximately 3 days to 8 days depending on the state, and may reflect changing care practices over time as this analysis used data that covered a long period of time. Likewise there was substantial variation in the inpatient mortality rates in the five years prior to implantation or leading up to 2003 for non-implementers (1.5% to 4.4%), again, likely a reflection of changing practices.[23] Lastly, there was a wide range across states in the five-year average of Medicare and Medicaid beds per 1000 population. This may have been due to the enrollment structures of the Medicaid program and the tendency for Medicare patients to retire to some states more than others.

23 There has been a steady decline in the mortality and length of stay for many years now, which has been due to many factors, including changing payment policy and patient care patterns.

Table 2.1 Descriptive statistics for characteristics used in model for assessing factors influencing mandated hospital outcomes reporting

Variable	Obs	Mean	Std. Dev.	Min	Max
Mandated reporting	50	0.28	0.45	0	1
Average 5yr State Margin	48	8890.32	9671.53	309.4	51204.2
Medicare discharges per 1000 discharges	37	167.45	50.15	77.33	269.22
Beds per 1000 population	50	2.52	0.58	1.30	3.84
Average length of stay*	33	4.53	1.19	2.99	7.98
Average inpatient mortality rate*	33	0.03	0.01	0.01	0.04
Medicaid discharges per 1000 discharges	37	386.41	73.53	221.04	593.47
Executive control Democrat	50	0.44	0.50	0	1
Executive control Republican	50	0.56	0.50	0	1
Legislative control Democrat	50	0.34	0.48	0	1
Legislative control Republican	50	0.46	0.50	0	1
Legislative control split	50	0.2	0.40	0	1
Adjacent state adoption	50	0.68	0.47	0	1

*Variables exclude Arkansas, Indiana, Kentucky, Maine, Michigan, Minnesota, North Carolina, Nebraska, New Hampshire, Nevada, Ohio, Oklahoma, Rhode Island, South Dakota, Texas, Vermont, West Virginia due to insufficient or unavailable data.

Table 2.2 Regression of state characteristics on whether a mandate was implemented in the state

Mandated reporting	Coef.	Std. Err.	T	P>t
Average 5yr state margin	-0.00002	5.64E-06	-3.71	0.001
Medicare discharges per 1000 discharges	0.0006	0.0012	0.53	0.603
Beds per 1000 population	0.0012	0.1179	0.01	0.992
Average length of stay	0.4500	0.0695	6.48	0
Mortality rate (inpatient deaths per total discharges)	-36.5189	13.724	-2.66	0.015
Medicaid discharges per 1000 discharges	-0.0001	0.0011	-0.08	0.937
Executive control Republican (1)	0.1297	0.1030	1.26	0.223
Executive control Democrat (2)	(omitted)			
Legislative control Republican	(omitted)			
Legislative control Democrat	0.0036	0.1410	0.03	0.98
Legislative control split	0.2114	0.1654	1.28	0.216
Adjacent state adoption	0.0663	0.1081	0.61	0.547
Construct	-0.8893	0.5988	-1.49	0.153

Note: model estimates based on ordinary least squares regression, using unweighted observations.

Several variations of the model were estimated, including versions that categorize variables in different ways. This was due to the limited sample size. The final model used predicts mandated reporting outcomes significantly explained the variation in mandated reporting (Adjusted R square = 0.58, $p<0.0009$). With regard to the predictors of mandated reporting of hospital outcomes, there were three variables that statistically significantly predicted outcomes – average five year margin (total general revenue-total general expenses), average five year length of stay, and average five year mortality rate (Table 2.2). Results indicate that an increase in the margin or an increase in the inpatient mortality rate will decrease the likelihood of having had a mandated reporting requirement. However, the higher the inpatient length of stay is the more likely the state would have mandated reporting.

Discussion

This study sought to determine whether the implementation of mandated hospital outcomes reporting in states was influenced by exogenous factors that may lead to biased outcomes in an analysis that would attempt to create a causal link between mandated reporting and changes in patient level health outcomes. The results indicate that there were three factors in the model that were associated with mandated reporting among states. These results indicate that a model that would attempt to estimate the relationship between state mandated reporting policies and health outcomes may be biased due to endogenous factors that may

be correlated with the decision to implement such reporting requirements and the outcomes of interest. Notwithstanding the significant R^2, the limited sample size and minimal variation found in several variables limits the interpretability of this analysis, as the directionality of the coefficients in some cases does not make logical sense.

Reverse causality can be a problem in many different models that attempt to predict healthcare outcomes and if not accounted for it can lead to biased outcomes. In this case we found that the causal pathway from poor outcomes in mortality and length of stay influenced mandated reporting; however, these factors are commonly used in mandated reports of hospital performance. This would lead one to question whether results that demonstrate that mandated reports have led to better outcomes may in fact be reversed in that poor outcomes have influenced mandated reporting. However, we found that the directionality of the coefficient for inpatient mortality outcomes was not as one might expect. More specifically, a poor outcome for inpatient mortality led to a lower likelihood of mandated reporting. The results for length of stay, a common proxy for cost of care, had an expected coefficient directionally. The directionality calls into question the meaningfulness of the mortality outcome and should give pause to whether it should be included in any subsequent modeling of the influence of mandates on outcomes of care.

The variable representing the margin of the state's revenue to expenses was found to be a significant predictor of whether a state adopted mandates, and indicates that when states are in a poor fiscal state they may be more likely to adopt mandates that may influence patient healthcare outcomes by exposing good and poor performance on healthcare outcomes at hospitals. Additionally, this seems to suggest that regardless of the party that is power, the status of the state's fiscal health can influence the likelihood of whether the state may implement mandates for healthcare. This is evidenced in Republican support of value based payment models that both provide protect the consumer, but still impose a mandate on businesses.

Taken together, the directionality of the association between mortality and mandated reporting and the association between length of stay and fiscal margin, the significant predictors of mandated reporting for hospital performance seems to indicate that the major influential factors related to implementing such a mandate are related to financial matters more than patient care. It also suggests that the blunt instrument of public reporting may not be for the benefit of the patient, but rather for the benefit of the payer and used to influence the cost of care (or its proxy of LOS).

Limitations

There were several limitations in this analysis; however, the biggest limitation was the sample size. This analysis included only 50 states, and the modeling exercise only included 31states due to the lack of information for 19 states. A

simple regression matrix would demonstrate that there are not sufficient data points to populate all of the cells in a model with 33 data points and 13 variables. Another limitation is the level of measurement. This analysis was at the state level, and attempting to capture factors that influence policies that cover such a large population, area, and constituency can be near impossible in a model such as this. Additionally, mortality as a measure of quality of care can be called into question given the rarity of the event, which in turn makes it difficult to detect a signal of variation in the outcome of mortality within a small sample size. Lastly, this analysis did not include a way to adjust for case mix by state which is likely to vary both clinically and by socioeconomic factors.

Conclusion

In modeling patient outcomes related to state-implemented mandates for publicly reporting healthcare outcomes at the hospital level, length of stay, state fiscal margin, and possibly the average hospital level inpatient mortality, should be included in models of the impact of state-mandated quality reporting to counter endogenous factors that may influence both the mandate and the patient outcomes of care. However, given the limitations of this analysis it is unclear if these variables are truly associated with mandated public reporting.

Chapter 3: Evaluating the effect of mandated state reporting requirements on of patient probability of dying in the hospital and length of stay outcomes prior to the 2003 implementation of the RHQDAPU program

Clearly, patient-centered appropriate care has become more and more important with the high cost of care, wherein each mistake can result in an extremely high physical toll and monetary cost to the patient and payer. However, year after year, reports from reputable institutions, such as The Commonwealth Fund, document the poor performance of the United States health care system in all measurement domains (quality, access, efficiency, equity, and healthy lifestyles) despite the high resource intensity and cost of care in the United States.[24] Although these reports are informative and have certainly influenced recent efforts at the federal level to begin the value-based purchasing (VBP) initiative, they fail to differentiate among providers that perform well and those that perform poorly, limiting knowledge transfer about best practices from areas that have good outcomes to areas with poor outcomes.

Clear evidence exists suggesting that care provision is better in some areas of the country than others. Recent studies have demonstrated that variation in patient care continues to be inconsistent across different regions of the country, and leads to variation in health care spending and resource allocation.[25] Along with the discordance in spending and resources, there are variations in patient

[24] Karen Davis, Cathy Schoen, Stephen C. Schoenbaum, Michelle M. Doty, Alyssa L. Holmgren, Jennifer L. Kriss, and Katherine K. Shea. Mirror, mirror on the wall: An international update on the comparative performance of American health care. The Commonwealth Fund pub. no. 1027. May 2007 1-30.

[25] Wennberg JE, Fisher ES, Skinner JS, Bronner KK. Extending The P4P agenda, Part 2: How Medicare can reduce waste and improve the care of the chronically ill. *Health Affairs.* 26 (6) 2007: 1575-85.

outcomes.[26] Given the variation in not only health care practices, but also health policy by state, it might not be surprising that such variation exists at the patient level. However, it is not always easy to link policy mandates with patient outcomes.

As discussed previously, states do not appear to be unified nationally with regard to their decision to implement mandated hospital-level reporting requirements, much less in the decision to implement this on the same time schedule (refer to Figure 2). However, because there is variation across states and over time in implementation of mandated hospital-level health outcomes reporting, there is an opportunity to evaluate the effects mandated reporting have on outcomes of care. Hence, this chapter of the dissertation seeks to take advantage of the variation in the implementation of mandated hospital-level health outcomes reporting across states and time to identify the impact of this mandate on patient outcomes. If indeed such mandates do appear to be associated with better outcomes, then one might hypothesize that a similar improvement in health care outcomes would be seen nationally with the implementation of the immediate value-based purchasing requirements of mandated reporting set out by the 2005 Deficit Reduction Act. Furthermore, at the state level, one might have expected that states that implemented public reporting programs, independent from the federal government, would have also seen similar improvements.

[26] Fisher ES, et al. The implications of regional variations in Medicare spending, Part 2: Health outcomes and satisfaction with care. *Annals of Internal Medicine.* 138 (4) 2003: 288-98.

Methods

To assess the state-level policy effect, this evaluation used all acute care patients admitted to all hospitals in states with available data to determine if there was a difference in patient outcome measures for states that had mandated reporting requirements prior to July 2003 compared to states that did not have reporting mandates.[27] In the context of the natural experiment literature, the "experimental" states were those that mandated reporting and the "control" states were not subject to such a requirement. The impact of state mandatory reporting requirements is estimated using the following base empirical model:

$$Y_{(ihjt)} = B_1 + B_2Pat_{(ihjt)} + B_3Hos_{(hjt)} + B_4Ext_{(jt)} + + B_5\text{Mandate Yes}_{(jt)+)} + e_{(ihjt)}$$

where $Y_{(ihjt)}$ is the outcome of interest for patient i, in hospital h, in state j, at time t. $Pat_{(ihjt)}$ is a set of patient characteristics for patient i, in hospital h, in state j, at time t, $Hos_{(hjt)}$ is a set of hospital characteristics in hospital h, in state j, at time t, and $Ext_{(jt)}$ represents the external factors in state j at time t that are associated with a state's decision to mandate report as identified in Chapter 2 above[28], and 'Mandate $Yes_{(jt)}$' equals one if the hospital reporting mandate is in effect in state j at time t and zero otherwise, and $e_{(ihjt)}$ is a stochastic error term. The coefficient (B_5) on 'Mandate Yes' provides an estimate of the impact of state reporting

[27] The year 2003 is used because that is the year that Federally mandated hospital reporting was started under the RHQDAPU system. This reporting was a national effort with a similar focus to that of most state mandates and in turn could introduce bias into this analysis.

[28] Length of stay, mortality rates, and margin of a state prior to implementation of the mandate were influential, as found in chapter 2. However, it the results were questionable given the very small sample size, and the coefficient for margin was negligible. With that in mind, only length of stay and mortality were included as they were easily obtained from the HCUP data for this model.

mandates on the specific outcome of interest for patients compared to states that did not mandate reporting requirements. External (Ext) characteristics, such as a state fixed effect, years the mandate has been in effect in the state, year the patient was admitted, and the average mortality and LOS at the time of the mandate implementation. A state fixed effect was included to control for unknown time-invariant influences that would be unique to the state that might affect patient outcomes. The year of admission was included to control for the trend in decreasing mortality and LOS outcomes seen across all hospitals.

We found that in Chapter 2 that there were other factors contributing to a state's decision to mandate reporting requirements, and that length of stay and inpatient mortality among all inpatients seemed to have an impact on the determination to mandate the implementation of hospital public reporting. State-level measures of average hospital level inpatient LOS and mortality for all patients regardless of disease group were included in the respective models to control for any endogenous effects they may have had in determining the outcomes of interest. In doing so, the average inpatient mortality rate and the average inpatient LOS for the state was included in the models. The average was based on the five years leading up to the mandate implementation and was derived from the data used for this study.

Relevant hospital (Hos) characteristics included number of beds, teaching status, ownership type, region, and rural/urban status. The number of beds or hospital

size was included because larger hospitals tend to have a greater volume and take on more complex cases because smaller facilities typically do not have the clinician specialists or technology and equipment to deal with them. Likewise teaching hospitals often take in more complex patients and patients that have failed treatment in other facilities, and teaching hospitals also have the unique aspect of using students as a part of the provider team. Ownership was included because public hospitals must take on all patients regardless of their ability to pay, and likewise many non-profit hospitals have missions to do the same, whereas private facilities can be selective about the patients they want to treat. Region was included because regional variation exists not only in patient outcomes, but also in the cost of care.[29] Lastly, the rural or urban location of a facility can indicate a patient's ability to select the hospital they want to go to and also the likelihood of having more technologically advanced facilities to care for unique patients.

Relevant patient characteristics include age, race, gender, payer type, admission source, admission type, and median household income (zip code based). Age was included as age is highly correlated with mortality and LOS. Gender was included because males and females have different symptoms with acute myocardial infarction (AMI) and heart failure (HF) and studies have found that females historically have not received equivalent treatment to males for these

[29] Fisher ES, Wennberg DE, Stukel TA, Gottlieb DJ, Lucas FL, Pinder EL. The implications of regional variations in Medicare spending. Part 2: health outcomes and satisfaction with care. Ann Intern Med. 2003 Feb 18;138(4):288-98.

conditions.[30] Payer type was included as patient treatment may be limited by the type of insurance they have. The admission source and admission type are included as they indicate whether the patient was being transferred from other facilities or locations and how urgent the admission was. Lastly, race and zip code level income were included as a way to proxy for unknown factors associated with the patient's socioeconomic status.

In implementing this model, the patient outcome measures (Y) included the probability of dying while in the hospital (the likelihood that a patient's discharge status will be recorded as deceased) and hospital length of stay (LOS). It was expected that patients in states with reporting mandates would experience decreases in the likelihood of dying while in the hospitals and LOS (i.e., a negative sign on B_5).

Given that many of the mandated reporting requirements were focused around primarily acute myocardial infarction (AMI), heart failure (HF) and pneumonia, this analysis will focus on two groups of patients – patients diagnosed with Heart Failure and those with Acute Myocardial Infarction. The definitions for these two groups were taken from the Centers for Medicare and Medicaid Services.[31] The pneumonia population has not been used in this analysis as the definition has

[30] Cardiovascular disease and other chronic conditions in women: Recent findings. AHRQ Pub. No. 12(13)-P011-EF

[31] http://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HospitalQualityInits/InpatientMeasures.html

fluctuated substantially over time, and the use of coded data to define this population adequately has been controversial.[32]

While multiple models were evaluated using the final parameters in the model along with other potential parameters, it was determined that the final model in Tables A3 – A6 in Appendix A resulted in the best fit while allowing for estimations of marginal effects for the key variables.

General linear regression models and ordinary least squares (OLS) estimates were used for all analyses to estimate patient discharge level outcomes. A linear probability model was estimated for the inpatient likelihood of dying while in the hospital, and the coefficients represent percentage point changes. Additional logistic regression models were estimated for the inpatient mortality outcome to test the reliability and sensitivity of the OLS estimates for a binary outcome. Because the measure of LOS is a count variable, a Poisson regression model was used to estimate the changes in LOS attributable to the variables included in the model, and marginal effects were subsequently calculated for the LOS measure. All results were generated using STATA® version 15.1 (StataCorp LLC, College Station, TX).

Data

[32] Rothberg MB, Pekow PS, Priya A, Lindenauer PK. Variation in Diagnostic Coding of Patients With Pneumonia and Its Association With Hospital Risk-Standardized Mortality Rates: A Cross-sectional Analysis. Ann Intern Med. 2014;160(6):380-388.

The data used for this study was from the Health Care Utilization Project Nationwide Inpatient Sample (HCUP-NIS) and covered the calendar years 1988 to 2006. As stated on the webpage for the data:

"The Nationwide Inpatient Sample (NIS) is part of a family of databases and software tools developed for the Healthcare Cost and Utilization Project (HCUP). The NIS is the largest all-payer inpatient health care database in the United States…" [33]

The HCUP-NIS is a nationally representative sample of hospital inpatient stays from across the United States. It includes information about a patient's stay in the hospital, including patient demographics, the diagnosis of the patient and procedures that the patient may have received. The procedures and diagnostic information is provided in the form of codes found in The International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM). The data is commonly referred to as administrative data as it is used to characterize the patients for payment purposes. It is collected by the Agency for Healthcare Research and Quality from either state governments or hospital associations in the participating states. It contains a complete census of patients from hospitals that submit the data, and there are no specific restrictions on hospital types or size that submit the data. The database was selected as it was the only nationally representative dataset that spanned both the timeframe required and the states necessary to do this analysis. Other datasets were considered such as the National Hospital Discharge Survey, the Medicare data found in the MedPar dataset, commercial datasets, such as the Premier data, Truven data,

[33] http://www.hcup-us.ahrq.gov/nisoverview.jsp

and several others; however, the aforementioned datasets either did not cover the required timeframe, did not have the outcomes that were required, or they didn't have a comprehensive coverage of the age groups or states necessary.[34] Appendix B has several tables describing the population from the HCUP NIS data set used in this analysis. In the results section of this chapter, the characteristics of the data are described and relevant nuances are identified.

Results

Descriptive statistics

The descriptive statistics (Appendix B, Tables B1-B15) calculated using data for this study tell an interesting story about the changes in patient populations and hospital types, and how it reflects the changing society. The results are only representative of the data submitted and cannot generalized nationally because while the sample size for the analyses was approximately 16 million, projection weights were not used with this analysis as the objective of this study did not require national projections. In the database used, the number of teaching hospitals was increasing over time and the concentration of facilities was increasing in the South, possibly due to a response to the poor health outcomes that have traditionally been associated with southern states. Also, in the database used for this study, hospitals saw an increase in the number patients admitted via the emergency department and being transferred to other facilities. Many reasons could be suggested for these trends, some of which could be an

[34] To be sure, there are limitations to the HCUP – NIS data. It does not have data from every state in the US, each state has varying time frames for which it supplies data, and the number of data elements available is not equivalent across the states that supply data. There are 38 states with data used in this analysis.

ageing patient population, which tends to have more chronic and comorbid conditions.

The age of the patient hospital population was shifting with the United States population, as the age distribution of the population shifted over time, and the Medicare patient population grew in this database. Interestingly, despite a shift in age toward older patients which tend to have more chronic and comorbid conditions, outcomes in both mortality and length of stay improved over time, with a steady decreasing trend. It may be likely that the trend in decreasing LOS and mortality are reflections of a trend in improved inpatient outcomes over time rather than a reflection of any effect associated with the increasing age of the patient population in the selected HCUP database.

From 1988 to 2006, the HCUP NIS data contained from 5.2 million to 8 million discharges per year from between 759 and 1,054 hospitals from between 8 and 38 states (Appendix B1) and increased in geographical coverage over that timeframe. The average hospital volume increased over time from an average of 16,243 discharges per year in 1988 to 20,904 discharges in 2006. In addition, the rate of transfers to other hospital facilities increased from 1.88% in 1988 to 2.13% in 2006, peaking at 2.54% in 1999. Rates of emergency room admissions (admit source[35]) increased in the selected database from 30.7% of patients to 43.6% of patients from 1988 to 2006, while the other sources of admissions

[35] Admission source relates to where the patient is coming from (e.g., another hospital, physician office, etc.)

decreased slightly over time. Of note, the missing or invalid data decreased from 12.7% to 1.2% over the same time period, so this may be an artifact of improved data collection. However, within the admission type (admit type[36]) variable, emergency admissions increased from 29.7% to 40.8% over the same time frame while all other admission types remained relatively stable, with the exception of urgent admissions which decreased from 24.7% to 16.5%. There appeared to be a slight increase in transfers to skilled nursing facilities and a slight decrease in routine discharges over the time frame of this study.

With regard to the payer mix over the time frame, there was an increase of about seven percentage points in both Medicare and Medicaid patients and a decrease of approximately the same magnitude for private payer patients in the HCUP data. The data contained some information about secondary payers, but it was unavailable or missing in too many patients (>65%) to gather any relevant information from it. Not surprisingly, the percentage of patients admitted to small, medium, and large facilities has not changed over the time frame. The type of facility ownership was re-categorized in the HCUP data by AHRQ in 1998 by collapsing categories into fewer groupings, however, using the collapsed categories prior to and post change there was little change in the ownership type over time. There was a 13.5 percentage point decrease in urban non-teaching hospitals while both rural and urban teaching facilities increased over time by 1.5 percentage points and 11.9 percentage points, respectively. With regard to the

[36] Admission type refers to the state of the patient's condition such that it affects how they are admitted. It captures whether the patient is an emergency, urgent, elective, trauma, newborn, etc.

geographic distribution of patient discharges in the HCUP database, there was a decrease in the percent in the Northeast (25.7% to 18.4%) and West (25.3% to 19.6%), and an increase in the Midwest (19.0% to 22%) and South (29.9% to 39.9%).

The characterization of the patient population changed slightly. However, the gender distribution of patients remained consistent over the timeframe of the study at approximately 42% male and 58% female. The average age ranges from 43.6 in 1989 to 47.8 in 2001, with the average age consistently increasing over time by approximately 4 years during the timeframe under consideration. The racial and ethnic composition of the patient population has remained relatively consistent over the timeframe in the HCUP database, however, the first 10 years (1988-1997) there was a substantial amount of unavailable data on race. From 1998 to 2006, there was a slight increase in Hispanic patients and a slight decrease in white patients. Not surprisingly, the rates of patients in the various income categories, based on the median income of the patient zip code, shifted quite a lot over the time frame, with incomes rising and shifting from the majority of patients in the lowest income to the majority in the highest income category.[37] The average LOS over the time frame of discharged patients ranged from 6.3 days in 1988 to 4.6 days starting in 2001 going through 2006. The overall unweighted and unadjusted mortality rate ranges from 2.94% in 1988 to 2.04% in 2006. Interestingly, the percentage of AMI patient discharges were 2.31% in 1988 and in 2006, and peaked in 2000 at 2.63%; however, the percentage of

[37] Income categories were: $1-$35,000, $35,001-$45,000, and $45,000 or more.

heart failure patients nearly doubled from 6.24% in 1988 to a peak of 11.37% in 2006.

Inpatient mortality rates for the two populations of interest (AMI and heart failure) by state can be found in Appendix A, Tables A2 and A3 for facilities submitting data to the HCUP database. The rates seem to have been similar across all states for heart failure patients with the exception of Hawaii and New York, which appear to have had higher rates than other states. However, like all other states the inpatient mortality rates seemed to be decreasing over time, with the overall average starting at 11.34% in 1988 and decreasing to 6.08% in 2006. Likewise, the AMI inpatient mortality rates seem to be similar across states. Hawaii, along with several states in the northeast, such as New York, New Jersey, and Rhode Island, seems to have had a higher rate of AMI inpatient deaths than most other states. A few states, such as, Colorado, New Hampshire and Minnesota seem to have had consistently lower rates of AMI inpatient deaths across the years than other states.

Inferential statistics

The base model designed to analyze the AMI and HF LOS and probability of dying while in the hospital association with mandated reporting, resulted in a model with several variables significantly associated with LOS and the probability of dying while in the hospital (Appendix A Tables A3-A6).

Table 3.1 Summary table of state mandated public reporting effect on the probability of dying while in the hospital and the average marginal LOS in the hospital among heart failure (HF) and acute myocardial infarction (AMI)

		Probability of dying		LOS	
Variable		**HF**	**AMI**	**HF**	**AMI**
Mandate	*Yes*	-0.0036^	-0.0025**	-0.2372^	-0.0961^
Hospital type	*Private*	Reference category			
	Government	-0.0002	-0.0004	0.0343^	0.0688^
	Private Non-profit	-0.0001	-0.0071^	0.0314^	-0.0484^
Payer	*Private - including HMO*	Reference category			
	Medicare	0.0053^	0.0392^	0.5664^	1.1890^
	Medicaid	0.0026^	0.0364^	1.7169^	2.3305^
	Self-pay	0.0042^	0.0220^	0.6795^	-0.0189
	No charge	-0.0124^	0.0040	1.1871^	1.9334^
Average length of stay in 5 years leading up to the mandate implementation for the state	*2.98-3.75*	Reference category			
	3.76-4.50 days	-0.0071^	-0.0060^	-0.3064^	-0.1121^
	4.51-5.50 days	0.0085^	0.0218^	1.3898^	0.8171^
	> 5.50 days	-0.0034^	0.0074^	0.7133^	0.3769^
Average mortality rate in 5 years leading up to the mandate implementation for the state	*<2%*	Reference category			
	2-2.49%	0.0137^	0.0099^	0.2009^	0.1422^
	2.5-2.99	0.0159^	0.0098^	0.0266^	0.1129^
** p<0.05, **p<0.01, ^p<0.001*					

Model variables include: sex, age groups, control of hospital, admission type, race, admission source, payer type, rural/urban teaching/non-teaching, region, bed size of facility, patient income, year of admission, state 5 year average length of stay leading up to the admission, state 5 year average mortality rate leading up to the admission, state mandate flag

Heart Failure probability of dying while in the hospital

As seen in the summary Table 3.1, it appears that there is a statistically significant decrease of dying while in the hospital when the state mandate was in effect. While statistically significant the decrease was an average of 0.36 percentage points, which may seem like a relatively small effect considering the average probability of dying while in the hospital as a HF patient was 9.29% in the HCUP database used for this analysis; however, among 10,046,482 HF patients in the database that would represent approximately 36,000 patients. Likewise, HF inpatient mortality in public and private non-profit hospitals appear to have been lower than HF inpatient mortality in private hospitals, however these associations were not statistically significant. With regard to payer type it appears that relative to patients with a private payer, patients with Medicare, Medicaid and self-pay have a higher probability of dying while in the hospital. Interestingly, patients who are not charged had a statistically significant decrease in the probability of dying while in the hospital which equates to a decrease of more than 124,000 patients.

Average state level LOS leading up to the mandate and average inpatient mortality leading up to the mandate implementation were identified as having been associated with the likelihood of implementing a mandate in Chapter 2. The average LOS categories of 3.76-4.50 and >5.50 days were statistically significantly associated with a decrease in the probability of dying while in the hospital relative to patients in the hospital on average 2.98-3.75 days. Conversely the category 4.51-5.50 days was associated with an increase in the

probability of dying while in the hospital relative to the 2.98-3.75 days category. With regard to the average state level inpatient mortality rate leading up to the mandate, there appeared to be a small trend associated with the average state level inpatient mortality rate. As the average inpatient mortality rate category increased relative to the lowest rates (<2%) so did the probability of dying while in the hospital. Within the two increasing categories of 2-2.49% and 2.5-2.99% there was an increase of 1.37 percentage points (~137,000 patients) and 1.59 percentage points (~159,000 patients) respectively.

Other variables that were associated with relatively large percentage point increases in or decreases in the probability of dying while in the hospital can be found in Table A3 in Appendix A. Most notably age 65+ (5.18, $p<0.001$) relative to age 18-45, admission source another facility including long term care (6.01, $p<0.001$) relative to admission source routine/birth/other were both associated with percentage point increases that would have represented more than 500,000 additional patients in the HCUP data used for this study dying while in the hospital. While this is certainly notable, it is not unexpected as patients that are older and in long-term care facilities would be expected to be more complex or have chronic conditions that could be associated with higher rates of inpatient death.

AMI probability of dying while in the hospital

Within the 3,278,939 patients included in this model there was a statistically significant decrease in probability of dying while in the hospital of -0.25 percentage points when mandated reporting was in effect at the state level. With an average inpatient mortality rate for AMI patients in the HCUP data used for this study of 14.11% (462,658 patients), that represents decrease of approximately 8,000 inpatient deaths in the HCUP database which is not a large decrease relative to the overall mortality rate.

Other variables of interest that were associated with a statistically significant percentage point decrease in inpatient mortality among AMI patients were having been admitted to a private non-profit hospital (-0.71 percentage points, $p<0.001$) relative to having been admitted to a private hospital. In addition, having been admitted in a state that had an average LOS cagegory of 3.76-4.50 days leading up to the implementation of the mandated reporting (-0.60 percentage points, $p<0.001$) relative to an average length of stay of 2.98-3.75 days was associated with a percentage point decrease. Conversely, there were a number of variables of interest with statistically significant increased associations with the probability of dying while in the hospital. Those included having had a payer type of Medicare, Medicaid, and self-pay, and having had an average LOS category of 4.51-5.50 days or >5.50 days relative to 2.98-3.75 days. Additionally, having an inpatient mortality rate category leading up to the implementation of the mandate of 2-2.49% and 2.5-2.99% were both statistically associated with increased probability of dying while in the hospital. The variables of interest that had the

largest marginal effects were related to payer type with Medicare patients having an increased probability of dying while in the hospital that was 3.92 percentage points higher than private payer patients, which represents approximately 128,000 AMI patients in the HCUP database, and similarly Medicaid patients had a 3.64 percentage point increase, which represents approximately 119,000 patients.

Other variables found to have been statistically significantly associated with a percentage point increase or decrease in the probability of dying in the hospital within the AMI population from the HCUP data used in this study can be found in Appendix A Table A4. The most notable variables among this population were age 65+ (11.06 percentage points, $p<0.001$) and admission type trauma (18.84 percentage points, $p<0.001$). The percentage point increases in mortality among these populations represent more than 360,000 and more than 617,000 patients in the HCUP data used for this study, respectively.

Heart Failure LOS

The results for the marginal effects in the HF LOS model were calculated using a Poisson regression model for count data, and average marginal effects and standard errors for coefficients were generated. The results from Table 3.1 showed a statistically significant decrease in LOS when the mandated reporting was in effect (-0.24 days, $P<0.001$). Given the average LOS among the HF patients in this study was 8.16 days, approximately one quarter of a day would

have reduced the patient stay to seven days using the average value; however, given the standard deviation is 12.72 days, it could certainly have been possible that this incremental amount could have led to fewer billed days of stay in the hospital for several more specific populations. The only other variable of interest that was statistically significantly associated with a decrease in LOS was the average state level LOS leading up to the mandate category of 3.76-4.50 days (-0.31 days, $p<0.001$). Like the state mandate implementation variable, this would have reduced the overall average LOS to seven days.

There were a number of variables of interest that were significantly associated with an increased marginal LOS among HF patients in this study, including the following: government and non-profit hospitals relative to private hospitals; Medicare, Medicaid, self-pay and no charge relative to private payers; categories representing the average LOS leading up to the mandate implementation of 4.51-5.50 and >5.50, relative to 2.98-3.75 days; and categories for the average state level inpatient mortality rates leading up to the mandate of 2-2.49% and 2.5-2.99%, relative to <0.2%. Based on the marginal effects from the study Table 3.1, the variables that would extend the hospital stay into another day based on the average of 8.16 days of stay for HF patients in this study were patients with the payer type of Medicaid (1.17 days, $p<0.001$), patients with a payer type of no charge (1.19 days, $p<0.001$), and states with an average LOS of 4.51-5.50 days leading up to the mandate being implemented (1.39 days, $p<0.001$). Given that there were also significant increases in Medicare and self-pay patients as well, it

is clear that patients with private insurers were more likely be discharged sooner than any other patient type; however, it is not clear what this can be attributed to. It could be related to lower negotiated payment rates by private insurers which would have led facilities to push to discharge sooner, or it could have been that private insurance patients were generally healthier and don't require as much care.

Other variables associated with statistically significant increases or decreases in LOS among the patient population used in this study can be found in Appendix A Table A5. The most notable variables and their related coefficients were admission source another hospital (0.40, $p<0.001$) relative to admission source routine/birth/other, having been admitted to an urban teaching hospital (0.25, $p<0.001$) relative to be admitted to a rural hospital, and being admitted in the northeast united states (0.28, $p<0.001$) relative to being admitted in the south region of the United States. It is not clear why being admitted in the northeast United States was related to increases in LOS, but with regard to being admitted from another hospital and admitted to urban teaching hospitals could both be related to patients with a greater acuity being transferred from another hospital or selecting to go to an urban teaching hospital because they have resources to deal with their conditions.

AMI LOS

Like the HF patient population in this study the effect of relevant variables were estimated using Poisson regression and average marginal effects and standard

errors were estimated for variables found in Table 3.1. The AMI patient population also had a statistically significant decrease in the marginal effect on LOS when the mandated state level reporting was in effect (-0.10 days, $p<0.001$), but with an average LOS in the AMI patient population in the HCUP data used for this study of 7.97 days this does not appear to have led to a substantively significant effect simply based on the average of this patient population. In this patient population we saw a standard deviation from the average LOS of 10.36 days and given the wide variation it is likely that there are more specific populations that would have had fewer billed days of stay.

Two other variables of interest had statistically significant decreases in the marginal effect on LOS. Private non-profit hospitals had significantly lower LOS (-0.05 days, $p<0.001$) relative to Private for-profit hospitals and having been admitted in a state that had an average LOS of 3.76-4.50 days leading up to the mandated reporting (-0.11, $p<0.001$) relative to an average of 2.98-3.75 days. Neither of these marginal decreases in LOS would have changed the total number of days of stay based on the average days of stay for AMI patients in this study.

There were a number of variables of interest that were associated with a statistically significant increased LOS. They were as follows: being admitted to a government run facility relative to private for profit facilities; having had a payer type of Medicare, Medicaid and no charge relative to private payers; having been admitted in a state with an average LOS category leading up to the mandate

implementation of 4.51-5.50 days, or >5.50 days, relative to 2.98-3.75 days; and having had an average inpatient mortality rate category leading up to the mandate implementation of 2-2.49%, or 2.5-2.99%. Given the average LOS for this patient population was 7.97 days, all of the marginal effects would have pushed the patient into an eighth day of stay; however, there were three variables that would have increased the day of stay regardless of the average LOS and they were all related to payer type. Medicare patients had an additional 1.19 days on average, Medicaid patients had an additional 2.33 days on average, and no charge patients had an additional 1.93 days on average, all relative to private insurance patients. The additional days of stay would have had a significant financial impact on hospitals. If hospitals were paid based on the current system of paying based in the diagnosis related grouping system which pays a single amount for a specific diagnosis they would have decreased their financial margin with these patients.

Other variables and their coefficients that were statistically significantly associated with increases or decreases in LOS among AMI patients in the HCUP data used in this study can be found in Appendix A Table A6. Three more notable variables and their coefficients were age 65+ (0.36, $p<0.001$) relative to age 18-45, admission type of trauma (0.74, $p<0.001$) relative to elective admissions, and being admitted to an urban teaching hospital (0.41, $p<0.001$) relative to being admitted to a rural hospital. Older and trauma patients tend to

be more complex or higher acuity, and urban teaching hospitals often see more complex patients; therefore, these findings while interesting are not unexpected.

Discussion

It is clear based on the findings in this study that implementing state level mandated public reporting is associated with decreases in the probability of dying while in the hospital and the patient LOS while in the hospital. These findings provide contributing evidence to the premise that performance-based reporting will lead to improvements in hospital-based patient outcomes of care. Additionally, the findings underscore the notion that transparency in performance based improvement activities can contribute to improvements in overall care.[38]

There have been mixed findings about the ability of public reporting to influence hospital providers to perform better.[39, 40] This was seen with the Premier Hospital Quality Incentive Demonstration project.[41] In that experiment CMS incentivized hospitals to public report their process measures and based on their performance they would receive an additional bonus incentive. While the facility performance

[38] Crimmins MM, Lowe TJ, Barrington M, Kaylor C, Phipps T, Le-Roy C, Brooks T, Jones M, Martin J. QUEST: A data driven collaboration to improve quality, efficiency, safety, and transparency in acute care. *The Joint Commission Journal on Quality and Patient Safety.* 42(6) June 2016:247-253(7).
[39] Rothberg MB, Morsi E, Benjamin EM, Lindenauer PK. Choosing the Best Hospital: The Limitations of Public Reporting of Hospital Quality. Health Affairs 2008;27(6):1680-87
[40] Rothberg MB, Pekow PS, Priya A, Lindenauer PK. Variation in Diagnostic Coding of Patients With Pneumonia and Its Association With Hospital Risk-Standardized Mortality Rates: A Cross-sectional Analysis. Ann Intern Med. 2014;160(6):380-388.
[41] Lindenauer PK, Remus D, Roman S, Rothberg MB, Benjamin EM, Ma A, Bratzler, DW. Public Reporting and Pay for Performance in Hospital Quality Improvement. N Engl J Med 2007:356:486-496.

on the process measures did indeed improve, Ryan, et al. found that outcomes measures did not improve in the same way. [42,43]

It was interesting that from the provider perspective Private hospitals performed worse when it came to the probability of dying while in the hospital among both AMI and HF patients, however, they seemed to have a lower LOS (except for AMI patients in private non-profit hospitals). It is possible that patients in private hospitals died early in the stay which lead to a lower average LOS; however, that doesn't address the fact that patients entering private for profit hospitals had a higher probability of dying while in the hospital, regardless of AMI or HF diagnosis.

Conversely from the payer perspective, it was interesting to see that private payers appeared to perform better than Medicaid, Medicare, Self-pay and no charge patients. It could be that while the models controlled for a number of variables that are associated with increased patient acuity, it didn't sufficiently account for all factors. For example, comorbid conditions and other factors such as socioeconomic factors were not controlled for and they are known to be associated with higher patient acuity.[44] Despite that, this study should help underscore that patients receiving publicly funded insurance plans or having to pay on their own are likely to be at a higher risk of mortality and stay in the

[42] Ryan AM, Blustein J, Doran T, Michelow MD, Casalino LP. The effect of Phase 2 of the Premier Hospital Quality Incentive Demonstration on incentive payments to hospitals caring for disadvantaged patients. *Health Serv Res.* 2012 Aug;47(4):1418-36.
[43] Ryan AM, Nallamothu BK, Dimick JB. Medicare's public reporting initiative on hospital quality had modest or no impact on mortality from three key conditions. *Health Aff* 2012 Mar; 31(3): 585-592.
[44] Iezzoni LI. Risk Adjustment for measuring health care outcomes. 3rd Ed. 2003.

hospital longer, which leads to increased cost of care. Therefore, the Centers for Medicare and Medicaid Services and policy makers should ensure that their payment models should be driven by the patient populations they serve and not by the overall inpatient population. This is not always happening, as we know that current performance measures used by CMS cover the entire inpatient population and not just Medicare or Medicaid patients.[45] Hopefully, evidence like that found in this study will help to clarify that point.

While the findings from this study on their own are likely not strong enough to induce policy makers to consider public reporting as a way to improve patient outcomes of care in the inpatient setting, they should add to the growing debate about transparency in healthcare and how far that can push the industry to improve its performance. In particular, this work calls out the important role states can play in improving care through enforced mandates.

Limitations

The data used for this analysis was based on administrative coded data which was originally used for the purposes of billing, therefore, it was not collected specifically to study the mandated reporting effect and may not have adequately captured the clinical conditions of interest. However, administrative data such as the HCUP data used for this study has been used in hundreds of studies to

[45] Centers for Medicare and Medicaid Services, http://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HospitalQualityInits/InpatientMeasures.html

measure the change in healthcare over time and has been shown to be a consistent and accurate method of evaluating care.[46]

As mentioned earlier another potential limitation is the potential to have an insufficient risk adjustment for the outcomes of interest. This was addressed by including many variables in the regression models to control for factors that were known to be associated with the outcomes of interest in an effort to control for patient risk, however, there were limitations to the data and the amount of information about the patient that can be drawn from administrative data.

[46] https://www.hcup-us.ahrq.gov/reports/pubsearch/Search.action

Chapter 4: Evaluating the effect of 2003 RHQDAPU reporting requirements on patient-level measures of patient probability of dying while in the hospital and length of stay

Background

In Chapter 3, the findings of an analysis of state mandated hospital performance reports it was found that for certain patient populations outcomes of care were affected by mandated reporting. To further explore the effect of mandated reporting on patient outcomes of care, a second study was designed to evaluate national reporting mandates to see if federal mandates were associated with improved outcomes in hospitals regardless of state variations in mandate implementation. The results of this analysis are intended to discriminate between the two forms of mandated reporting, federal versus state mandated reporting, and identify which is more likely to lead to improved hospital performance. Because the analysis of state mandated hospital performance reports in Chapter 3 found mixed effects on patient outcomes, it is important to evaluate whether imposing a national mandate yields an effect on outcomes of care that is not possible with a state mandate. It is not clear if a federal mandate, will in fact, carry a greater influence on health care changes than a state mandate, and this analysis could provide further insight into answering that question. Furthermore, it could provide insight into the level of government that should be used for health policy mandate implementation.

The above questions are important, particularly in the current health care environment wherein the US Department of Health and Human Services is now publicly reporting provider outcomes on the Hospital Compare website

(www.hospitalcompare.hhs.gov).[47] Additionally, with the implementation of the Patient Protection and Affordable Care Act (ACA) and the Medicare Access and CHIP Reauthorization Act of 2015 (MACRA)[48], performance is being tied to payment via the blunt instrument of payment reform, and providers are being incentivized to move into alternative payment models with CMS. Moving forward, the reporting on Hospital Compare will continue to be a useful public resource to help patients understand which hospitals provided the best care over the prior 12 month period, and hopefully to direct patients, payers, or physicians to hospitals that have a high performance. If the market theory and the drafters of the ACA and MACRA are correct, this will create an environment in the hospital care industry that will drive providers to compete by improving their patient outcomes thereby attracting more patients and receiving larger payments. It is unclear if this will happen, and studies such as this may help to motivate hospital responsiveness to public reporting. There are critics to public reporting who feel that patients do not typically choose a hospital based on the hospital performance, but rather on anecdotal evidence or other factors.[49,50] Although the objective of this evaluation is not to test the causal relationship between public reporting and patient choice, it will evaluate part of the causal pathway – i.e., whether public reporting results in better patient outcomes across all hospitals,

[47] The Hospital Compare website and reporting mechanism became publicly available in June of 2007, and included reporting on one year of historical data.
[48] Public Law 114-10, 114th Congress. April 16, 2015.
[49] Magee H, Davis LJ, Coulter A. Public Views on health care performance indicators and patient choice. Journal of the Royal Society of Medicine; 96(7) 2003: 338-342.
[50] Schneider EC, Epstein AM. Use of public performance reports: A survey of patients undergoing cardiac surgery. JAMA. 279 1998:1638-1642.

and help clarify whether public reporting in itself was sufficient to improve patient outcomes.

Methods

To assess the federal-level policy effect, this evaluation used all acute care patients admitted to all hospitals in states with available data to determine if there was a difference in patient outcome measures prior to the federally mandated reporting requirements implemented in 2003 compared post reporting mandate.[51] In the context of the natural experiment literature, the "experiment" was to assess whether patients post 2003 had better outcomes than those prior to 2003. This analysis used the 1988 to 2006 Health Care Cost and Utilization Project National Inpatient Sample data to assess the impact of Federal mandatory reporting requirements. The following empirical model was used to estimate the association between mandated reporting and the probability of dying while in the hospital, and also length of stay (LOS):

$$Y_{(ihjt)} = B_1 + B_2 Pat_{(ihjt)} + B_3 Hos_{(hjt)} + B_4 Ext_{(jt)} + B_5 St\ Man\ Yes_{(jt)} + B_6 Fed\ Mandate\ Yes_{(t)} + B_7 St\ Man\ Yes * Fed\ Mandate\ Yes_{(jt)} + e_{(ihjt)}$$

where $Y_{(ihjt)}$ is the outcome of interest for patient i, in hospital h, in state j, at time t. $Pat_{(ihjt)}$ is a set of patient characteristics for patient i, in hospital h, in state j, at time t, $Hos_{(hjt)}$ is a set of hospital characteristics in hospital h, in state j, at time t, and $Ext_{(jt)}$ represents the external factors in state j at time t that are associated

[51] The year 2003 is used because that is the year that Federally mandated hospital reporting was started under the RHQDAPU system.

with a state's decision to mandate report as identified in Chapter 2. Additionally, 'St Man Yes$_{(jt)}$' equals one if the hospital is in a state with state-mandated hospital reporting at time t and zero otherwise, 'Fed Man Yes$_{(t)}$' equals one if it is post 2003 at time t and zero otherwise, 'St Man Yes *Fed Mandate Yes$_{(jt)}$' equals one if during the post 2003 time frame the hospital was in as state that mandated state reporting, and $e_{(ihjt)}$ is a stochastic error term.

Set of external (Ext) characteristics includes a state fixed effect, number of years the mandate has been in effect in the state, year the patient was admitted, and the average inpatient mortality and LOS at the time of the state mandate implementation, or the average inpatient mortality and LOS at the time of the Federal mandate implementation for those states that did not implement a state mandate prior to 2003. A state fixed effect was included to control for unobserved time-invariant state influences that would be unique to the state that might affect patient outcomes. The number of years a mandate has been in effect was included to test whether the experience of the state under the mandated reporting program had an influence on patient outcomes. The year of admission was included to control for the trend in decreasing mortality and LOS outcomes seen across all hospitals. Finally, the average mortality and LOS for the five years leading up to the implementation of the mandate were incorporated because of the findings in chapter 2 indicated these two patient outcomes may have actually influenced the implementation of state mandates. The average was derived from the data used for the study.

Relevant hospital (Hos) characteristics included number of beds, teaching status, ownership type, region, and rural/urban status. The number of beds or hospital size was included because larger hospitals tend to have a greater volume and take on more complex cases because smaller facilities typically do not have the facilities to deal with them. Likewise teaching hospitals often take in more complex patients and patients that have failed treatment in other facilities, and teaching hospitals also have the unique aspect of using students as a part of the provider team. Ownership was included because public hospitals must take on all patients regardless of their ability to pay, and likewise many non-profit hospitals have missions to do the same, whereas private facilities can be selective about the patients they want to treat. Region was included because regional variation exists not only in patient outcomes, but also in the cost of care.[52] Lastly, the rural or urban location of a facility can indicate a patient's ability to select the hospital they want to go to and also the likelihood of having more tools and technology at that particular facility.

Relevant patient characteristics include age, race, gender, payer type, admission source, admission type, and median household income (mean zip code based). Age was included as age is highly correlated with mortality. Gender was included because males and females have different symptoms with AMI and HF and

[52] Fisher ES, Wennberg DE, Stukel TA, Gottlieb DJ, Lucas FL, Pinder EL. The implications of regional variations in Medicare spending. Part 2: health outcomes and satisfaction with care. Ann Intern Med. 2003 Feb 18;138(4):288-98.

studies have found that females historically have not received equivalent treatment to males for these conditions.[53] Payer type was included as patient treatment may be limited by the type of insurance they have. The admission source and admission type are included as they indicate whether the patient was transferred from other facilities or locations and how urgent the admission was. Lastly, race and income were included as a way to proxy for unknown factors associated with the patient's socioeconomic status and or likelihood of receiving certain types of care.

In implementing this model, the patient outcome measures (Y) included the probability of dying while in the hospital (the likelihood that a patient's discharge status will be recorded as deceased) and length of stay in the hospital (LOS). A linear probability model was used to evaluate the outcomes of interest since marginal effects can be obtained directly from the estimated coefficients.[54]

A Poisson model was used with the LOS measure due to the skewed count data, and average marginal effects and standard errors were estimated for the primary variables of interest. It was hypothesized that patients post 2003 would experience decreases in the probability of dying while in the hospital and LOS.

Given that many of the mandated reporting requirements were focused around acute myocardial infarction (AMI), heart failure (HF) and pneumonia, this analysis will focus on two groups of patients – patients diagnosed with HF and those with

[53] Cardiovascular disease and other chronic conditions in women: Recent findings. AHRQ Pub. No. 12(13)-P011-EF

[54] Norton EC, Wang H, Ai C. Computing interaction effects and standard errors in logit and probit models. Stata Journal. 2004;4:154-67.

AMI. The definitions for these two groups were taken from the Centers for Medicare and Medicaid Services.[55] The pneumonia population has not been used in this analysis as the definition has fluctuated substantially over time, and the use of coded data to define this population adequately has been controversial.[56]

Data

The data used for this study was from the Health Care Utilization Project Nationwide Inpatient Sample (HCUP-NIS). As stated on the webpage for the data:

"The Nationwide Inpatient Sample (NIS) is part of a family of databases and software tools developed for the Healthcare Cost and Utilization Project (HCUP). The NIS is the largest all-payer inpatient health care database in the United States..." [57]

The HCUP-NIS is a nationally representative sample of hospital inpatient stays from across the United States. It includes information about a patient's stay in the hospital, including patient demographics, the diagnosis of the patient and procedures that the patient may have received. The procedures and diagnostic information is provided in the form of codes found in The International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM). The data is commonly referred to as administrative data as it is used to characterize the patients for payment purposes. It is collected by the Agency for Healthcare

[55] http://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HospitalQualityInits/InpatientMeasures.html

[56] Rothberg MB, Pekow PS, Priya A, Lindenauer PK. Variation in Diagnostic Coding of Patients With Pneumonia and Its Association With Hospital Risk-Standardized Mortality Rates: A Cross-sectional Analysis. Ann Intern Med. 2014;160(6):380-388.

[57] http://www.hcup-us.ahrq.gov/nisoverview.jsp

Research and Quality from either state governments or hospital associations in the participating states. It contains a complete census of patients from hospitals that submit the data, and there are no specific restrictions on hospital types or size that submit the data. The database was selected as it was the only nationally representative dataset that spanned both the timeframe required and the states necessary to do this analysis. Other datasets were considered such as the National Hospital Discharge Survey, the Medicare data found in the MedPar dataset, commercial datasets, such as the Premier data, Truven data, and several others; however, the aforementioned datasets either did not cover the required timeframe, did not have the outcomes that were required, or they didn't have a comprehensive coverage of the age groups or states necessary.[58] Appendix B has several tables describing the population from the HCUP NIS data set used in this analysis, and additional interpretation can be found in Chapter 3 Results.

Results

The results seen in the summary Table 4.1 below show that there was a statistically significant impact of reporting mandates on both mortality and length of stay for both the AMI and HF patients, however, interpretation of the results requires considering more than just one variable given the multiple levels of mandates Full model results can be found in Appendix A in Tables A7-A10.

[58] To be sure, there are limitations to the HCUP – NIS data. It does not have data from every state in the US, each state has varying time frames for which it supplies data, and the number of data elements available is not equivalent across the states that supply data. There are 38 states with data used in this analysis.

Table 4.1 Summary table of Federally mandated public reporting marginal effect on mortality and LOS in acute myocardial infarction (AMI) and heart failure (HF) patients

	Federal mandate models*			
	Probability of dying		Length of Stay	
Variable	**HF**	**AMI**	**HF**	**AMI**
Pure state mandate effect (i.e., no federal effect)	-0.0041^	-0.0039^	-0.7784^	-0.5081^
Pure federal mandate effect (i.e., no state effect)	0.0045^	0.0123^	0.8410^	1.1270^
Total federal mandate effect	0.0063^	0.0181^	0.1361^	0.2248^
Total state mandate effect	-0.0023^	0.0019^	-0.0709^	0.0139^
Total effect of any mandated reporting	0.0022^	0.0142^	0.0366^	0.1592^
** p<0.05, **p<0.01, ^p<0.001*				

*Model variables include: sex, age groups, control of hospital, admission type, race, admission source, payer type, rural/urban teaching/non-teaching, region, bed size of facility, patient income, year of admission, years of experience with state mandates, state 5 year average length of stay leading up to the admission, state 5 year average mortality rate leading up to the admission, state mandate flag, federal mandate flag, both federal and state mandate

To assess the increase or decrease in the probability of dying while in the hospital and the LOS the marginal effects were calculated to determine the pure state mandate effect, the pure federal mandate effect, the total federal mandate effect, the total state mandate effect and the total effect of any mandated reporting. The pure state and pure federal effects only consider the effect of each respective mandate without the other mandate having been in effect. The total federal effect included any patient when the federal mandated reporting was in effect, regardless of whether the state mandate was in effect. Likewise, the total state effect included patients in all states where a state reporting mandate was in effect, regardless of whether the federal mandate was in effect. Lastly, the total

effect of any mandated reporting included all patients when any mandate was in effect, whether it was state mandated reporting or federally mandated reporting.

Among the 13,897,356 HF patients the overall inpatient mortality rate in the HCUP data used in this study was 8.7%. It appeared that the marginal effect was statistically significant for each mandate and the combination of the mandates, however the directionality of the mandate effect varied. Both the pure state mandate effect (-0.41 percentage point, $p<0.001$) and the total state mandate effect (-0.23 percentage point, $p<0.001$) were associated with small size reductions in the probability of dying while in the hospital, which would equate approximately 57,000 and 32,000 fewer patients dying, respectively in the database used for this study. Conversely, the pure federal mandate, the total federal mandate and the total effect of any reporting were associated with an increase in the probability of dying while in the hospital.

As seen in Appendix A, Table A7, there are other variables that appear to be significantly associated with percentage point increases or decreases in the probability of dying. The most notable appear to have been an increase associated with an admission type of trauma (3.18, $P<0.001$) relative to elective admissions; an admission source of another hospital (3.89, $p<0.001$) and admission source of another facility including long term care (5.75, $p<0.001$) relative to routine/birth/other. Having had an admission type of other (-4.17,

p<0.001) relative to elective was a notable variable with a statistically significant percentage point decrease.

Overall, the inpatient mortality rate was higher (13.6%) among AMI patients, and similar findings were seen among the 4,303,593 AMI patients in this study. However, only the pure state mandate effect (-0.39, p<0.001) was significantly associated with a percentage point reduction in in the probability of dying while in the hospital. The margin represents approximately 17,000 fewer patients dying while in the hospital respectively. As with the HF patients, the pure federal mandate effect, the total federal mandate effect and the total effect of any reporting were associated with statistically significant percentage point increases in the probability of dying. The pure federal mandate effect (1.23, p<0.001), the total federal mandate effect (1.18, p<0.001), and the total effect of any reporting (1.62, p<0.001) were much stronger than was seen in the HF population and would have represented approximately 53,000, 78,000, and 70,000 more patients dying respectively.

Other variables that were found to be statistically significant can be found in Appendix A, Table A8. Four of the most notable variables that are associated with a percentage point increase in the probability of dying in the hospital were being age 65+ (10.53, p<0.001) relative to age 18-45 years; having had an admission type of trauma (8.65, p<0.001) relative to elective admission; and having had a payer type of Medicare (3.77, p<0.001) or Medicaid (3.62, p<0.001)

relative to a private payer. Additionally, there were three notable variables with statistically significant percentage point decreases in the likelihood of dying while in the hospital - Admission type of newborn (-1.77, p<0.001) and admission type of other[59] (-2.62, p<0.001), and having had an admission source of another hospital (-3.39, p<0.001).

With regard to the LOS among the 13,911,446 HF patients in the HCUP data used in this study the average LOS was 11.64 days. The pure state mandate average marginal effect (-0.78, p<0.001) and the total state mandate average marginal effect (-0.07, p<0.001) were both statistically significantly associated with a decrease in the LOS. The pure federal mandate, total federal mandate, and total effect of any reporting were all associated with significant increases in LOS. The pure federal mandate marginal effect was associated with the largest marginal LOS change with an increase of 0.84 days.

The full regression model used for the HF LOS analysis can be found in Appendix A, Table A9. A few of the larger coefficients in the Poisson regression model were an admission source of another hospital (0.4217, p<0.001) relative to routine/birth/other, having been admitted to an urban teaching hospital (0.2569, p<0.001) relative to a rural hospital, and having been admitted in the northeast region (0.2539, p<0.001) of the United States relative to the south region. The largest coefficient associated with a decrease in HF LOS besides the state only

[59] Admission type of "other" means it was not classifiable into common categories, but was not missing.

mandate effect was having had an admission type of urgent (-0.0794, p<0.001) relative to an elective admission type.

Among the 4,306,377 AMI patients included in the study of LOS, the average LOS was 9.93 days. In this patient population, only the pure state mandate marginal effect (-0.51, p<0.001) was statistically significantly associated with a decrease in LOS. The pure federal mandate, the total federal mandate, the total state mandate, and the total effect of any mandated reporting were all associated with statistically significant increases in LOS among AMI patients in the data used for this study. Of note, the pure federal mandate marginal effect (1.13, p<0.001) was associated with an increase of larger than one day.

The full Poisson regression model used in the analysis of AMI LOS can be found in Appendix A, Table A10. There were many notable variables with coefficients that had associations with significant increases in LOS. Among them were being age 65+ (0.3573, p<0.001) relative to age 18-45 years, having had a payer type of Medicaid (0.3095, p<0.001) relative to private payers, and having been admitted to an urban teaching hospital (0.4224, p<0.001) relative to a rural hospital. In addition, having had an admission type of newborn (-0.2350) was a coefficient that was associated with a statistically significant decrease in AMI LOS.

Discussion

Using HCUP data, we find that for the patients in the data used for this study, state level mandated reporting of hospital level outcomes were able to improve patient outcomes and appear to be more effective than the federal mandate. In fact, the federal mandate on its own and when it was in effect where there were state mandates appeared to lead to worse outcomes. In addition, when a federal mandate is implemented at the same time as state level mandates it appeared to erase the effects of any positive impact seen with the state mandate among AMI patients. This was not the case for HF patients, which maintained some positive effect from the state mandate, however it was diminished with the federal mandate implementation. . Lastly, based on the results it doesn't appear that implementing any mandated reporting, regardless of the level the mandate is implemented, will be an effective strategy to substantially improve outcomes of the probability of dying or LOS while in the hospital.

The results of this study point to the need to carefully consider how mandates are implemented and at what level they will be effective.[60,61,62] The results also suggest that there may be a greater effect if mandates are implemented at a local or regional levels. While there is controversy over the idea of the effectiveness of publicly reporting healthcare outcomes at the Federal level, there

[60] Sonfield A, Gold RB, Frost JJ, Darroch JE. US insurance coverage of contraceptives and the impact of contraceptive coverage mandates, 2002. Perspect Sex Reprod Health. 2004 Mar-Apr;36(20): 72-9.
[61] Karpman M, Long SK, Bart L., The Affordable Care Act's marketplaces expanded insurance coverage for adults with chronic health conditions. *Health Aff (Millwood)*. 2018 Apr;37(4):600-606. doi: 10.1377/hlthaff.2017.1505
[62] Gil JA, Goodman AD, Kleiner J, Kamal RN, Baker LC, Akelman E. The Affordable Care Act Decreased the proportion of uninsured patients in a safety net orthopaedic clinic. *Clin Orthop Relat Res.* 2018 May;476(5):925-931. doi: 10.1007/s11999.0000000000000078.

have been studies showing that it can be effective particularly at improving processes of care or helping patients gain access to care.[63,64]

As indicated in the results, the marginal impact of the state mandated reporting had significant impacts on the number of patients that avoided dying while in the hospital and reduced the LOS significantly. The greatest effects were seen with the state mandate implementation on its own. This finding is interesting given that there has been such a heavy focus in the past five to ten years on implementing federal mandates to improve outcomes of care.[65] It calls into question whether that is the most effective way to improve patient outcomes, and suggests this is still a ripe area for further study, especially as some states are implementing healthcare programs on their own through Medicare or Medicaid via state waiver programs.[66] If this study is any indication, allowing the state waivers to continue to implement changes at the state level may turn out to be the more effective approach compared to the national CMS program.

With regard to the metrics used for this study, there has long been a push to use balanced scorecards in hospitals and health systems to ensure the total care of the patient and organization are considered in daily management.[67] The use of

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[63] Lindenauer PK, Remus D, Roman S, Rothberg MB, Benjamin EM, Ma A, Bratzler, DW. Public Reporting and Pay for Performance in Hospital Quality Improvement. N Engl J Med 2007:356:486-496.
[64] Courtemanche Ch, Marton J, Ukert B, Yelowitz A, Zapata D. Early impacts of the Affordable Care Act on health insurance coverage in Medicaid expansion and non-expansion states. *J Policy Anal Manage.* 2017 winter;36(1):178-210.
[65] Patient Protection and Affordable Care Act, 42, U.S.C. § 18001. et seq. (2010).
[66] Social Security Act § 223(e), 42 U.S.C. § 423(e). sections 1915(b), 1915(c), 1115
[67] Castaneda-Mendez K, Mangan K, Lavery AM. The role and application of the balanced scorecard in healthcare quality management. *J Healthc Qual.* 1998 Jan-Feb;20(1): 10-3.

LOS and probability of dying metrics offered a balanced assessment of the effect of mandates for public reporting and should have identified where providers were perversely incentivized to provide poor outcomes of care through sacrificing one metric to improve on another. The relationship between mortality and LOS can be interesting given that patients who are sicker will not only have a greater chance of dying, but if you keep them alive it will likely extend the LOS. However, if a sicker patient dies quickly it may perversely improve the LOS metric. Clearly this was not the finding in this study, as the results for LOS and the probability of dying tracked well with one another and were directionally consistent, strengthening the findings.

From a policy perspective the results in this study appear to indicate that there is indeed a place for state level mandates, to help improve patient outcomes, however, implementation of reporting mandates at the federal level must be used with caution. It is not entirely clear why the federal mandates had no positive effect on patient outcomes. However, it may be that states have been able to tailor their mandated reporting policies to fit their state marketplace better. Or states may have been able to focus their publicity campaigns around publicly reported outcomes better and were able to craft messages to reach their respective target populations better. Whatever it may have been, it was clear in this study that state mandates requiring publicly reported hospital performance were a more effective method than similar requirements implemented at the federal level.

Limitations

The data used for this analysis was based on administrative coded data which was originally used for the purposes of billing, therefore, it was not collected specifically to study the mandated reporting effect and may not have adequately captured the clinical conditions of interest. However, administrative data such as the HCUP data used for this study has been used in hundreds of studies to measure the change in healthcare over time and has been shown to be a consistent and accurate method of evaluating care.

As mentioned earlier another potential limitation is the potential to have an insufficient risk adjustment for the outcomes of interest. This was addressed by including many variables in the regression models to control for factors that were known to be associated with the outcomes of interest in an effort to control for patient risk, however, there were limitations to the data and the amount of information about the patient that can be drawn from administrative data.

An additional limitation to hospital administrative data is the lack of visibility into the patient status post discharge. This is important to note given that the measure of mortality used in this study was restricted to the patient stay and the measure itself was based on the discharge code indicating died. Therefore, the patient may have died soon after discharge and the data used for this study would not have captured that death.

Lastly, there was a limited timeframe (three years) captured about the federally mandated hospital reporting. While it was felt this should have been sufficient to see a change in performance and there was an attempt made to control for the experience with reporting, it is still possible that with additional experience of federally mandated reporting there may have been improvements in patient outcomes similar to that seen in the state level mandated reporting.

Chapter 5: Summary and conclusions

The focus of this dissertation was on hospital level-reporting mandates at both the state and federal levels, and whether there have been demonstrative improvements in health care quality and efficiency due to their implementation.

As discussed in Chapter 1, while many states have required public reporting of hospital outcomes for years, there has not been consistency across states on the time frame in which reporting has been required. In July of 2003 the Federal Government joined many states and required facilities to publicly report outcomes to be eligible for participation in Medicare payment plans. As with state-mandated public reporting, there was a hope that a federal program requiring public reporting of hospital performance would spark competition among hospitals that would in turn lead to improved care for patients because patients would select superior-performing hospitals for their care Subsequently, under the 2005 Deficit Reduction Act (Section 5001(a)), the Centers for Medicare and Medicaid Services (CMS) began requiring the use of reporting methods in order to implement a system of payments based on performance – Value Based Purchasing – that took effect in 2008. Despite the many challenges and much push back from providers, it went into effect, and with the more recent implementation in 2010 of the Patient Protection and Affordable Care Act (ACA) and in 2015, the Medicare Access and CHIP Reauthorization Act (MACRA)[68], there has been an introduction of additional layers of performance measurement tied to payment. Today hospital providers are faced with payments that are

[68] Public Law 114-10, 114th Congress. April 16, 2015.

based on several publicly reported outcomes of care. As previously stated, it is not clear that public reporting alone led to improved patient outcomes of care, and there certainly has been no causal pathway demonstrating the link from the mandated reporting to improved care.[69,70] However, the results found in this dissertation further contribute to disentangling the association between improved patient outcomes associated with mandated reporting at the state and federal level when both are required.

To determine the effects of mandated reporting, an observational data set was used to study the change in patient outcomes over time relative to the implementation of reporting mandates at both the state and federal levels. As part of the effort to identify whether either the state or federal mandates were associated with improved outcomes, it was important to determine whether there could have been endogenous factors not directly captured in the data and modeling that would have led to associations between mandated reporting and improved patient outcomes. In the case of this dissertation, it may have been that prior experience with the performance in the measures of interest (probability of dying and length of stay) of hospitals, or other unknown factors could have led to implementation of mandated reporting. Had that been the case, estimates of an

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[69]Epstein AJ. Do cardiac surgery report cards reduce mortality? Assessing the evidence. *Med Care Res Rev.* 2006 Aug;63(4):403-26; Epstein AJ.; Hospital report cards: intent, impact, and illusion. *Am J Med Qual.* 2004 Sep-Oct;19(5):183-92..

[70] E.L. Hannan et al., "Improving the Outcomes of Coronary Artery Bypass Surgery in New York State," *Journal of the American Medical Association* 271, no. 10 (1994): 761–766; E.D. Peterson et al., "The Effects of New York's Bypass Surgery Provider Profiling on Access to Care and Patient Outcomes in the Elderly," *Journal of the American College of* ***Cardi****ology* 32, no. 4 (1998): 993–999.; Guru V, Fremes SE, Naylor CD, Austin PC, Shrive FM, Ghali WA, Tu JV; Cardiac Care Network of Ontario. *Am Heart J.* 2006 Sep;152(3):573-8; Andrew M Ryan, Jan Blustein, Tim Doran, Marilyn D Michelow, Lawrence P Casalino Health Serv Res. 2012 Aug; 47(4): 1418–1436.

association between the mandate and reporting would have led to biased estimates because unknown or unobserved factors may have been the cause of the change in performance over time. Therefore, in Chapter 2 an analysis following a previously published article by Stream (1999) was completed at the state level to identify variables that would be associated with a state's decision to implement mandated reporting.[71]

The findings indicated that several factors should be considered to control for potential endogeneity in modeling the association between state mandated reporting and patient outcomes. Specifically, the average patient length of hospital stay leading up to mandate implementation, state fiscal margin, and possibly the average hospital-level inpatient mortality leading up to the implementation of a mandate were potential endogenous factors. They were considered for inclusion in the subsequent models of patient outcomes. However, given the limitations in the analysis, particularly the small sample size for the analysis, it was unclear if there was a true association between these variables and mandated public reporting implementation.

Although the findings in Chapter 2 may have been questionable, a decision was made to take a conservative approach to modeling the effects of state-mandated reporting on outcomes of the probability of dying while in the hospital and the length of a patient stay (LOS) in the hospital. Therefore, in the study described in

[71] Stream, C. Health reform in the states: A model of state small group health insurance market reforms. *Political Research Quarterly*. 52 (3); Sep. 1999: 499-525.

Chapter 3 the average state level inpatient mortality and average state level LOS leading up to the state mandate were included in the model.

In developing the approach for evaluating the state level mandated reporting effect described in Chapter 3, several steps were taken to ensure patient outcomes were comparable across states. First, a large national database (Hospital Cost and Utilization Project - National Inpatient Sample) was used to ensure sufficient information and patient observations would be available to detect statistical differences among Acute Myocardial Infarction (AMI) and heart failure (HF) patients. Second, the patient cohorts were chosen from this data because they were consistent patient cohorts used in public reporting across states. Third, risk factors associated with patient outcomes were incorporated at the state level, the hospital level, and the patient level to control for known factors associated with variation in outcomes. Fourth, various modeling techniques were attempted to adjust for the nature of the data and their distributions. In the end two regression models, a Poisson model for LOS and a linear probability model for the probability of dying while in the hospital were selected.

Findings in Chapter 3 indicated that implementing state level mandated public reporting was associated with decreases in the probability of dying while in the hospital and the patient LOS while in the hospital for both AMI and HF patients. Because inpatient mortality happens in approximately 14 percent of AMI patients and 9 percent of HF patients, the decrease of 0.25 and 0.36 percentage points

does not appear be a large effect, however, mortality is a relatively rare and highly consequential event so even a small effect is meaningful. Conversely, the LOS only decreased by less than one quarter of a day in both cohorts, which is less meaningful in the world of hospital care where patient stays are measured in full day increments. As indicated previously, the findings underscore the notion that transparency in performance-based improvement activities can contribute to improvements in overall care.[72] It is important to note that similar to previous studies looking at the relationship between public reporting and patient outcomes, there was no causal pathway established in this study that directly connects the mandated reporting to improved outcomes.[73, 74] However, given the intense debates around the aforementioned implementation of the deficit reduction act and value-based purchasing, it is at least important to see that there does not appear to be a perverse effect associated with state level public reporting. Indeed, there may be some positive value for patients, but further analyses on data that is generated through a randomized trial or data that will allow for more complex natural experiment model (e.g., a difference- in-differences analysis) is needed to make the leap from association to causation.

While evidence in Chapter 3 suggested that mandates at the state level were associated with improved patient outcomes for AMI and HF patients, it was not

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[72] Crimmins MM, Lowe TJ, Barrington M, Kaylor C, Phipps T, Le-Roy C, Brooks T, Jones M, Martin J. QUEST: A data driven collaboration to improve quality, efficiency, safety, and transparency in acute care. *The Joint Commission Journal on Quality and Patient Safety.* 42(6) June 2016:247-253(7).

[73] Rothberg MB, Morsi E, Benjamin EM, Lindenauer PK. Choosing the Best Hospital: The Limitations of Public Reporting of Hospital Quality. Health Affairs 2008;27(6):1680-87

[74] Rothberg MB, Pekow PS, Priya A, Lindenauer PK. Variation in Diagnostic Coding of Patients With Pneumonia and Its Association With Hospital Risk-Standardized Mortality Rates: A Cross-sectional Analysis. Ann Intern Med. 2014;160(6):380-388.

clear if application of a similar mandate at the national level would lead to the same findings. To that end, the analysis of Chapter 4 examined the implementation of public reporting required by CMS beginning in 2003 and whether that was also associated with better patient outcomes. This observational study used a similar approach to the study described in Chapter 3, including the use of the same data source, same definitions for patient cohorts, and similar regression modeling. The primary difference was the inclusion of a federal mandate variable that indicated the years in which the federal mandate was in place. This variable was also interacted with the state mandate variable to parse out the effect of the state mandate, the effect of the federal mandate, and the effect of implementing any mandate on patient outcomes.

The findings of the study in Chapter 4 indicated that state-level mandated reporting of hospital-level outcomes was associated with improved patient outcomes and the federal mandate was associated with worse outcomes. Also, the implementation of the federal mandate when a state mandate was in place erased much or all of the positive impact of the state mandate. Additionally, the findings for a variable that captured the implementation of any mandate, regardless of state or federal level, didn't appear to be associated with improved outcomes.

There were limitations associated with using administrative coded inpatient data in Chapters 3 and 4 restricting clinical knowledge about patients and confining

the analysis to the hospital inpatient stay. However, given the combined findings in both chapters, it would appear that state-level mandated reporting could be an effective but blunt instrument to change hospital patient outcomes of care. Unfortunately, there is no additional contribution to positive outcomes of federal mandate implementation subsequent to the implementation of state-level. It appears to suggest that the state mandate can potentially be used effectively to implement policy changes but federal health mandates cannot. Of course, this study only provides evidence that this might be effective in changing outcomes for hospital patients present in the HCUP data with AMI and HF, and a larger body of evidence would be required to make a more general statement about state and federal mandate effects. More specifically, it would be prudent to evaluate the effect of the federal mandate after several more years post implementation.

As a concluding statement, this dissertation attempted to evaluate the value of mandated hospital-level reporting of patient outcomes from care at both the state and Federal level using a natural experiment and administrative data. The findings were limited to patients in the HCUP-NIS, which is a national multistate database, but from a policy perspective, the results should add to the evidence supporting transparency in performance as a way to encourage hospital providers to improve care. The novel portion of this work was the evidence suggesting that only state mandated reporting is an effective way for policy

makers to incentivize change, and there is a potential for perverse outcomes if the mandate is implemented at the wrong level of government.

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APPENDIX A

Table A1. Heart failure mortality rates by state by year for the study population

	Year																			
State	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Mean**
AR																	5.89%	6.91%	5.71%	6.17%
AZ		9.84%	9.19%	7.93%	8.18%	7.56%	6.24%	5.77%	5.74%	6.33%	5.84%	6.45%	5.71%	4.89%		4.38%	4.82%	5.25%	3.88%	6.35%
CA	11.26%	10.98%	10.48%	10.20%	9.88%	9.22%	8.55%	8.48%	8.27%	8.21%	8.36%	7.81%	7.85%	8.17%	7.58%	7.80%	7.61%	7.50%	7.18%	8.71%
CO	9.77%	9.16%	8.93%	8.25%	7.52%	7.04%	7.35%	7.88%	7.26%	6.43%	6.27%	6.61%	5.55%	5.83%	5.22%	5.40%	6.34%	4.74%	5.45%	6.89%
CT						9.50%	9.48%	9.13%	9.73%	8.54%	9.18%	7.30%	8.11%	9.43%	8.91%	7.21%	7.55%	6.45%	6.62%	8.37%
FL	11.64%	11.39%	10.85%	10.16%	10.04%	9.78%	9.24%	8.68%	8.11%	7.84%	7.84%	7.86%	7.43%	7.27%	6.89%	6.98%	6.12%	5.80%	6.08%	8.42%
GA										7.43%	7.28%	7.83%	7.01%	6.64%	6.34%	6.31%	5.95%	5.62%	5.66%	6.61%
HI										7.85%	3.77%	10.72%	10.55%	10.58%	9.99%	10.30%	8.05%	8.25%	10.01%	9.01%
IA	11.65%	10.99%	10.29%	10.00%	8.96%	9.58%	8.60%	8.24%	8.06%	7.60%	7.29%	8.09%	7.45%	7.42%	6.68%	4.76%	6.45%	5.42%	4.88%	8.02%
IL	10.05%	9.58%	8.79%	8.43%	8.01%	7.88%	7.59%	7.46%	7.23%	6.77%	6.86%	6.74%	6.46%	5.93%	5.76%	5.69%	5.36%	5.29%	5.12%	7.10%
IN																6.26%	5.36%	5.99%	5.15%	5.69%
KS						8.89%	8.81%	8.64%	7.86%	8.01%	7.56%	6.77%	7.56%	7.64%	6.99%	5.89%	5.91%	6.27%	5.76%	7.33%
KY													6.73%	6.28%	6.71%	6.17%	5.60%	5.29%	5.51%	6.04%
MA	12.79%	12.05%	11.42%	10.26%	9.98%	9.51%	8.97%	8.48%	8.29%	7.75%	7.21%	7.78%	7.86%	7.31%	6.94%	7.11%	6.57%	6.44%	6.42%	8.59%
MD						9.03%	8.80%	8.30%	7.80%	7.36%	6.96%	7.11%	6.67%	6.49%	6.29%	6.54%	5.45%	5.48%	4.81%	6.93%
ME												7.99%	8.12%	7.83%	7.39%					7.83%
MI														6.01%	5.84%	6.13%	5.43%	5.51%	5.27%	5.70%
MN														6.32%	5.99%	5.22%	5.54%	4.99%	4.75%	5.47%
MO								8.29%	7.83%	7.46%	7.74%	7.66%	7.71%	6.55%	6.72%	6.35%	5.59%	6.64%	6.34%	7.07%
NC													7.57%	7.53%	6.96%	6.45%	6.24%	6.55%	5.91%	6.74%
NE														6.83%	6.63%	7.28%	5.69%	6.27%	5.28%	6.33%
NH																5.95%	7.15%	7.85%	7.03%	6.99%
NJ	13.90%	14.24%	13.74%	13.22%	12.29%	8.74%	10.88%	10.46%	10.18%	8.73%	9.62%	8.83%	8.90%	8.32%	8.07%	7.37%	7.27%	7.05%	6.36%	9.90%
NV															7.91%	6.88%	8.51%	7.67%	8.30%	7.86%
NY						12.47%	11.25%	11.74%	10.92%	10.16%	10.19%	9.74%	9.19%	8.71%	9.23%	9.07%	8.84%	8.85%	7.67%	9.86%
OH															6.34%	5.54%	5.01%	4.81%	4.58%	5.26%
OK																		6.50%	6.42%	6.46%
OR						7.38%	7.31%	7.33%	7.13%	6.97%	6.19%	6.59%	6.41%	6.62%	6.75%	6.48%	6.57%	6.55%	6.04%	6.74%
PA		10.40%	10.23%	9.60%	8.95%	8.65%	7.91%	8.16%	7.86%	7.31%	6.60%	7.05%	6.70%	6.50%	6.64%	5.78%				7.89%
RI														7.22%	6.56%	8.15%	6.82%	7.56%	7.66%	7.33%
SC						9.58%	8.92%	8.67%	7.47%	7.97%	7.38%	7.09%	7.44%	7.16%	6.91%	7.12%	6.08%	6.78%	5.93%	7.47%
SD															6.68%	4.29%	5.81%	5.65%	5.57%	5.60%
TN								8.20%	8.25%	7.73%	8.04%	7.77%	7.65%	7.25%	7.11%	6.74%	6.68%	6.63%	6.20%	7.35%
TX													6.97%	7.01%	6.61%	6.22%	5.93%	6.05%	5.71%	6.36%
UT										7.11%	6.94%	6.12%	5.08%	7.02%	6.56%	6.45%	5.84%	4.77%	6.06%	6.19%
VA												7.40%	6.34%	7.15%	7.57%	7.20%	6.80%		6.62%	7.01%
VT														6.02%	6.46%	5.93%	8.89%	8.68%	7.48%	7.24%
WA	9.71%	9.06%	8.62%	7.78%	7.60%	7.43%	7.83%	7.74%	7.21%	6.80%	6.83%	7.26%	7.53%	7.09%	6.65%	7.46%	5.84%	6.60%	6.34%	7.44%
WI		10.07%	9.48%	8.68%	8.34%	8.19%	8.06%	7.92%	7.52%	7.34%	6.95%	6.84%	6.79%	6.98%	6.30%	6.10%	5.45%	5.43%	5.24%	7.31%
WV													6.57%	6.40%	6.30%	6.35%	5.82%	6.12%	5.99%	6.22%
Mean	11.34%	10.71%	10.18%	9.50%	9.07%	8.85%	8.58%	8.40%	8.04%	7.62%	7.31%	7.56%	7.28%	7.10%	6.93%	6.52%	6.35%	6.33%	6.08%	7.47%

Table A2. AMI mortality rates for the study population by state by year

										Year										
State	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Mean**
AR																	11.78%	12.82%	9.51%	11.37%
AZ		13.23%	12.67%	10.20%	13.24%	12.86%	10.59%	9.56%	7.56%	9.19%	10.20%	10.03%	8.44%	8.62%		8.28%	8.03%	9.84%	7.75%	10.02%
CA	14.99%	14.18%	14.19%	13.31%	12.79%	12.67%	11.91%	11.97%	11.23%	11.01%	11.55%	12.00%	11.76%	12.90%	12.52%	12.21%	11.96%	11.73%	12.37%	12.49%
CO	11.65%	10.46%	11.71%	12.63%	10.74%	9.08%	10.65%	9.98%	11.26%	10.58%	8.59%	9.77%	9.03%	9.72%	7.94%	8.14%	9.84%	8.54%	8.96%	9.96%
CT						12.15%	11.96%	10.06%	11.49%	11.27%	12.10%	10.54%	11.59%	10.85%	11.46%	10.17%	10.84%	10.11%	11.00%	11.11%
FL	15.93%	15.37%	15.52%	15.40%	14.52%	14.07%	13.00%	12.27%	11.53%	11.26%	12.05%	12.12%	11.04%	11.80%	10.60%	11.06%	11.32%	9.87%	10.42%	12.59%
GA										10.28%	11.55%	11.77%	10.54%	10.59%	8.66%	9.32%	9.68%	10.49%	10.11%	10.30%
HI										11.31%	11.74%	16.61%	18.24%	14.31%	15.32%	17.31%	15.72%	15.62%	15.92%	15.21%
IA	17.93%	15.84%	15.78%	15.10%	14.70%	14.01%	12.94%	12.50%	11.65%	12.02%	12.27%	11.27%	11.04%	11.80%	11.49%	6.89%	11.57%	8.93%	8.44%	12.43%
IL	15.60%	15.89%	16.15%	15.19%	15.11%	13.71%	13.43%	12.48%	11.77%	12.76%	11.93%	12.24%	11.73%	11.83%	12.04%	10.43%	10.84%	11.45%	9.56%	12.85%
IN																9.72%	9.48%	10.71%	8.57%	9.62%
KS						14.51%	12.63%	14.28%	12.55%	12.29%	13.71%	11.83%	12.18%	12.66%	12.99%	11.07%	12.35%	10.27%	9.28%	12.33%
KY													9.26%	11.17%	10.12%	11.96%	11.06%	9.09%	7.85%	10.07%
MA	15.73%	15.50%	15.13%	13.82%	13.52%	13.17%	12.54%	11.09%	10.80%	10.71%	9.93%	10.53%	10.55%	10.36%	10.52%	10.90%	10.05%	10.09%	9.21%	11.80%
MD						12.10%	11.91%	11.66%	11.36%	10.58%	10.13%	11.37%	10.70%	10.58%	10.77%	11.11%	11.99%	11.25%	9.55%	11.08%
ME												8.88%	11.15%	10.48%	10.44%					10.24%
MI														10.29%	10.65%	11.82%	10.96%	10.77%	10.05%	10.76%
MN														8.72%	10.15%	7.01%	8.63%	7.91%	7.10%	8.25%
MO								13.99%	13.84%	13.23%	13.81%	13.11%	13.63%	14.05%	12.28%	11.39%	11.15%	11.29%	10.47%	12.69%
NC													10.89%	10.24%	10.71%	10.65%	9.64%	10.20%	10.45%	10.40%
NE														9.22%	11.38%	9.34%	11.82%	9.03%	7.00%	9.63%
NH																7.79%	9.46%	8.67%	7.13%	8.26%
NJ	17.44%	17.92%	17.75%	16.54%	15.69%	14.41%	12.82%	12.39%	11.98%	13.37%	11.25%	13.24%	11.99%	11.84%	11.85%	11.82%	10.57%	12.74%	10.93%	13.50%
NV															10.70%	9.46%	12.50%	12.89%	12.76%	11.66%
NY						14.84%	13.34%	13.52%	13.11%	11.91%	13.13%	12.77%	13.25%	11.81%	12.16%	13.46%	13.33%	12.68%	12.62%	13.00%
OH															10.51%	9.83%	8.85%	8.53%	8.42%	9.23%
OK																		13.49%	11.69%	12.59%
OR						10.67%	12.10%	10.70%	10.48%	8.90%	9.30%	9.72%	9.60%	9.51%	8.85%	10.07%	8.90%	10.98%	8.66%	9.89%
PA		14.69%	14.36%	13.96%	13.64%	12.59%	11.61%	11.30%	10.89%	11.30%	10.66%	11.87%	11.32%	10.93%	11.33%	10.23%				12.04%
RI														9.80%	15.56%	12.35%	13.54%	14.32%	17.74%	13.88%
SC						12.76%	12.18%	13.86%	12.57%	12.85%	11.95%	12.97%	12.16%	11.48%	13.04%	12.00%	10.96%	11.73%	10.54%	12.22%
SD															9.57%	13.18%	9.98%	18.63%	11.58%	12.59%
TN								11.30%	11.91%	11.76%	11.73%	11.98%	10.80%	10.97%	12.17%	9.52%	12.13%	9.85%	9.32%	11.12%
TX													11.64%	11.42%	11.30%	11.07%	10.54%	11.16%	9.63%	10.97%
UT										9.08%	7.46%	9.05%	10.70%	9.73%	7.89%	8.14%	8.14%	8.58%	9.52%	8.83%
VA												10.03%	7.40%	9.58%	10.95%	9.75%	10.09%		9.12%	9.56%
VT														11.21%	10.63%	9.07%	10.68%	9.83%	9.79%	10.20%
WA	13.07%	11.66%	11.05%	11.02%	11.24%	11.48%	12.30%	11.63%	10.15%	9.78%	9.90%	10.57%	10.79%	10.13%	10.13%	11.01%	9.81%	9.69%	9.24%	10.77%
WI		14.60%	15.18%	14.03%	12.97%	12.13%	12.47%	11.49%	11.47%	11.16%	10.98%	10.76%	11.82%	10.82%	11.55%	9.77%	10.82%	10.32%	8.66%	11.72%
WV													11.76%	10.59%	8.75%	10.57%	10.70%	8.50%	12.96%	10.55%
Mean	15.29%	14.48%	14.50%	13.75%	13.47%	12.78%	12.26%	11.90%	11.45%	11.21%	11.18%	11.46%	11.25%	10.91%	11.06%	10.48%	10.80%	10.88%	10.10%	11.47%

Table A3 Heart Failure mortality linear probability model

Source	SS	df	MS	Number of obs	=	10046482
		F(51, 10046430)	=	2342.14		
Model	9943.643	51	194.9734	Prob > F	=	0
Residual	836323.1	10046430	0.083246	R-squared	=	0.0118
		Adj R-squared	=	0.0117		
Total	846266.7	10046481	0.084235	Root MSE	=	0.28852

Died in hospital	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
Sex	-0.01183	0.000185	-64.06	0	-0.01219	-0.01147
Age 45-64 yrs	0.00831	0.000583	14.25	0	0.007167	0.009453
Age 65+ yrs	0.051809	0.000589	88	0	0.050655	0.052963
Age 18-45 yrs	0	(omitted)				
Government owned hospital	-0.00023	0.000326	-0.72	0.474	-0.00087	0.000406
Private non-profit	-0.00014	0.000297	-0.46	0.643	-0.00072	0.000444
Admission type emergency	0.028708	0.000359	79.93	0	0.028004	0.029412
Admission type urgent	0.012178	0.000342	35.63	0	0.011508	0.012848
Admission type newborn	0.014202	0.008811	1.61	0.107	-0.00307	0.031471
Admission type trauma	-0.00095	0.01808	-0.05	0.958	-0.03639	0.034486
Admission type other	-0.03831	0.003735	-10.26	0	-0.04563	-0.03099
Admission type na	0.022461	0.000494	45.47	0	0.021493	0.023429
Race black	-0.0176	0.000355	-49.53	0	-0.0183	-0.0169

Race other	-0.0042	0.00046	-9.15	0	-0.00511	-0.0033
Admission source ER	0.01413	0.000255	55.37	0	0.013629	0.01463
Admission source another hospital	0.037301	0.000455	82.05	0	0.03641	0.038192
Admission source another facility including long term care	0.060125	0.000567	105.99	0	0.059013	0.061237
Admission source court of law	0.005097	0.005577	0.91	0.361	-0.00583	0.016029
Admission source na	0.014703	0.000536	27.43	0	0.013653	0.015753
Payer Medicare	0.005325	0.000298	17.89	0	0.004741	0.005908
Payer Medicaid	0.002624	0.000484	5.42	0	0.001675	0.003572
Payer self-pay	0.004195	0.000757	5.54	0	0.002712	0.005679
Payer no charge	-0.01237	0.003048	-4.06	0	-0.01834	-0.0064
Payer other	0	(omitted)				
Urban non-teaching	0.007885	0.000274	28.78	0	0.007348	0.008422
Urban teaching	0.009704	0.000301	32.23	0	0.009114	0.010295
Region Northeast	0.003226	0.000381	8.47	0	0.00248	0.003972
Region Midwest	-0.00812	0.000373	-21.78	0	-0.00885	-0.00739
Region West	0.003209	0.00041	7.83	0	0.002405	0.004013
Bed size for hospital medium	0.006365	0.000299	21.26	0	0.005779	0.006952
Bed size for hospital large	0.009598	0.00028	34.25	0	0.009048	0.010147

Income of patient $25000 - $35000	0.000901	0.000247	3.65	0	0.000417	0.001385
Income of patient $35000 - $45,000	0.001626	0.000277	5.86	0	0.001082	0.002169
Mandate is in effect	-0.00355	0.000349	-10.19	0	-0.00424	-0.00287
Year 1988	0.049454	0.000613	80.64	0	0.048252	0.050656
Year 1989	0.042938	0.00058	74	0	0.041801	0.044076
Year 1990	0.036149	0.000567	63.72	0	0.035037	0.037261
Year 1991	0.029228	0.000553	52.83	0	0.028144	0.030312
Year 1992	0.025481	0.000535	47.65	0	0.024432	0.026529
Year 1993	0.025515	0.000518	49.23	0	0.0245	0.026531
Year 1994	0.01977	0.000512	38.65	0	0.018768	0.020773
Year 1995	0.017426	0.000496	35.13	0	0.016454	0.018399
Year 1996	0.01221	0.000493	24.75	0	0.011243	0.013177
Year 1997	0.007873	0.000479	16.44	0	0.006934	0.008812
Year 1998	0.0064	0.000452	14.16	0	0.005514	0.007285
Year 1999	0.005823	0.00045	12.93	0	0.00494	0.006705
Year 2000	0.003486	0.000441	7.91	0	0.002623	0.00435
Year 2001	0.001201	0.000436	2.76	0.006	0.000347	0.002055
Year 2002	0	(omitted)				
Ave LOS leading up to mandate	-0.00705	0.000417	-16.91	0	-0.00787	-0.00623

3.76-4.5 yrs						
Ave LOS leading up to mandate 4.51-5.5 yrs	0.008467	0.000544	15.56	0	0.0074	0.009533
Ave LOS leading up to mandate >5.5 yrs	-0.00337	0.000569	-5.92	0	-0.00448	-0.00225
Ave mortality leading up to mandate 2-2.49%	0.013717	0.000518	26.49	0	0.012702	0.014732
Ave mortality leading up to mandate 2.5-2.99%	0.015885	0.000582	27.29	0	0.014745	0.017026
Ave mortality leading up to mandate >3%	0	(omitted)				
_cons	-0.00773	0.000931	-8.31	0	-0.00956	-0.00591

Table A4 AMI mortality linear probability model

Source	SS	df	MS	Number of obs	=	3,278,939
		F(51, 3278887)	=	2167.62		
Model	12959.1315	51	254.100617	Prob > F	=	0
Residual	384369.054	3,278,887	0.117225465	R-squared	=	0.0326
		Adj R-squared	=	0.0326		
Total	397328.186	3,278,938	0.121175876	Root MSE	=	0.34238

Died in hospital	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
Sex	0.0164351	0.0003925	41.87	0	0	0.017204
Age 45-64 yrs	0.0265939	0.0009889	26.89	0	0	0.028532
Age 65+ yrs	0.110594	0.0010679	103.56	0	0	0.112687
Age 18-45 yrs	0	(omitted)				
Government owned hospital	-0.0004034	0.0007113	-0.57	0.571	-0	0.000991
Private non-profit	-0.0071171	0.0006357	-11.2	0	-0	-0.00587
Admission type emergency	0.0197728	0.0008211	24.08	0	0	0.021382
Admission type urgent	0.0033609	0.0008098	4.15	0	0	0.004948
Admission type newborn	-0.0235512	0.0173328	-1.36	0.174	-0	0.010421
Admission type trauma	0.1884103	0.1210583	1.56	0.12	-0	0.42568
Admission type other	-0.0242103	0.0078985	-3.07	0.002	-0	-0.00873
Admission type na	0.0184954	0.0010973	16.86	0	0	0.020646
Race black	0.0023936	0.0009094	2.63	0.008	0	0.004176
Race other	-0.0006919	0.0009655	-0.72	0.474	-0	0.0012
Admission source ER	0.0006393	0.0005782	1.11	0.269	-0	0.001773

Admission source another hospital	-0.0358023	0.0007169	-49.94	0	-0	-0.0344
Admission source another facility including long term care	0.0344466	0.0012808	26.89	0	0	0.036957
Admission source court of law	0.0147771	0.0120944	1.22	0.222	-0	0.038482
Admission source na	-1.75E-06	0.0011535	0	0.999	-0	0.002259
Payer Medicare	0.0392212	0.000605	64.83	0	0	0.040407
Payer Medicaid	0.0363585	0.0010571	34.39	0	0	0.03843
Payer self-pay	0.0220213	0.0011718	18.79	0	0	0.024318
Payer no charge	0.0039502	0.005358	0.74	0.461	-0	0.014452
Payer other	0	(omitted)				
Urban non-teaching	0.0089356	0.0006023	14.83	0	0	0.010116
Urban teaching	0.0108224	0.0006529	16.57	0	0	0.012102
Region Northeast	0.0023798	0.0007737	3.08	0.002	0	0.003896
Region Midwest	0.0054805	0.0007775	7.05	0	0	0.007005
Region West	0.0094847	0.0008378	11.32	0	0	0.011127
Bed size for hospital medium	0.0040375	0.0006611	6.11	0	0	0.005333
Bed size for hospital large	0.0033888	0.0006205	5.46	0	0	0.004605
Income of patient $25000 - $35000	-0.004861	0.0005078	-9.57	0	-0	-0.00387
Income of patient $35000 - $45,000	-0.0070514	0.0005651	-12.48	0	-0	-0.00594

Mandate is in effect	-0.0024905	0.0007491	-3.32	0.001	-0	-0.00102
Year 1988	0.0540432	0.0011919	45.34	0	0	0.056379
Year 1989	0.0474062	0.0011399	41.59	0	0	0.04964
Year 1990	0.0422769	0.0011474	36.85	0	0	0.044526
Year 1991	0.0360163	0.0011336	31.77	0	0	0.038238
Year 1992	0.0308357	0.0011125	27.72	0	0	0.033016
Year 1993	0.0281628	0.0010868	25.91	0	0	0.030293
Year 1994	0.021369	0.0010888	19.63	0	0	0.023503
Year 1995	0.0175791	0.0010634	16.53	0	0	0.019663
Year 1996	0.0108713	0.0010639	10.22	0	0	0.012957
Year 1997	0.0080319	0.0010379	7.74	0	0	0.010066
Year 1998	0.0051443	0.0009748	5.28	0	0	0.007055
Year 1999	0.0047964	0.0009689	4.95	0	0	0.006695
Year 2000	-0.0001817	0.0009459	-0.19	0.848	-0	0.001672
Year 2001	-0.0005067	0.0009428	-0.54	0.591	-0	0.001341
Year 2002	0	(omitted)				
Ave LOS leading up to mandate 3.76-4.5 yrs	-0.0059584	0.0008871	-6.72	0	-0	-0.00422
Ave LOS leading up to mandate 4.51-5.5 yrs	0.0218156	0.0011421	19.1	0	0	0.024054
Ave LOS leading up to mandate >5.5	0.0073883	0.0012263	6.02	0	0	0.009792

yrs						
Ave mortality leading up to mandate 2-2.49%	0.0098754	0.0010723	9.21	0	0	0.011977
Ave mortality leading up to mandate 2.5-2.99%	0.0098299	0.0012086	8.13	0	0	0.012199
Ave mortality leading up to mandate >3%	0	(omitted)				
_cons	-0.0415857	0.001859	-22.37	0	-0	-0.03794

Table A5 Heart failure LOS Poisson regression model

Poisson regression	Number of obs	=	10,054,314
LR chi2(51)	=	5416674	
Prob > chi2	=	0	
Log likelihood = -49447778	Pseudo R2	=	0.0519

Length of stay	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Sex	0.033985	0.000224	151.51	0	0.033545	0.034425
Age 45-64 yrs	0.057569	0.000735	78.36	0	0.056129	0.059008
Age 65+ yrs	0.138844	0.000741	187.45	0	0.137392	0.140295
Age 18-45 yrs	0	(omitted)				
Government owned hospital	0.004199	0.000419	10.01	0	0.003377	0.005021
Private non-profit	0.003842	0.000377	10.19	0	0.003103	0.00458

Admission type emergency	-0.05927	0.000423	-140.2	0	-0.0601	-0.05844
Admission type urgent	-0.08595	0.000404	-212.54	0	-0.08674	-0.08516
Admission type newborn	-0.08486	0.01091	-7.78	0	-0.10624	-0.06347
Admission type trauma	-0.04884	0.021287	-2.29	0.022	-0.09056	-0.00712
Admission type other	0.153982	0.003732	41.26	0	0.146667	0.161297
Admission type na	0.025035	0.000587	42.64	0	0.023884	0.026186
Race black	0.030435	0.000431	70.69	0	0.029591	0.031279
Race other	0.045142	0.000551	81.92	0	0.044062	0.046222
Admission source ER	-0.04629	0.00031	-149.37	0	-0.0469	-0.04568
Admission source another hospital	0.403235	0.000466	865.33	0	0.402322	0.404148
Admission source another facility including long term care	0.13946	0.000639	218.12	0	0.138207	0.140714
Admission source court of law	0.187289	0.006348	29.5	0	0.174846	0.199731
Admission source na	0.00067	0.000667	1.01	0.315	-0.00064	0.001976
Payer Medicare	0.069375	0.000369	188.25	0	0.068653	0.070097
Payer Medicaid	0.210304	0.000575	365.97	0	0.209177	0.21143
Payer self-pay	0.083235	0.000933	89.17	0	0.081406	0.085065
Payer no charge	0.145408	0.003788	38.39	0	0.137984	0.152832
Payer other	0	(omitted)				
Urban non-teaching	0.15759	0.000358	439.87	0	0.156887	0.158292
Urban teaching	0.247555	0.000384	644.56	0	0.246803	0.248308

Region Northeast	0.275928	0.000455	606.85	0	0.275037	0.276819
Region Midwest	0.045827	0.000467	98.08	0	0.044911	0.046743
Region West	0.164578	0.000512	321.43	0	0.163575	0.165582
Bed size for hospital medium	0.067228	0.000381	176.25	0	0.06648	0.067976
Bed size for hospital large	0.156871	0.000357	439.2	0	0.156171	0.157571
Income of patient $25000 - $35000	0.004748	0.000299	15.87	0	0.004162	0.005335
Income of patient $35000 - $45,000	0.016385	0.000335	48.88	0	0.015728	0.017042
Mandate is in effect	-0.02911	0.000441	-65.96	0	-0.02997	-0.02824
Year 1988	0.425854	0.000709	601.08	0	0.424466	0.427243
Year 1989	0.407787	0.000682	598.09	0	0.406451	0.409123
Year 1990	0.375227	0.000672	558.76	0	0.373911	0.376543
Year 1991	0.350775	0.000661	530.83	0	0.34948	0.352071
Year 1992	0.31729	0.000645	491.77	0	0.316026	0.318555
Year 1993	0.294717	0.000631	467.08	0	0.293481	0.295954
Year 1994	0.248836	0.000631	394.36	0	0.247599	0.250072
Year 1995	0.182635	0.000622	293.52	0	0.181415	0.183854
Year 1996	0.106735	0.000628	169.99	0	0.105505	0.107966
Year 1997	0.067241	0.000616	109.19	0	0.066034	0.068448
Year 1998	0.021309	0.000586	36.36	0	0.02016	0.022458
Year 1999	0.011893	0.000585	20.33	0	0.010746	0.01304

Year 2000	-0.00535	0.000572	-9.35	0	-0.00647	-0.00423
Year 2001	-0.00613	0.000568	-10.8	0	-0.00725	-0.00502
Year 2002	0	(omitted)				
Ave LOS leading up to mandate 3.76-4.5 yrs	-0.03753	0.00054	-69.53	0	-0.03859	-0.03647
Ave LOS leading up to mandate 4.51-5.5 yrs	0.170236	0.000652	261.22	0	0.168959	0.171513
Ave LOS leading up to mandate >5.5 yrs	0.087375	0.000733	119.18	0	0.085938	0.088812
Ave mortality leading up to mandate 2-2.49%	0.02461	0.000686	35.88	0	0.023265	0.025954
Ave mortality leading up to mandate 2.5-2.99%	0.003263	0.000762	4.28	0	0.00177	0.004755
Ave mortality leading up to mandate >3%	0	(omitted)				
_cons	1.299527	0.001195	1087.7	0	1.297185	1.301868

Table A6 AMI LOS poisson regression model

Poisson regression	Number of obs	=	3,280,138
LR chi2(51)	=	2015769	
Prob > chi2	=	0	
Log likelihood = -15119652	Pseudo R2	=	0.0625

Length of stay	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Sex	0.070518	0.000402	175.33	0	0.069729	0.071306
Age 45-64 yrs	0.204343	0.001205	169.55	0	0.201981	0.206705
Age 65+ yrs	0.363858	0.001269	286.77	0	0.361372	0.366345
Age 18-45 yrs	0	(omitted)				
Government owned hospital	0.008641	0.000784	11.03	0	0.007106	0.010177
Private non-profit	-0.00607	0.000696	-8.73	0	-0.00744	-0.00471
Admission type emergency	-0.0582	0.000823	-70.76	0	-0.05981	-0.05659
Admission type urgent	-0.07431	0.000814	-91.26	0	-0.0759	-0.07271
Admission type newborn	-0.30002	0.019699	-15.23	0	-0.33863	-0.26141
Admission type trauma	0.73604	0.082774	8.89	0	0.573805	0.898274
Admission type other	0.177897	0.007367	24.15	0	0.163458	0.192337
Admission type na	0.005843	0.001125	5.2	0	0.003639	0.008047
Race black	0.124489	0.000909	136.97	0	0.122708	0.126271
Race other	0.094075	0.000984	95.58	0	0.092146	0.096004
Admission	-0.06817	0.000588	-115.89	0	-0.06933	-0.06702

source ER						
Admission source another hospital	-0.01778	0.000721	-24.67	0	-0.01919	-0.01636
Admission source another facility including long term care	-0.01443	0.00129	-11.19	0	-0.01696	-0.0119
Admission source court of law	0.071672	0.012489	5.74	0	0.047193	0.096151
Admission source na	-0.04699	0.001209	-38.85	0	-0.04936	-0.04462
Payer Medicare	0.149241	0.000642	232.32	0	0.147982	0.1505
Payer Medicaid	0.292517	0.001059	276.28	0	0.290442	0.294592
Payer self-pay	-0.00237	0.001366	-1.74	0.083	-0.00505	0.000306
Payer no charge	0.24268	0.005657	42.9	0	0.231592	0.253768
Payer other	0	(omitted)				
Urban non-teaching	0.228156	0.000691	330.23	0	0.226802	0.22951
Urban teaching	0.409697	0.000726	564.06	0	0.408273	0.41112
Region Northeast	0.229672	0.000802	286.56	0	0.228101	0.231243
Region Midwest	0.079428	0.000835	95.14	0	0.077791	0.081064
Region West	0.115024	0.000899	127.93	0	0.113261	0.116786
Bed size for hospital medium	0.104672	0.000733	142.86	0	0.103236	0.106108
Bed size for hospital large	0.240574	0.000688	349.64	0	0.239225	0.241922
Income of patient $25000 - $35000	-0.00449	0.000525	-8.54	0	-0.00552	-0.00346
Income of patient $35000	-0.00373	0.000588	-6.35	0	-0.00488	-0.00258

- $45,000						
Mandate is in effect	-0.01208	0.000817	-14.77	0	-0.01368	-0.01047
Year 1988	0.386801	0.001204	321.15	0	0.38444	0.389162
Year 1989	0.374548	0.001167	320.99	0	0.372261	0.376835
Year 1990	0.357361	0.001172	304.95	0	0.355064	0.359658
Year 1991	0.341043	0.001165	292.87	0	0.33876	0.343325
Year 1992	0.296207	0.001153	256.93	0	0.293947	0.298467
Year 1993	0.26477	0.001136	233.03	0	0.262543	0.266997
Year 1994	0.21249	0.001154	184.19	0	0.210229	0.214751
Year 1995	0.151075	0.001145	131.94	0	0.148831	0.153319
Year 1996	0.079853	0.001161	68.81	0	0.077578	0.082127
Year 1997	0.054015	0.001141	47.36	0	0.051779	0.05625
Year 1998	-0.00856	0.001077	-7.94	0	-0.01067	-0.00644
Year 1999	-0.01237	0.001069	-11.57	0	-0.01446	-0.01027
Year 2000	-0.01414	0.001042	-13.57	0	-0.01618	-0.0121
Year 2001	-0.01751	0.00104	-16.84	0	-0.01955	-0.01547
Year 2002	0	(omitted)				
Ave LOS leading up to mandate 3.76-4.5 yrs	-0.01407	0.000982	-14.32	0	-0.01599	-0.01214
Ave LOS leading up to mandate 4.51-5.5 yrs	0.102558	0.001181	86.88	0	0.100244	0.104872
Ave LOS	0.047304	0.001355	34.9	0	0.044647	0.04996

leading up to mandate >5.5 yrs						
Ave mortality leading up to mandate 2-2.49%	0.017852	0.001202	14.85	0	0.015495	0.020208
Ave mortality leading up to mandate 2.5-2.99%	0.014167	0.001343	10.55	0	0.011536	0.016799
Ave mortality leading up to mandate >3%	0	(omitted)				
_cons	0.899857	0.002112	426.16	0	0.895719	0.903996

Table A7 Federal mandate HF mortality linear probability model

Source	SS	df	MS	Number of obs	=	13896589
		F(45, 13896543)	=	3754.23		
Model	13201.08	45	293.3573	Prob > F	=	0
Residual	1085882	13896543	0.07814	R-squared	=	0.012
		Adj R-squared	=	0.012		
Total	1099083	13896588	0.07909	Root MSE	=	0.27954

Died in hospital	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
Sex	-0.01083	0.0001521	-71.22	0	-0.01113	-0.01053
Age 45-64 yrs	0.008676	0.0004673	18.57	0	0.00776	0.009592
Age 65+ yrs	0.051138	0.0004736	107.97	0	0.05021	0.052066
Age 18-45 yrs	0	(omitted)				
Government owned hospital	-0.00072	0.0002619	-2.75	0.006	-0.00123	-0.00021
Private non-profit	-0.00153	0.0002455	-6.24	0	-0.00201	-0.00105
Admission type emergency	0.024579	0.0002958	83.09	0	0.023999	0.025158
Admission type urgent	0.010075	0.0002809	35.87	0	0.009525	0.010626
Admission type newborn	0.017021	0.0078277	2.17	0.03	0.001678	0.032363
Admission type trauma	0.031747	0.0045645	6.96	0	0.0228	0.040693
Admission type other	-0.04167	0.0032569	-12.8	0	-0.04806	-0.03529
Admission type na	0.02275	0.0004239	53.66	0	0.021919	0.023581
Race black	-0.01603	0.000284	-56.43	0	-0.01658	-0.01547
Race other	-0.00293	0.0003568	-8.22	0	-0.00363	-0.00223
Admission source ER	0.013489	0.0002162	62.39	0	0.013065	0.013913
Admission source another	0.038872	0.0003721	104.47	0	0.038143	0.039602

hospital						
Admission source another facility including long term care	0.057488	0.0004779	120.29	0	0.056551	0.058424
Admission source court of law	-0.00137	0.0045561	-0.3	0.764	-0.0103	0.007562
Admission source na	0.013482	0.0004911	27.45	0	0.012519	0.014444
Payer Medicare	0.001988	0.0002472	8.04	0	0.001503	0.002472
Payer Medicaid	0.000917	0.0003899	2.35	0.019	0.000152	0.001681
Payer self-pay	0.00243	0.0006079	4	0	0.001239	0.003622
Payer no charge	-0.00922	0.0021233	-4.34	0	-0.01338	-0.00506
Payer other	0	(omitted)				
Urban non-teaching	0.007199	0.0002301	31.28	0	0.006748	0.00765
Urban teaching	0.008129	0.0002534	32.08	0	0.007632	0.008626
Region Northeast	0.006741	0.0003414	19.74	0	0.006072	0.00741
Region Midwest	-0.00593	0.0003255	-18.23	0	-0.00657	-0.0053
Region West	0.006806	0.0003962	17.18	0	0.00603	0.007583
Bed size for hospital medium	0.005091	0.0002472	20.6	0	0.004607	0.005576
Bed size for hospital large	0.007937	0.000228	34.81	0	0.00749	0.008384
Income of patient $25000 - $35000	0.001964	0.0002012	9.76	0	0.00157	0.002359
Income of patient $35000 - $45,000	0.002264	0.000214	10.58	0	0.001845	0.002684
Year patient	-0.00322	0.0000244	-	0	-0.00327	-0.00317

admitted			132.13			
1 yr of experience with state mandate	-0.00037	0.0006508	-0.57	0.569	-0.00165	0.000905
2 yrs of experience with state mandate	-0.00709	0.0004362	-16.25	0	-0.00794	-0.00623
4 yrs of experience with state mandate	0.002164	0.0008181	2.64	0.008	0.00056	0.003767
5 yrs of experience with state mandate	0.007991	0.002032	3.93	0	0.004008	0.011974
6 yrs of experience with state mandate	0.002682	0.0003922	6.84	0	0.001913	0.003451
Ave LOS leading up to mandate 3.76-4.5 yrs	-0.00288	0.0004039	-7.14	0	-0.00368	-0.00209
Ave LOS leading up to mandate 4.51-5.5 yrs	0.010625	0.000551	19.28	0	0.009545	0.011705
Ave LOS leading up to mandate >5.5 yrs	-0.0022	0.0005172	-4.25	0	-0.00321	-0.00119
Ave mortality leading up to mandate 2-2.49%	0.006002	0.000401	14.97	0	0.005216	0.006787
Ave mortality leading up to mandate 2.5-2.99%	0.006456	0.000454	14.22	0	0.005566	0.007345
Ave mortality leading up to mandate >3%	0	(omitted)				
State only mandate effect	-0.00406	0.0003559	-11.4	0	-0.00475	-0.00336

Federal only mandate effect	0.004533	0.0004219	10.74	0	0.003706	0.005359
Combined federal and state mandate effect	0.001758	0.0004079	4.31	0	0.000958	0.002557
_cons	6.445404	0.0486814	132.4	0	6.34999	6.540818

Table A8 Federal mandate AMI mortality linear probability model

Source	SS	df	MS	Number of obs	=	4,303,232
		F(45, 4303186)	=	3008.51		
Model	15406.04	45	342.3565	Prob > F	=	0
Residual	489685.7	4,303,186	0.113796	R-squared	=	0.0305
		Adj R-squared	=	0.0305		
Total	505091.7	4,303,231	0.117375	Root MSE	=	0.33734

Died in hospital	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
Sex	0.013706	0.000337	40.68	0	0.013046	0.014367
Age 45-64 yrs	0.025124	0.00085	29.55	0	0.023458	0.02679
Age 65+ yrs	0.105258	0.000919	114.6	0	0.103458	0.107059
Age 18-45 yrs	0	(omitted)				
Government owned hospital	-0.00104	0.000593	-1.75	0.08	-0.0022	0.000124
Private non-profit	-0.00796	0.000549	-14.51	0	-0.00904	-0.00689
Admission type emergency	0.018302	0.000702	26.06	0	0.016925	0.019678
Admission type urgent	0.002579	0.000691	3.73	0	0.001224	0.003934
Admission type newborn	-0.01772	0.015641	-1.13	0.257	-0.04837	0.012938
Admission type trauma	0.0865	0.011238	7.7	0	0.064475	0.108526
Admission type other	-0.02617	0.007436	-3.52	0	-0.04075	-0.0116
Admission type na	0.019402	0.000967	20.07	0	0.017507	0.021297
Race black	0.003911	0.000754	5.19	0	0.002434	0.005388
Race other	0.0004	0.000778	0.51	0.607	-0.00112	0.001925
Admission source ER	0.001489	0.000504	2.95	0.003	0.0005	0.002477

Admission source another hospital	-0.03387	0.000617	-54.94	0	-0.03508	-0.03266
Admission source another facility including long term care	0.030863	0.001085	28.44	0	0.028736	0.03299
Admission source court of law	0.006491	0.01064	0.61	0.542	-0.01436	0.027345
Admission source na	0.001038	0.001073	0.97	0.334	-0.00107	0.003141
Payer Medicare	0.037689	0.000522	72.21	0	0.036666	0.038711
Payer Medicaid	0.036242	0.000882	41.08	0	0.034513	0.037972
Payer self-pay	0.021261	0.00098	21.69	0	0.01934	0.023183
Payer no charge	0.007404	0.003809	1.94	0.052	-6.1E-05	0.014868
Payer other	0	(omitted)				
Urban non-teaching	0.006852	0.000529	12.96	0	0.005816	0.007888
Urban teaching	0.008343	0.000573	14.55	0	0.007219	0.009467
Region Northeast	0.002523	0.000716	3.52	0	0.001119	0.003928
Region Midwest	0.00239	0.000701	3.41	0.001	0.001016	0.003764
Region West	0.008704	0.000844	10.32	0	0.00705	0.010358
Bed size for hospital medium	0.003571	0.000571	6.25	0	0.002451	0.004691
Bed size for hospital large	0.003919	0.000531	7.39	0	0.002879	0.004959
Income of patient $25000 - $35000	-0.00347	0.000434	-7.98	0	-0.00432	-0.00261
Income of patient $35000 - $45,000	-0.00522	0.00046	-11.35	0	-0.00613	-0.00432

Year patient admitted	-0.00386	5.08E-05	-75.89	0	-0.00396	-0.00376
1 yr of experience with state mandate	-0.00419	0.001449	-2.89	0.004	-0.00703	-0.00135
2 yrs of experience with state mandate	-0.00276	0.000983	-2.81	0.005	-0.00469	-0.00084
4 yrs of experience with state mandate	0.01104	0.001876	5.88	0	0.007363	0.014717
5 yrs of experience with state mandate	0.020591	0.004399	4.68	0	0.011969	0.029213
6 yrs of experience with state mandate	0.00051	0.000877	0.58	0.561	-0.00121	0.002228
Ave LOS leading up to mandate 3.76-4.5 yrs	-0.00342	0.000894	-3.83	0	-0.00517	-0.00167
Ave LOS leading up to mandate 4.51-5.5 yrs	0.023012	0.001185	19.43	0	0.02069	0.025334
Ave LOS leading up to mandate >5.5 yrs	0.008434	0.001167	7.22	0	0.006146	0.010722
Ave mortality leading up to mandate 2-2.49%	0.006438	0.000879	7.32	0	0.004715	0.008161
Ave mortality leading up to mandate 2.5-2.99%	0.00666	0.000999	6.67	0	0.004702	0.008619
Ave mortality leading up to mandate >3%	0	(omitted)				
State only mandate effect	-0.00389	0.000761	-5.11	0	-0.00538	-0.0024

Federal only mandate effect	0.012261	0.000959	12.78	0	0.010381	0.014141
Combined federal and state mandate effect	0.005811	0.000891	6.52	0	0.004064	0.007558
_cons	7.687601	0.101509	75.73	0	7.488648	7.886554

Table A9 HF LOS poisson regression model

Poisson regression	Number of obs	=	13,910,675
LR chi2(45)	=	6831727	
Prob > chi2	=	0	
Log likelihood = -66288704	Pseudo R2	=	0.049

Length of stay	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Sex	0.028108	0.000195	144.4	0	0.027727	0.02849
Age 45-64 yrs	0.058061	0.00062	93.68	0	0.056847	0.059276
Age 65+ yrs	0.123458	0.000627	196.88	0	0.122229	0.124687
Age 18-45 yrs	0	(omitted)				
Government owned hospital	-0.02543	0.00035	-72.57	0	-0.02611	-0.02474
Private non-profit	-0.01541	0.000325	-47.37	0	-0.01605	-0.01478
Admission type emergency	-0.05539	0.000368	-150.55	0	-0.05611	-0.05467
Admission type urgent	-0.07943	0.000351	-226.28	0	-0.08012	-0.07874
Admission type newborn	-0.05213	0.009992	-5.22	0	-0.07172	-0.03255
Admission type trauma	0.054029	0.00586	9.22	0	0.042544	0.065514
Admission type other	0.122123	0.003431	35.6	0	0.115399	0.128847
Admission type na	0.015116	0.000528	28.62	0	0.014081	0.016151
Race black	0.024264	0.000362	67.05	0	0.023555	0.024974
Race other	0.050534	0.000448	112.74	0	0.049656	0.051413
Admission source ER	-0.04057	0.000276	-146.78	0	-0.04111	-0.04003

Admission source another hospital	0.421675	0.000401	1052.9	0	0.42089	0.422459
Admission source another facility including long term care	0.148017	0.000565	261.91	0	0.146909	0.149124
Admission source court of law	0.168873	0.005496	30.73	0	0.158102	0.179645
Admission source na	0.015424	0.000633	24.36	0	0.014183	0.016665
Payer Medicare	0.067652	0.000321	210.57	0	0.067023	0.068282
Payer Medicaid	0.19145	0.00049	391.11	0	0.19049	0.192409
Payer self-pay	0.053568	0.000799	67.09	0	0.052003	0.055133
Payer no charge	0.121015	0.002797	43.27	0	0.115534	0.126496
Payer other	0	(omitted)				
Urban non-teaching	0.17954	0.000317	567.27	0	0.17892	0.180161
Urban teaching	0.256868	0.000341	754.41	0	0.256201	0.257535
Region Northeast	0.253928	0.000426	595.76	0	0.253093	0.254764
Region Midwest	0.040767	0.000427	95.58	0	0.039931	0.041603
Region West	0.134755	0.000515	261.84	0	0.133746	0.135764
Bed size for hospital medium	0.056489	0.00033	171.12	0	0.055842	0.057136
Bed size for hospital large	0.14933	0.000305	490.04	0	0.148733	0.149928
Income of patient $25000 - $35000	0.004389	0.000258	17.05	0	0.003885	0.004894
Income of patient $35000 - $45,000	0.015439	0.000274	56.43	0	0.014903	0.015976

Year patient admitted	-0.03347	3.07E-05	1088.83	0	-0.03353	-0.03341
1 yr of experience with state mandate	-0.06637	0.000811	-81.84	0	-0.06796	-0.06478
2 yrs of experience with state mandate	0.021869	0.000592	36.93	0	0.020709	0.02303
4 yrs of experience with state mandate	0.056715	0.001145	49.55	0	0.054472	0.058959
5 yrs of experience with state mandate	0.050711	0.002683	18.9	0	0.045454	0.055969
6 yrs of experience with state mandate	-0.023	0.000528	-43.57	0	-0.02403	-0.02196
Ave LOS leading up to mandate 3.76-4.5 yrs	0.041259	0.000551	74.9	0	0.04018	0.042339
Ave LOS leading up to mandate 4.51-5.5 yrs	0.232926	0.000686	339.63	0	0.231582	0.23427
Ave LOS leading up to mandate >5.5 yrs	0.159382	0.000704	226.27	0	0.158002	0.160763
Ave mortality leading up to mandate 2-2.49%	-0.05693	0.000558	-102.06	0	-0.05803	-0.05584
Ave mortality leading up to mandate 2.5-2.99%	-0.03667	0.000618	-59.38	0	-0.03788	-0.03546
Ave mortality leading up to mandate >3%	0	(omitted)				
State only mandate effect	-0.09946	0.000485	-205.22	0	-0.10041	-0.09851

Federal only mandate effect	0.107461	0.000582	184.57	0	0.10632	0.108602
Combined federal and state mandate effect	0.028607	0.000553	51.73	0	0.027523	0.029691
_cons	68.3693	0.061408	1113.37	0	68.24894	68.48965

Table A10 AMI LOS poisson regression model

Poisson regression	Number of obs	=	4,306,068
LR chi2(45)	=	2456258	
Prob > chi2	=	0	
Log likelihood = -19806229	Pseudo R2	=	0.0584

Length of stay	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Sex	0.06381	0.000356	179.5	0	0.063113	0.064507
Age 45-64 yrs	0.206928	0.001064	194.44	0	0.204842	0.209014
Age 65+ yrs	0.357272	0.001121	318.73	0	0.355075	0.359469
Age 18-45 yrs	0	(omitted)				
Government owned hospital	-0.00879	0.000667	-13.18	0	-0.0101	-0.00748
Private non-profit	-0.01653	0.000615	-26.87	0	-0.01774	-0.01533
Admission type emergency	-0.05758	0.000725	-79.45	0	-0.059	-0.05616
Admission type urgent	-0.077	0.000717	-107.45	0	-0.07841	-0.0756
Admission type newborn	-0.23502	0.017724	-13.26	0	-0.26976	-0.20028
Admission type trauma	0.249844	0.010588	23.6	0	0.229092	0.270595
Admission type other	0.152805	0.007063	21.64	0	0.138963	0.166648
Admission type na	-0.01689	0.001015	-16.63	0	-0.01888	-0.0149
Race black	0.119338	0.00077	154.94	0	0.117828	0.120847
Race other	0.094646	0.00081	116.79	0	0.093058	0.096234

Admission source ER	-0.06898	0.000528	-130.63	0	-0.07001	-0.06794
Admission source another hospital	-0.03345	0.000639	-52.33	0	-0.0347	-0.03219
Admission source another facility including long term care	-0.02872	0.001127	-25.48	0	-0.03092	-0.02651
Admission source court of law	0.039317	0.011366	3.46	0.001	0.01704	0.061593
Admission source na	-0.03589	0.001145	-31.36	0	-0.03814	-0.03365
Payer Medicare	0.1651	0.000571	289.17	0	0.163981	0.166219
Payer Medicaid	0.30946	0.000907	341.13	0	0.307682	0.311238
Payer self-pay	-0.00313	0.001179	-2.66	0.008	-0.00544	-0.00082
Payer no charge	0.162947	0.004275	38.12	0	0.154569	0.171325
Payer other	0	(omitted)				
Urban non-teaching	0.247711	0.000624	397.12	0	0.246488	0.248934
Urban teaching	0.422368	0.000657	642.87	0	0.42108	0.423655
Region Northeast	0.197723	0.000758	260.78	0	0.196237	0.199209
Region Midwest	0.046655	0.00077	60.56	0	0.045145	0.048165
Region West	0.060306	0.000916	65.85	0	0.058511	0.062101
Bed size for hospital medium	0.10442	0.00065	160.67	0	0.103147	0.105694
Bed size for hospital large	0.246093	0.000604	407.17	0	0.244908	0.247278
Income of patient $25000 - $35000	-0.00689	0.000462	-14.91	0	-0.0078	-0.00598

Income of patient $35000 - $45,000	-0.00936	0.000492	-19.04	0	-0.01033	-0.0084
Year patient admitted	-0.032	0.000054	-592	0	-0.0321	-0.03189
1 yr of experience with state mandate	-0.02068	0.001509	-13.71	0	-0.02364	-0.01773
2 yrs of experience with state mandate	0.055414	0.001102	50.3	0	0.053255	0.057573
4 yrs of experience with state mandate	0.15906	0.002159	73.68	0	0.154828	0.163291
5 yrs of experience with state mandate	0.088425	0.004731	18.69	0	0.079153	0.097696
6 yrs of experience with state mandate	-0.07341	0.000986	-74.46	0	-0.07535	-0.07148
Ave LOS leading up to mandate 3.76-4.5 yrs	0.036283	0.00102	35.57	0	0.034283	0.038282
Ave LOS leading up to mandate 4.51-5.5 yrs	0.13644	0.001249	109.24	0	0.133992	0.138888
Ave LOS leading up to mandate >5.5 yrs	0.147752	0.001331	111.02	0	0.145143	0.15036
Ave mortality leading up to mandate 2-2.49%	-0.01129	0.001014	-11.13	0	-0.01328	-0.0093
Ave mortality leading up to mandate 2.5-2.99%	0.018527	0.001132	16.37	0	0.016309	0.020745
Ave mortality leading up to	0	(omitted)				

mandate >3%						
State only mandate effect	-0.06553	0.000866	-75.63	0	-0.06723	-0.06383
Federal only mandate effect	0.14535	0.001096	132.58	0	0.143201	0.147499
Combined federal and state mandate effect	0.079403	0.001006	78.94	0	0.077431	0.081374
_cons	64.953	0.10795	601.69	0	64.74142	65.16458

Appendix B: Descriptive statistics for the HCUP NIS data used

Table B1 Total Discharges

Calendar Year	Discharges	Hospitals	States
1988	5,265,756	759	8
1989	6,110,064	882	11
1990	6,268,515	871	11
1991	6,156,188	859	11
1992	6,195,744	856	11
1993	6,538,976	913	17
1994	6,385,011	904	17
1995	6,714,935	938	19
1996	6,542,069	906	19
1997	7,148,420	1,012	22
1998	6,827,350	984	22
1999	7,198,929	984	24
2000	7,450,992	994	28
2001	7,452,727	986	33
2002	7,853,982	995	35
2003	7,977,728	994	37
2004	8,004,571	1,004	37
2005	7,995,048	1,054	37
2006	8,074,825	1,045	38

Table B2 Summary of Mortality and Length of Stay

Calendar year	Total Discharges	Total Died	Mort ality Denominator	Min LOS (Edited)	Max LOS (Edited)	Avg LOS (Edited)	Count LOS (Edited)	Min LOS Uncleaned	Max LOS Uncleaned	Avg LOS Uncleaned	Count LOS Uncleaned
1988	5,265,756	154,747	5,255,700	0	4,691	6.3	5,244,027	-24	7,307	6.4	5,265,745
1989	6,110,064	172,969	6,104,464	0	32,166	6.2	6,094,758	-281	32,166	6.2	6,110,058
1990	6,268,515	172,998	6,263,518	0	7,307	6.1	6,261,899	-3,285	32,528	6.1	6,268,512
1991	6,156,188	169,521	6,150,637	0	7,046	6.0	6,150,792	-364	29,226	6.0	6,156,187
1992	6,195,744	168,037	6,190,249	0	26,670	5.9	6,186,433	-1,073	26,670	5.9	6,195,743
1993	6,538,976	177,392	6,525,755	0	28,665	5.8	6,532,344	-1,082	30,684	5.9	6,538,974
1994	6,385,011	166,813	6,381,186	0	25,644	5.5	6,370,843	-2,434	29,078	5.7	6,385,007
1995	6,714,935	172,844	6,708,561	0	32,205	5.3	6,696,550	-364	32,513	5.4	6,714,932
1996	6,542,069	164,836	6,539,499	0	29,532	5.0	6,524,952	-29,218	29,532	5.1	6,542,066
1997	7,148,420	174,605	7,141,825	0	6,118	4.9	7,123,113	-493	32,145	4.9	7,148,418
1998	6,827,350	170,667	6,823,496	0	365	4.7	6,826,873	-183	5,047	4.8	6,827,341
1999	7,198,929	176,978	7,195,297	0	365	4.7	7,198,571	-297	4,141	4.7	7,198,922
2000	7,450,992	176,093	7,447,289	0	365	4.6	7,450,696	-19	3,959	4.6	7,450,991
2001	7,452,727	172,722	7,448,549	0	365	4.6	7,452,406	-12	4,758	4.6	7,452,725
2002	7,853,982	175,041	7,835,734	0	365	4.6	7,853,125	-365	7,274	4.7	7,853,546
2003	7,977,728	177,270	7,954,480	0	365	4.6	7,976,668	-365	7,233	4.7	7,977,032
2004	8,004,571	170,719	8,001,741	0	365	4.6	8,004,163	-180	5,628	4.7	8,004,570
2005	7,995,048	167,150	7,992,007	0	365	4.6	7,994,611	-1,458	6,231	4.7	7,995,047
2006	8,074,825	164,643	8,072,762	0	365	4.6	8,074,566	-347	7,294	4.6	8,074,825

Table B3 Patient age and diseases of interest over time

Calendar year	Total Discharges	Total Discharges (Cumulative %)	Min Age	Max Age	Avg Age	Count Age	Count of Patients Age 45 to 64	Count of Patients Over 65 Years of Age	Total AMI Patients	Total HF Patients
1988	5,265,756	4.0%	0	124	43.7	5,258,491	952,795	1,620,482	121,826	328,586
1989	6,110,064	4.6%	0	124	43.6	6,102,960	1,072,290	1,903,159	139,403	387,637
1990	6,268,515	4.7%	0	119	43.7	6,262,118	1,087,454	1,976,501	132,485	418,343
1991	6,156,188	4.7%	0	119	44.4	6,151,279	1,065,832	2,020,171	137,904	458,946
1992	6,195,744	4.7%	0	120	45.0	6,191,990	1,077,268	2,093,849	145,707	517,467
1993	6,538,976	4.9%	0	123	45.1	6,537,017	1,169,483	2,193,623	155,058	560,562
1994	6,385,011	4.8%	0	124	45.6	6,382,733	1,139,361	2,180,131	154,892	597,905
1995	6,714,935	5.1%	0	123	46.1	6,713,084	1,217,483	2,331,459	167,997	661,346
1996	6,542,069	5.0%	0	124	46.8	6,540,511	1,203,307	2,330,618	166,987	676,688
1997	7,148,420	5.4%	0	124	46.9	7,146,385	1,337,650	2,558,168	181,112	752,797
1998	6,827,350	5.2%	0	124	47.6	6,825,945	1,311,725	2,486,032	178,879	734,394
1999	7,198,929	5.4%	0	124	46.9	7,196,772	1,409,574	2,532,318	184,160	745,761
2000	7,450,992	5.6%	0	124	47.1	7,449,624	1,510,726	2,598,606	196,252	784,220
2001	7,452,727	5.6%	0	124	47.8	7,452,276	1,533,790	2,667,981	194,466	795,520
2002	7,853,982	5.9%	0	124	47.3	7,853,039	1,663,499	2,729,186	200,748	840,566
2003	7,977,728	6.0%	0	123	47.5	7,966,479	1,740,516	2,752,902	200,977	881,341
2004	8,004,571	6.1%	0	124	47.1	7,994,246	1,767,289	2,695,666	186,118	893,333
2005	7,995,048	6.0%	0	115	47.2	7,984,586	1,770,612	2,725,342	179,862	899,018
2006	8,074,825	6.1%	0	120	47.7	8,066,796	1,864,108	2,752,801	186,612	917,814

Table B4 Hospital discharge and transfer status

Calendar year	Total Discharges	Min Total Discharges	Max Total Discharges	Avg Total Discharges	Count Total Discharges	Min Hosp Transfer Rate	Max Hosp Transfer Rate	Avg Hosp Transfer Rate
1988	5,265,756	3	88,224	16,243	5,265,756	0.00%	24.54%	1.88%
1989	6,110,064	24	91,530	16,110	6,110,064	0.00%	20.57%	1.96%
1990	6,268,515	19	86,849	16,394	6,268,515	0.00%	25.00%	1.99%
1991	6,156,188	25	62,328	15,458	6,156,188	0.00%	25.10%	2.17%
1992	6,195,744	52	60,841	15,653	6,195,744	0.00%	21.52%	2.24%
1993	6,538,976	4	58,852	15,814	6,538,976	0.00%	25.45%	2.18%
1994	6,385,011	47	57,824	15,528	6,385,011	0.00%	23.39%	2.25%
1995	6,714,935	29	62,712	16,255	6,508,607	0.00%	35.02%	2.32%
1996	6,542,069	29	62,712	16,319	6,542,069	0.00%	31.46%	2.40%
1997	7,148,420	17	64,476	16,607	7,148,420	0.00%	24.06%	2.44%
1998	6,827,350	31	62,192	15,536	6,827,350	0.00%	23.66%	2.47%
1999	7,198,929	19	71,358	17,408	7,198,929	0.00%	26.30%	2.54%
2000	7,450,992	1	57,137	18,143	7,450,992	0.00%	22.81%	2.53%
2001	7,452,727	5	61,231	17,452	7,452,727	0.00%	40.00%	2.49%
2002	7,853,982	8	67,685	19,023	7,853,982	0.00%	31.64%	2.35%
2003	7,977,728	17	68,464	19,895	7,977,728	0.00%	24.40%	2.21%
2004	8,004,571	15	71,580	19,856	8,004,571	0.00%	26.67%	2.28%
2005	7,995,048	10	114,163	20,187	7,995,048	0.00%	26.84%	2.15%
2006	8,074,825	18	115,262	20,904	8,074,825	0.00%	31.96%	2.13%

Table B5 Hospital admission source and type

Admit Source	Desc	1988	1989	1990	1991	1992	1993	1994	1995
1	ER	1,614,012	1,885,111	2,023,442	1,977,953	2,015,032	2,182,361	2,214,384	2,393,401
2	Another hospital	110,193	128,016	138,795	145,952	165,074	202,428	200,725	222,800
3	Another facility including long-term care	66,617	63,945	69,451	70,786	68,630	108,680	102,694	119,085
4	Court/law enforcement	4,702	4,816	4,287	6,106	5,716	4,382	5,126	6,499
5	Routine/birth/other	2,799,132	3,278,978	3,423,228	3,358,123	3,378,041	3,568,647	3,488,013	3,685,920
9	Missing or Invalid	671,100	749,198	609,312	597,268	563,251	472,478	374,069	287,230

Admit Type	Desc	1988	1989	1990	1991	1992	1993	1994	1995
1	Emergency	1,563,328	1,782,504	1,872,301	1,847,945	1,874,059	1,998,493	2,266,708	2,263,617
2	Urgent	1,303,074	1,577,345	1,669,898	1,696,706	1,694,782	1,628,153	1,655,236	1,459,997
3	Elective	1,170,836	1,361,815	1,390,704	1,303,785	1,310,330	1,254,550	1,389,397	1,400,300
4	Newborn	493,939	585,133	644,589	613,766	633,426	622,208	694,076	591,671
5	Trauma Center (after 2003)	143,514	135,428	156,554	139,534	150,329	157,342	183,425	50,515
6	Other	3,826	154	21	9	22	3,911	6,720	8,792
9	Missing or Invalid	587,239	667,685	534,448	554,443	532,796	874,319	189,449	940,043

Admit Source	Desc	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	ER	2,369,231	2,620,999	2,611,158	2,775,054	2,873,762	2,985,996	3,368,406	3,474,427	3,457,270	3,409,769	3,521,637
2	Another hospital	229,500	271,745	226,704	228,963	228,102	245,693	246,558	257,180	279,707	275,869	283,187
3	Another facility including long-term care	119,402	135,053	119,826	114,191	110,385	127,304	112,620	113,420	119,038	108,741	100,956
4	Court/law enforcement	8,502	11,468	7,307	9,470	7,613	6,408	5,813	7,218	12,038	5,779	10,902
5	Routine/birth/other	3,595,541	3,830,877	3,616,448	3,723,429	3,844,628	3,911,609	3,961,274	4,054,350	4,075,067	4,104,010	4,059,020
9	Missing or Invalid	219,893	278,278	245,907	347,822	386,502	175,717	159,311	71,133	61,451	90,880	99,123

Admit Type	Desc	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	Emergency	2,245,444	2,440,024	2,369,935	2,550,749	2,614,091	2,719,862	2,942,747	3,045,449	3,133,016	3,131,545	3,293,447
2	Urgent	1,390,931	1,514,259	1,563,969	1,475,529	1,523,003	1,432,445	1,445,460	1,440,050	1,401,140	1,436,292	1,330,999
3	Elective	1,390,803	1,502,835	1,412,648	1,561,168	1,717,689	1,725,236	1,741,623	1,864,861	1,852,920	1,738,940	1,806,668
4	Newborn	581,483	627,082	603,132	644,677	721,895	654,756	713,239	718,158	741,765	745,207	746,821
5	Trauma Center (after 2003)	49,814	39,595						3,852	13,965	30,716	19,332
6	Other	11,935	12,171	8,018	8,820	624	3,200	6,844	5,119	3,255	2,615	6,640
9	Missing or Invalid	871,659	1,012,454	869,648	957,986	873,690	917,228	1,004,069	900,239	858,510	909,733	870,918

Table B6 Discharge status

Disposition of patient (uniform)	Description	1988	1989	1990	1991	1992	1993	1994	1995
1	Routine	4,513,610	5,199,167	5,271,877	5,088,563	5,048,083	5,324,013	5,080,214	5,253,737
2	Short-term hospital	98,856	119,756	125,044	133,428	138,896	142,254	143,685	155,801
5	Other transfers (including SNF and intermediate care)	274,548	355,444	393,436	416,637	460,111	489,249	537,362	619,525
6	Home health care	166,622	206,735	249,172	291,632	321,837	329,561	391,404	445,869
7	Against medical advice	47,317	50,393	50,991	50,856	53,285	63,286	61,708	60,785
20	Died	154,747	172,969	172,998	169,521	168,037	177,392	166,813	172,844
99	Discharged alive, destination unknown								
.	Missing	4,413	5,349	4,284	5,029	4,332	6,946	3,255	4,062
A	Invalid	5,643	251	713	522	1,163	6,275	570	2,312

Disposition of patient (uniform)	Description	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	Routine	5,040,483	5,496,384	5,218,338	5,525,843	5,760,539	5,679,377	5,985,672	6,064,366	5,923,727	5,914,963	5,947,216
2	Short-term hospital	157,106	174,279	168,553	182,771	188,333	185,697	184,201	176,280	182,321	172,166	171,755
5	Other transfers (including SNF and intermediate care)	665,555	762,748	777,829	781,711	804,403	847,193	881,724	890,377	957,514	968,356	979,881
6	Home health care	457,530	479,201	433,975	473,563	460,337	501,803	544,557	576,547	693,961	698,114	727,369
7	Against medical advice	53,989	54,608	54,134	54,431	57,584	59,251	61,737	66,310	70,732	68,443	79,649
20	Died	164,836	174,605	170,667	176,978	176,093	172,722	175,041	177,270	170,719	167,150	164,643
99	Discharged alive, destination unknown						2,506	2,802	3,330	2,767	2,815	2,249
.	Missing	1,950	6,079	380	443	756	3,548	5,935	4,032	1,918	2,407	1,748
A	Invalid	620	516	3,474	3,189	2,947	630	12,313	19,216	912	634	315

Table B7 Patient sex

Sex	Description	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	Male	2,219,346	2,572,602	2,623,734	2,584,506	2,593,601	2,736,860	2,659,285	2,787,066	2,702,674
2	Female	3,045,462	3,536,978	3,644,444	3,571,358	3,601,651	3,801,214	3,724,805	3,926,839	3,838,855
.	Missing	204	134	100	94	101	211	512	640	221
A	Invalid		1		1		5	2	94	20
C	Inconsistent	744	349	237	229	391	686	407	296	299

Sex	Description	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	Male	2,936,209	2,797,517	2,963,522	3,032,592	3,039,856	3,193,850	3,239,551	3,264,088	3,275,925	3,331,684
2	Female	4,211,388	4,028,724	4,234,072	4,416,912	4,411,795	4,659,046	4,707,746	4,713,953	4,692,644	4,721,215
.	Missing	463	727	1,032	881	837	720	30,265	26,311	26,246	21,552
A	Invalid	8	1	9	13	34	9	3	2	1	10
C	Inconsistent	352	381	294	594	205	357	163	217	232	364

Table B8 Patient race

Race	Description	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	White	2,043,397	1,499,367	1,747,371	1,995,690	3,237,655	3,700,633	3,643,315	4,008,351	3,860,456
2	Black	241,125	179,386	202,704	194,855	438,437	695,343	703,492	769,018	745,221
3	Hispanic	275,776	249,901	292,376	243,048	390,987	400,861	425,888	472,382	480,337
4	Asian or pacific islander	60,710	54,248	60,385	72,077	81,566	68,700	81,687	76,886	75,931
5	Native american	3,702	3,159	3,917	5,972	9,370	16,168	15,372	21,414	20,139
6	Other	31,027	30,103	32,801	29,847	53,976	118,685	81,384	84,792	81,490
.	Missing	136,998	109,102	206,143	191,990	166,964	194,189	148,732	176,491	179,492
A	Invalid			1	2	130	2		328	49
B	Unavailable from source	2,473,021	3,984,798	3,722,817	3,422,707	1,816,659	1,344,395	1,285,141	1,105,273	1,098,954

Race	Description	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	White	4,137,046	3,735,791	3,972,604	3,982,390	3,824,605	3,726,295	3,851,917	3,958,974	4,006,661	3,916,050
2	Black	771,554	725,423	768,933	742,954	709,844	792,809	838,737	877,715	697,890	807,980
3	Hispanic	529,512	502,149	468,725	648,492	689,327	713,035	822,184	774,583	758,956	872,342
4	Asian or pacific islander	111,094	101,439	115,770	116,096	132,186	157,115	147,362	154,218	145,396	133,308
5	Native American	17,925	16,526	17,217	22,056	24,910	17,189	12,541	27,652	27,369	41,224
6	Other	116,684	113,842	155,437	154,932	148,766	189,294	178,239	171,853	204,563	185,425
.	Missing	722,421	1,632,112	1,699,840	1,783,657	1,922,889	2,257,994	2,126,311	2,039,228	2,152,901	2,118,245
A	Invalid	77	68	403	415	200	251	437	348	1,312	251
B	Unavailable from source	742,107									

Table B9 Primary payer type (patient payment type)

I:Primary expected payer, uniform		1988	1989	1990	1991	1992	1993	1994	1995	1996
1	Medicare	1,610,074	1,656,564	1,991,843	2,029,011	2,131,286	2,241,472	2,221,834	2,388,082	2,362,646
2	Medicaid	644,194	743,266	951,596	927,714	1,044,173	1,193,183	1,181,662	1,232,912	1,150,217
3	Private (including HMO)	2,178,329	2,237,998	2,576,319	2,555,468	2,416,349	2,444,818	2,348,611	2,473,991	2,456,231
4	Self-pay	242,808	221,738	239,692	205,040	341,678	368,190	331,170	342,388	318,252
5	No Charge	9,009	6,952	8,293	7,428	5,807	7,805	4,353	10,846	10,615
6	Other	574,149	492,830	471,765	419,988	232,962	231,791	255,333	231,975	219,078
.	Missing	7,034	17,304	24,496	7,144	23,207	51,711	40,869	25,432	23,098
A	Invalid	159	321	4,511	4,395	282	6	1,179	9,309	1,932
B	Unavailable from source		733,091							

I:Primary expected payer, uniform		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	Medicare	2,594,934	2,489,009	2,581,888	2,685,729	2,749,788	2,877,847	2,956,310	2,896,566	2,967,695	3,004,546
2	Medicaid	1,173,049	1,124,053	1,197,106	1,228,336	1,284,211	1,368,152	1,463,984	1,525,136	1,563,386	1,572,240
3	Private (including HMO)	2,756,836	2,633,521	2,817,536	2,916,365	2,824,744	2,974,990	2,925,914	2,888,736	2,789,963	2,750,515
4	Self-pay	324,750	329,459	342,135	338,778	336,047	353,767	338,577	401,952	393,487	420,409
5	No Charge	24,267	14,591	16,690	25,540	20,802	24,666	30,809	32,312	36,872	41,878
6	Other	258,089	203,549	203,281	226,625	217,256	244,340	245,987	245,642	233,516	271,644
.	Missing	14,495	31,533	37,935	20,933	13,776	8,608	13,830	10,936	7,961	11,462
A	Invalid	2,000	1,635	2,358	8,686	6,103	1,612	2,317	3,291	2,168	2,131
B	Unavailable from source										

Table B10 Secondary payer type

I:Secondary expected payer, uniform	Description	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	Medicare	16,859	20,334	24,106	22,767	25,140	34,416	38,602	56,173	56,552
2	Medicaid	50,475	69,001	82,819	90,128	91,939	159,322	174,320	238,231	237,438
3	Private (including HMO)	279,399	374,261	429,922	422,901	413,479	621,660	686,543	951,303	885,353
4	Self-pay	179,186	197,959	214,709	232,373	181,278	250,623	272,208	560,991	564,525
5	No Charge	1,610	689	1,192	1,107	1,262	1,395	1,610	2,561	2,549
6	Other	333,845	190,377	230,675	189,879	167,925	132,514	43,295	79,858	102,679
.	Missing	1,099,634	1,219,282	1,182,696	1,158,785	1,133,855	2,032,432	1,908,369	2,055,621	1,898,661
A	Invalid		7		2	1,338	2		2,946	1,754
B	Unavailable from source	3,127,302	3,923,467	3,988,131	3,924,416	4,057,303	3,194,139	3,135,853	2,497,572	2,500,506
C	Inconsistent	177,446	114,687	114,265	113,830	122,225	112,473	124,211	269,679	292,052

I:Secondary expected payer, uniform	Description	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	Medicare	56,801	312,598	335,653	390,870	409,209	366,431	466,368	437,876	415,941	389,185
2	Medicaid	240,175	309,940	314,526	362,589	376,144	407,316	506,205	582,921	616,116	574,897
3	Private (including HMO)	816,155	815,578	781,150	886,507	924,024	995,894	1,075,228	1,100,515	1,055,082	1,085,134
4	Self-pay	546,003	390,142	409,526	497,366	416,192	447,491	570,377	575,217	508,381	525,771
5	No Charge	3,166	1,787	2,671	6,573	4,782	3,269	6,993	8,622	31,283	9,203
6	Other	93,640	82,389	85,323	89,114	116,193	100,823	126,502	112,177	141,380	139,251
.	Missing	2,016,488	4,913,392	5,269,386	5,182,001	5,177,081	5,466,419	5,131,576	5,151,897	5,172,869	5,322,169
A	Invalid	1,815	1,524	694	35,972	29,102	66,339	94,479	35,346	53,996	29,215
B	Unavailable from source	3,057,688									
C	Inconsistent	316,489									

Table B11 Patient income category based on median income of zip code

ZipInc4	Description	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	$1 - $35,000	2,956,898	3,904,515	4,059,823	3,932,174	3,936,106	3,892,247	3,789,376	4,120,336	3,971,986
2	$35,001 - $45,000	953,589	1,048,552	1,094,874	1,088,264	1,095,419	1,072,635	1,091,290	1,117,900	1,077,151
3	$45,001 or More	672,248	575,240	590,085	593,188	603,492	699,560	709,973	708,833	691,612
.	Missing	683,021	581,757	523,733	542,562	560,727	874,534	794,372	767,866	801,320
A	Invalid									

ZipInc4	Description	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	$1 - $35,000	4,303,790	2,669,537	2,709,542	2,824,209	2,239,840	1,973,218	2,153,326	2,330,838	2,171,176	2,271,361
2	$35,001 - $45,000	1,150,728	1,995,368	2,125,006	1,930,651	1,919,894	2,014,364	2,053,914	2,030,858	1,976,904	2,019,979
3	$45,001 or More	788,198	1,931,196	2,139,292	2,559,416	3,200,211	3,679,967	3,590,603	3,475,930	3,648,216	3,580,941
.	Missing	905,704	231,249	225,089	136,716	92,782	186,433	179,885	166,945	198,752	201,888
A	Invalid										656

Table B12 Facility bed size to which patient is admitted

ST_BEDSZ	Description	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	Small	586,142	616,148	638,769	649,162	682,445	728,714	861,999	975,849	977,078
2	Medium	1,512,406	1,813,864	1,899,765	1,840,895	1,764,920	2,021,797	2,086,281	2,061,802	2,066,687
3	Large	3,167,208	3,677,769	3,729,661	3,662,641	3,742,119	3,775,406	3,424,250	3,458,566	3,486,491
.	Missing		2,283	320	3,490	6,260	13,059	12,481	218,718	11,813

ST_BEDSZ	Description	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	Small	1,117,903	924,157	929,458	873,432	850,405	980,473	983,075	1,063,546	976,980	1,122,232
2	Medium	2,284,023	2,002,027	2,031,335	2,050,266	2,018,557	1,998,737	2,090,163	2,099,039	1,988,122	2,045,291
3	Large	3,720,911	3,874,987	4,238,136	4,515,709	4,583,765	4,874,772	4,900,611	4,841,986	5,029,946	4,890,792
.	Missing	25,583	26,179		11,585			3,879			16,510

Table B13 Facility control to which patient is admitted (e.g., facility owner type)

ST_ OWNER	Description	1988	1989	1990	1991	1992	1993	1994	1995	1996
0	Government or private, collapsed category									
1	Government, nonfederal public	879,947	938,395	952,454	763,956	746,818	963,216	923,980	940,902	938,176
2	Private, non-profit	3,871,701	4,640,128	4,776,302	4,873,634	4,934,032	4,995,645	4,879,596	4,875,180	4,894,675
3	Private, invest-own	514,108	529,258	539,439	515,108	508,634	567,056	568,954	680,135	697,405
4	Private, collapsed category									
.	Missing		2,283	320	3,490	6,260	13,059	12,481	218,718	11,813

ST_ OWNER	Description	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
0	Government or private, collapsed category		4,059,046	4,302,260	4,363,272	4,261,331	4,590,410	4,692,866	4,770,999	4,641,938	4,877,781
1	Government, nonfederal public	1,046,681	498,980	503,997	548,751	564,472	575,055	556,130	545,432	604,468	516,336
2	Private, non-profit	5,116,211	1,251,798	1,358,061	1,475,368	1,505,775	1,568,577	1,570,047	1,562,168	1,573,168	1,492,343
3	Private, invest-own	959,945	664,951	681,623	707,735	808,176	778,922	835,058	799,477	887,194	864,365
4	Private, collapsed category		326,396	352,988	344,281	312,973	341,018	319,748	326,495	288,280	307,490
.	Missing	25,583	26,179		11,585			3,879			16,510

Table B14 Location and teaching status of hospitals to which patients are admitted

LOCTEACH	Description	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	Rural	567,707	780,167	778,026	740,655	673,547	828,301	794,561	905,250	909,013
2	Urban non-teaching	2,878,857	3,263,597	3,385,810	3,476,649	3,526,467	3,601,347	3,393,130	3,255,741	3,275,682
3	Urban teaching	1,819,192	2,064,017	2,104,359	1,935,394	1,989,470	2,096,269	2,184,839	2,335,226	2,345,561
.	Missing		2,283	320	3,490	6,260	13,059	12,481	218,718	11,813

LOCTEACH	Description	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	Rural	1,068,507	1,033,074	1,157,512	1,134,917	1,140,872	1,171,940	1,098,390	1,014,380	1,021,865	989,493
2	Urban non-teaching	3,511,794	2,714,202	2,758,264	3,143,418	3,206,832	3,262,805	3,455,189	3,474,923	3,732,513	3,323,958
3	Urban teaching	2,542,536	3,053,895	3,283,153	3,161,072	3,105,023	3,419,237	3,420,270	3,515,268	3,240,670	3,744,864
.	Missing	25,583	26,179		11,585			3,879			16,510

Table B15 Hospital location region to which patients are admitted

	Description	1988	1989	1990	1991	1992	1993	1994	1995	1996	
1	Northeast	1,355,234	1,568,953	1,655,951	1,632,119	1,603,184	1,612,580	1,453,591	1,384,746	1,375,767	
2	Midwest	1,001,807	1,550,370	1,560,968	1,542,014	1,509,106	1,573,645	1,565,281	1,623,099	1,614,470	
3	South	1,574,518	1,594,570	1,618,243	1,598,068	1,640,639	2,182,557	2,160,687	2,276,553	2,315,007	
4	West	1,334,197	1,396,171	1,433,353	1,383,987	1,442,815	1,170,194	1,205,452	1,224,209	1,236,825	
.	Missing								206,328		
	Description	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	Northeast	1,478,923	1,331,304	1,365,983	1,446,269	1,459,148	1,424,526	1,546,371	1,611,261	1,567,310	1,487,191
2	Midwest	1,638,735	1,507,097	1,611,291	1,707,141	1,600,870	1,798,719	1,782,535	1,719,774	1,803,828	1,779,316
3	South	2,623,227	2,624,062	2,811,554	2,857,364	2,928,355	3,071,238	3,184,805	3,182,571	3,076,474	3,221,740
4	West	1,407,535	1,364,887	1,410,101	1,440,218	1,464,354	1,559,499	1,464,017	1,490,965	1,547,436	1,586,578
.	Missing										