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Hospital-Acquired Conditions–Present on Admission: Examination of Spillover Effects and Unintended Consequences

Final Report

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EXECUTIVE SUMMARY

The Hospital-Acquired Conditions–Present on Admission (HAC-POA) program was mandated by the Deficit Reduction Act (DRA) of 2005. The DRA required the Secretary of the U.S. Department of Health and Human Services to identify high-cost and high-volume preventable conditions that result in higher payments for Medicare. The conditions had to be high cost, high volume, or both; result in the assignment of a case to a Medicare severity diagnosis-related group (MS-DRG) that has a higher payment when present as a secondary diagnosis; and be reasonably preventable through the application of evidence-based guidelines. The Centers for Medicare & Medicaid Services (CMS) identified eight conditions for which it would no longer pay a higher DRG rate if the conditions occurred in the inpatient setting and were not present on admission. Two additional conditions were added in fiscal year (FY) 2009, and one of the original categories was expanded. The DRA mandated that for discharges occurring on or after October 1, 2008, the acquisition of one or more of these preventable conditions during a hospital stay could not assign the patient's stay to a higher-paying MS-DRG.

The first eight conditions included serious reportable events (sometimes called "never events"),[1] such as foreign object accidentally retained after surgery, air embolism, and transfusing the wrong blood type (ABO incompatibility). They also included five harmful conditions that occur more often yet are believed to be reasonably preventable if accepted standards of care are followed: stage III and IV pressure ulcer; falls and trauma leading to fractures, dislocations, head injuries, burns, or other trauma; catheter-associated urinary tract infection (CAUTI); vascular catheter-associated infection; and a surgical site infection (SSI) (mediastinitis) following coronary artery bypass graft.

The HAC for SSIs was expanded in the FY 2009 rules to include those following specific orthopedic procedures to the spine, neck, shoulder, and elbow and infections following bariatric procedures. A ninth and tenth HAC were also identified: one for serious complications of diabetes acquired during a stay (manifestations of poor glycemic control) and one for deep vein thrombosis (DVT) or pulmonary embolism (PE) following certain orthopedic procedures.

The HAC-POA program may result in many spillover effects and unintended consequences. We expect that these effects will differ across payers. Medicaid programs that share in the cost of care for Medicare/Medicaid dual enrollees will be directly affected by the HAC-POA program, whereas private commercial payers, the Department of Veterans Affairs, and self-pay payers may be more indirectly affected. Patient-level spillover effects from the mandatory POA coding are also likely. We expect increased provider awareness of the incidence and costs of HACs to lead to improved hospital protocols and reductions in the number of reasonably preventable events across all patients. These are the hoped-for spillovers, occurring as hospitals adapt their behavior and create new procedures in response to the payment incentives or the new documentation requirements. Each of the new policy responses by other payers or State governments increases the likelihood of desirable spillover effects to the non-Medicare population.

[1] The National Quality Forum defines serious reportable events as preventable, serious, and unambiguous events that should never occur.

As part of its evaluation of the Medicare HAC-POA program, RTI International was asked to investigate several of these suggested possible spillover effects and unintended negative consequences using appropriate qualitative or quantitative research approaches. This report summarizes findings from investigations of some of these effects, using quantitative analysis of claims and other secondary data.

E.1 Study Questions and Data

In this report, we address the following research questions:

1. How much variation in the reporting of HACs is there across all payers?

2. Has the HAC-POA program reduced the overall reporting of HACs for all payers; in other words, is there a positive spillover to all payers?

3. Have hospitals failed to identify HACs by not recording the relevant conditions in the first eight secondary diagnosis codes?

4. How does the coding of secondary diagnosis codes and location of HACs among the secondary diagnosis codes vary by hospital characteristics such as for-profit status, teaching status, and location?

The primary data for the all-payer analysis are the Agency for Healthcare Research and Quality (AHRQ) Healthcare Cost and Utilization Project (HCUP) State inpatient databases (SIDs) for Arizona, California, Florida, and New Jersey. California has a long history of coding the POA variable. A POA variable has been on the California claim since 1997. Florida, however, did not begin including the POA variable on its inpatient claims until 2007. Arizona and New Jersey did not begin until FY 2008.

E.2 Findings From the Analysis of Spillovers

- We did not find any consistent pattern in the reporting of the rates of HACs across 3 years or by type of payer or by State. Medicare had the highest rates of hospital-acquired falls and trauma, stage III and IV pressure ulcer, CAUTI, and vascular catheter-associated infection. Medicaid had the highest rates of hospital-acquired mediastinitis following coronary artery bypass graft surgery and SSI following certain orthopedic procedures. It is not possible to draw any conclusions for air embolism, blood incompatibility, or SSI following bariatric surgery because they occurred too infrequently.

- Comparing rates of HACs from 2008 through 2010, we observe a general decline in the rate for several HACs: falls and trauma, catheter-associated UTI, DVT/PE following certain orthopedic procedures, and SSI following certain orthopedic procedures. However, in most cases, the rate actually increased in 2009 compared to 2008 before declining again in 2010. We found two different trends when we analyzed stage III and IV pressure ulcers. Between 2009 and 2010, rates fell in Arizona and California, but increased in Florida and New Jersey. One explanation is that some hospitals were still "learning" how to recognize and code the stages of pressure ulcers, a new requirement under the Medicare HAC-POA program.

- The multivariate analysis of the all-payer data for three of the HACs provides some limited evidence of positive spillover effects on other payers, primarily in the first year of the Medicare HAC-POA program, for two of the three conditions. But we can also interpret the results as showing no impact of the Medicare HAC-POA program on the three studied HACs. There was no observed decline in the rate of CAUTI, and the observed decline in the rates of falls and trauma and DVT/PE following certain orthopedic procedures across all payers could be a naturally occurring secular trend, as the benefit appeared to be greatest in hospitals with initially highest rates.

E.3 Findings From the Analysis of Unintended Consequences

- Across public and private payers, counting all secondary diagnosis codes had the greatest positive effect in raising HAC rates for Medicare and Medicaid beneficiaries. One possible explanation for this finding is that Medicare and Medicaid patients are more likely to have multiple comorbidities or complications due to greater severity of illness, which increases the likelihood that more than eight secondary diagnosis fields are needed to code them all. Reporting more than eight diagnoses, in turn, provides more opportunity, intended or otherwise, to put HAC codes in the ninth or later fields.

- We examined the extent to which hospitals with the *ability* to code strategically *are* coding strategically by limiting our analysis to just those discharges with nine or more secondary diagnosis codes**.** We did not find any consistent pattern in coding across hospital characteristics across the HACs.

Beginning in January 2011, CMS began processing data for up to 25 diagnosis fields for all hospitals when submitted in the version 5010 format. This change may increase reported rates for some HACs and will improve accuracy. For example, the reported rate for hospital-acquired stage III or IV pressure ulcer could more than double and the rate for hospital-acquired falls and trauma could increase by 20 percent. The actual change may be more or less depending on hospital changes in quality in the interim. However, some HACs may still be missed to the extent that HACs do not manifest in the hospital or are coded POA on another admission, not coded at all, or coded in the 26th–30th secondary diagnosis fields.

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SECTION 1
INTRODUCTION, STUDY QUESTIONS, AND ORGANIZATION OF REPORT

1.1 Introduction

The purpose of this study is to look at spillovers and unintended consequences of the Medicare Hospital-Acquired Conditions–Present on Admission (HAC-POA) Program. The Deficit Reduction Act of 2005 (DRA) required the Secretary of the U.S. Department of Health and Human Services to identify high-cost and high-volume preventable conditions that result in higher payments for Medicare. As a result of this act, the Centers for Medicare & Medicaid Services (CMS) was required to identify by October 1, 2007, at least two preventable complications of care that could cause patients to be assigned to a higher-severity diagnosis-related group (DRG).[2] The conditions had to be high cost, high volume, or both; result in the assignment of a case to a DRG that has a higher payment when present as a secondary diagnosis; and be reasonably preventable through the application of evidence-based guidelines. The DRA mandated that for discharges occurring on or after October 1, 2008, the acquisition of one or more of these preventable conditions during a hospital stay could not lead to the patient's being assigned to a higher-paying DRG. To accomplish this, CMS required providers paid under the inpatient prospective payment system (IPPS) to code POA indicators on all *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) diagnoses for all claims submitted, beginning October 1, 2007. After considerable public comment in the published rules for IPPS and other inpatient settings during fiscal years (FY) 2007 and 2008, CMS identified eight conditions for which it would no longer pay a higher DRG rate if the conditions occurred in the inpatient setting and were not present on admission. Two additional conditions were added in FY 2009, and one of the original categories was expanded.

The first eight conditions included serious reportable events such as foreign object accidentally retained after surgery, air embolism, and transfusing the wrong blood type (ABO incompatibility). They also included five harmful conditions that occur more often yet are believed to be reasonably preventable if accepted standards of care are followed: stage III and IV pressure ulcer; falls and trauma leading to fractures, dislocations, head injuries, burns, or other trauma; catheter-associated urinary tract infection (CAUTI); vascular catheter-associated infection; and a surgical site infection (SSI) (mediastinitis) following coronary artery bypass graft (CABG).

The HAC for SSIs was expanded in the FY 2009 rules to include those following specific orthopedic procedures to the spine, neck, shoulder, and elbow and infections following bariatric procedures. A ninth and tenth HAC were also identified: one for serious complications of diabetes acquired during a stay (manifestations of poor glycemic control) and one for deep vein thrombosis (DVT) or pulmonary embolism (PE) following certain orthopedic procedures.

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[2] By FY 2008, CMS had replaced DRGs with Medicare Severity DRGs (MS-DRGs), which are more sensitive to the presence or absence of complicating conditions.

Table 1.1 displays each of the current conditions that were selected by CMS to be included in the HAC-POA program for 2009. Additional ICD-9-CM codes were added in October 2010 (FY 2011) to the HAC blood incompatibility. These are shown in Table 1.1 in a parenthetical.

Although the HAC-POA policy targets Medicare beneficiaries, the policy may have spillover effects on other insurers as well. Adoption of the policy by other payers is viewed as a desired and positive spillover effect by patient advocates. Since the implementation of the HAC-POA program, policy-level spillover effects have been documented in the form of payment policy changes in other payers (National Conference of State Legislatures, 2009). We expect that these effects will differ across payers. Medicaid programs that share in the cost of care for Medicare/Medicaid dual enrollees will be directly affected by the rule, whereas private commercial payers, the Department of Veterans Affairs, and self-pay payers may be more indirectly affected. After the announcement of the rule, CMS sent a letter to Medicaid programs in which the programs were encouraged to implement Medicaid payment policies to coordinate their payment policies with the existing Medicare HAC payment policy (Center for Medicaid and State Operations, 2008). CMS issued a notice of proposed rulemaking on February 17, 2011, and a final rule on June 6, 2011, that provided guidance for States to implement Section 2702 of the Patient Protection and Affordable Care Act of 2010. This section directs the Secretary to issue Medicaid regulations effective as of July 1, 2011, prohibiting Federal payments to States under Section 1903 of the Social Security Act for any amounts expended for providing medical assistance for health care-acquired conditions. It also authorizes States to identify other provider-preventable conditions for which Medicaid payment would be prohibited. Such regulations must ensure that the prohibition of payment for health care-acquired conditions shall not result in a loss of access to care or services for Medicaid beneficiaries.

The National Conference of State Legislatures also reports that several commercial payers—including Aetna, CIGNA HealthCare, Anthem Blue Cross Blue Shield in New Hampshire, Blue Cross Blue Shield of Massachusetts, and WellPoint—have adopted similar payment provisions for reasonably preventable errors.

- WellPoint, Aetna, and other private insurers are implementing no-pay policies based on National Quality Forum never events (Sorenson et al., 2011).
- Anthem and Blue Cross Blue Shield of Massachusetts reimburse providers for complications related to HACs as long as the provider was not involved in the adverse event (Sorenson et al., 2011).
- United Healthcare requires hospitals to include POA documentation; they will deny or not close commercial claims without the POA indicator (Sorenson et al., 2011).

Table 1.1
Hospital-acquired conditions that are subject to the Hospital-Acquired Condition–Present on Admission program for FY 2009–2011

Hospital-Acquired Condition	ICD-9-CM Diagnosis Code and Complication Status
Foreign object retained after surgery	998.4 (CC) or 998.7 (CC)
Air embolism	999.1 (MCC)
Blood incompatibility	999.60 (CC) [as of FY 2011, also 999.61 (CC), 999.62 (CC), 999.63 (CC), 999.69 (CC)]
Pressure ulcer stages III and IV	707.23 (MCC) or 707.24 (MCC)
Falls and trauma	Codes with these ranges on the CC/MCC list:
—Fracture	800–829
—Dislocation	830–839
—Intracranial injury	850–854
—Crushing injury	925–929
—Burn	940–949
—Electric shock	991–994
Catheter-associated urinary tract infection	996.64 (CC) Also excludes the following from acting as a CC/MCC: 112.2 (CC), 590.10 (CC), 590.11 (MCC), 590.2 (MCC), 590.3 (CC), 590.80 (CC), 590.81 (CC), 595.0 (CC), 597.0 (CC), 599.0 (CC)
Vascular catheter-associated infection	999.31 (CC)
Manifestations of poor glycemic control	250.10–250.13 (MCC), 250.20–250.23 (MCC), 251.0 (CC), 249.10–249.11 (MCC), 249.20–249.21 (MCC)
Surgical site infection, mediastinitis, following coronary artery bypass graft	519.2 (MCC) and one of the following ICD-9-CM procedure codes: 36.10–36.19
Surgical site infection following certain orthopedic procedures	996.67 (CC) or 998.59 (CC) and one of the following ICD-9-CM procedure codes: 81.01–81.08, 81.23–81.24, 81.31–81.38, 81.83, 81.85
Surgical site infection following bariatric surgery for obesity	Principal diagnosis—278.01 and 998.59 (CC) and one of the following ICD-9-CM procedure codes: 44.38, 44.39, or 44.95
Deep vein thrombosis or pulmonary embolism following certain orthopedic procedures	415.11 (MCC) or 415.19 (MCC) or 453.40–453.42 (MCC) and one of the following ICD-9-CM procedure codes: 00.85–00.87, 81.51–81.52, or 81.54

NOTE: CC = complication or comorbidity; ICD-9-CM = *International Classification of Diseases, Ninth Revision, Clinical Modification*; MCC = major complication or comorbidity.

Finally, the National Conference of State Legislatures reports that some States have negotiated or are in the process of negotiating with state hospital associations and larger hospital systems to refrain from sending any bills (regardless of payer) when certain never events[3] occur. As of February 2011, 27 States and the District of Columbia had enacted legislation to establish adverse event reporting systems for adverse events or HACs, while 31 States and the District of Columbia are tracking at least one Medicare HAC (West, Eng, and Lyda-McDonald, 2011).

Patient-level spillover effects from the mandatory POA coding are also likely. We expect increased provider awareness of the incidence and costs of HACs to lead to improved hospital protocols and reductions in the number of reasonably preventable events across all patients. These are the hoped-for spillovers, occurring as hospitals adapt their behavior and create new procedures in response to the payment incentives or the new documentation requirements. Each of the new policy responses by other payers or State governments increases the likelihood of desirable spillover effects to the non-Medicare population.

Understanding the hospital contribution to variation in the incidence of HACs is key to evaluating the program's effects on quality and patient safety. Hospitals face different market conditions, competitive pressures, and budget constraints. They also vary in the effectiveness of their management and their levels of commitment to safety and quality. A strong culture of safety will not necessarily correlate with low adverse event rates and could be associated with higher baseline adverse event rates if the culture of safety has resulted in more honest and accurate reporting. Such a culture should, however, be associated with an ability to respond to policy incentives such as those offered by the HAC-POA program that is greater than that found in poor cultures of safety.

It is also possible that hospitals will change behaviors in undesirable ways, resulting in unintended negative consequences for the HAC-POA program. Examples that have been suggested to CMS in public comments to the rules include altering admission patterns to avoid patients at higher risk for complications; ordering more laboratory tests to help identify asymptomatic POA conditions; overusing antibiotics to prevent infections; or simply not recording HACs in the medical record.

As part of its evaluation of the Medicare HAC-POA program, RTI International was asked to investigate several of these suggested possible spillover effects and unintended negative consequences using appropriate qualitative or quantitative research approaches. This report summarizes findings from investigations of some of these effects, using quantitative analysis of claims and other secondary data.

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[3] The National Quality Foundation has defined 28 never events. Initially, never events were defined as medical errors that should never occur. Today, the term includes any adverse events that should never occur (AHRQ, n.d.).

1.2 Study Questions

We address the following research questions:

1. How much variation in the reporting of HACs is there across all payers?

2. Has the HAC-POA program reduced the overall reporting of HACs for all payers; in other words, is there a positive spillover to all payers?

3. Have hospitals failed to identify HACs by not recording the relevant conditions in the first eight secondary diagnosis codes?

4. How does the coding of secondary diagnosis codes and location of HACs among the secondary diagnosis codes vary by hospital characteristics such as for-profit status, teaching status, and location?

1.3 Organization of Report

Section 2 of this report describes the data and methods. The primary data for this report are the Agency for Healthcare Research and Quality (AHRQ) Healthcare Cost and Utilization Project (HCUP) State inpatient databases (SIDs) for Arizona, California, Florida, and New Jersey for 2008–2010. The SID is an all-payer database, and each of the four States included in the analysis has been coding conditions present on admission since at least 2008.

Section 3 of this report answers the first two research questions. The SID data are used to look at HAC rates across primary payers and over time. We compared the levels and variation in HACs across six types of payers before and after the implementation of the HAC-POA program by calculating 10 different HAC rates by payer and State from 2008 to 2010, and we prepared descriptive tables showing the trend in rates from 2008 to 2010. We then used logistic regression to estimate the log-likelihood of the occurrence of three HACs in a particular hospitalization as a function of patient, hospital, and geographic characteristics with policy-relevant payer status, year, and State variables to examine the degree of spillover effect on other payers. We restricted the multivariate analysis to those conditions that had a sufficiently high incidence of occurrence to produce reliable estimates.

Section 4 of this report focuses on the last two research questions. The SID data are used to identify HACs that are coded in the ninth or beyond secondary diagnosis code. This is relevant because before FY 2011 CMS captured only the first eight secondary diagnosis codes. Section 4 also examines whether hospital characteristics can help explain the pattern of coding for different HACs and the trend in coding over time.

Section 5 provides an overall summary of the findings.

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SECTION 2
DATA AND METHODS

The primary dataset for this analysis is the all-payer data from AHRQ HCUP SIDs for 2008–2010. We purchased data for Arizona, California, Florida, and New Jersey, four States for which SID documentation indicated that the POA variable was populated in 2008 and for which the 2010 SID data were available by April 2012. California's history of coding POA on hospital claims goes back to 1997. Consequently, there has been sufficient time for researchers to study the POA coding for California hospitals (Coffey, Milenkovic, and Andrews, 2006). Florida began coding the POA variable in 2007, whereas Arizona and New Jersey began coding the POA variable in 2008.

We kept only discharges from acute care hospitals, identified by their Medicare provider IDs. We excluded critical access hospitals, children's hospitals, and other facility types because they are not paid under the IPPS and are therefore not subject to the HAC-POA rule. Using the information in the annual American Hospital Association Guide Issue, we merged Medicare provider IDs to the SID discharges. We further limited our sample to discharges for individuals over age 18 because not all HACs are relevant for children and, for those HACs that are applicable to children, hospital protocols and best practices may not apply (Bernard et al., 2011). By dropping individuals under age 18, we disproportionately dropped Medicaid and private insurer discharges: 37 percent of the Medicaid discharges and 25 percent of the private insurance discharges were for individuals 18 or under, compared with less than 0.5 percent of Medicare discharges. Finally, we dropped discharges in which the primary payer variable was coded as missing or invalid. ***Table 2.1*** shows the number of discharges in our final dataset by primary payer and State for 2008–2010.

We supplemented the SID data with hospital characteristic variables from the 2010 Provider of Services File (POS), rural-urban codes from http://www.census.gov, and information on academic medical centers (AMCs) from the University HealthSystem Consortium (UHC). The data from the POS file were merged with the SID data by Medicare provider ID. Using the POS file, we assigned each hospital an ownership type based on the control type (PROV2885). Hospitals whose control type equaled 1, 2, or 3 were coded as "nonprofit." Hospitals with a control type of 4 were classified as "for-profit," whereas hospitals with a control type of 6 or 7 were classified as "State or local" and hospitals with control type of 5 or 8 were classified as "other government." No other control types are associated with acute care hospitals.

Table 2.1
Number and percentage of discharges by primary payer and State, 2008–2010

Primary payer	Arizona	California	Florida	New Jersey
Medicare	683,163 (42%)	3,451,267 (40%)	3,122,461 (50%)	1,137,329 (44%)
Medicaid	339,390 (21%)	1,757,723 (20%)	849,792 (14%)	189,220 (7%)
Private insurance	460,168 (28%)	2,681,277 (31%)	1,560,780 (25%)	973,202 (37%)
Self-pay	47,587 (3%)	339,604 (4%)	396,194 (6%)	269,342 (10%)
No charge	4,030 (0%)	—	138,002 (2%)	657 (0%)
Other	83,618 (5%)	445,567 (5%)	220,611 (4%)	38,302 (1%)
Total	1,617,956 (100%)	8,675,438 (100%)	6,287,840 (100%)	2,608,052 (10%)

NOTES: Excludes discharges with missing payer information. "—" means there were no discharges for that cell.

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

We used 2003 rural-urban codes from the census to assign hospitals an urbanicity level. Hospitals in counties with a rural-urban code of 1 (county in metro area with 1 million population or more) were classified as "large urban." Counties with a rural-urban code of 2 (county in metro area of 250,000 to 1 million population) or 3 (county in metro area of fewer than 250,000 population) were classified as "small urban." All other counties were classified as "rural."

Finally, we created markers for hospitals considered AMCs. To determine which hospitals are AMCs, we used the current member list from UHC and assigned AMC status to full member hospitals/hospital systems.

We created 10 HAC variables using the diagnosis, procedure, and DxPOA fields on the Medicare Provider Analysis and Review (MedPAR) claim: 1 for each of the 9 non-SSI HACs and 3 separate variables for each of the distinct types of SSIs. We created separate HAC variables for the different types of SSIs because it is unlikely that any admission is a candidate for more than one of the SSI HACs. For example, a patient admitted for bariatric surgery is a candidate for SSI following bariatric surgery, but not for SSI following certain orthopedic procedures.

An admission was considered to have 1 of the 10 HACs if any HAC-related diagnosis codes were not present on admission (i.e., DxPOA was not equal to Y or W) *and* that corresponding diagnosis code met criteria for the HAC. For the 3 SSI HACs as well as DVT/PE following certain orthopedic procedures, beneficiaries also needed to meet the procedure requirements to have the HAC. The criteria for assigning a HAC are based on the ICD-9-CM diagnosis and procedure codes in Table 1.1.

After assigning each beneficiary any study HACs, we next calculated HAC rates based on the number of beneficiaries with a particular HAC for every 10,000 discharges eligible for that HAC. All discharges were eligible for all HACs except the three SSI HACs and DVT/PE following certain orthopedic procedures. ***Table 2.2*** shows the number of eligible discharges for each HAC for 2008–2010.

Table 2.2
Number of eligible discharges, by HAC, 2008–2010

Hospital-acquired condition	Number of eligible discharges
Foreign object retained after surgery	19,190,202
Falls and trauma	19,190,202
Manifestations of poor glycemic control	19,190,202
Air embolism	19,190,202
Blood incompatibility	19,190,202
Stage III or IV pressure ulcer	19,190,202
Catheter-associated urinary tract infection	19,190,202
Vascular catheter-associated infection	19,190,202
Deep vein thrombosis /pulmonary embolism following certain orthopedic procedures	535,057
SSI—mediastinitis following coronary artery bypass graft surgery	136,177
SSI following certain orthopedic procedures	229,204
SSI following bariatric surgery	73,746

NOTE: Eligible discharges include discharges with missing primary payer.

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

2.1 Potential Issue: Problems Coding the POA Variable Within a Hospital

A 2011 AHRQ study (Maeda et al., 2011) found that in 2008 there were hospitals that coded all POA variables "yes," or coded all POA variables "no," or left more than 10 percent of the POA variables missing or undetermined. Although we do include these hospitals in our study because we are interested in coding of HACs and improvements over time, both in the HAC rate and coding of HACs, in this section we explore the extent of the POA coding problem in hospitals.

The first step in this analysis was to count the number of secondary diagnosis fields coded on each discharge. Next, we counted the number of POA indicators with a value of "Y" or "W," indicating POA "yes," and the number of POA indicators with a value of "N" or "E," indicating POA "no" for each discharge. For each discharge, we then calculated the share of POA indicators that were yes, no, and missing. ***Table 2.3*** shows the number of hospitals by State where all POA variables were coded yes, no, or with more than 10 percent of the POA indicators missing. Table 2.3 shows that the biggest problem hospitals have with POA coding is leaving the indicator missing and that the problem was most acute in New Jersey. We found only one hospital in Florida in 2010 that coded all the secondary diagnosis POA indicators with a value of yes.

Table 2.3
Number of hospitals where all POA variables are coded "yes," "no," or more than 10 percent missing 2010

State	Year	Number of hospitals with all POA indicators = yes	Number of hospitals with all POA indicators = no	Number of hospitals with more than 10 percent of POA indicators with missing values	Number of hospitals in sample
AZ	2010	0	0	0	52
CA	2010	0	0	0	309
FL	2010	1	0	0	168
NJ	2010	0	0	43	65

SOURCE: RTI analysis of 2010 Healthcare Cost and Utilization Project State inpatient databases.

SECTION 3
SPILLOVER EFFECTS OF THE HAC-POA PROGRAM TO OTHER PAYERS

3.1 Introduction

We expect that, if the HAC-POA program resulted in any changes in the incidence of HACs, these changes will be observed across all patients within a hospital, independent of payer. Quality and safety improvements, such as new protocols for avoiding SSIs, will generate hospital-wide changes that should affect all patients, regardless of payer. However, not all hospitals may have the same incentives to modify their behavior.

Many factors could influence a hospital's behavior in response to the implementation of the HAC-POA program. Initial RTI estimates in support of rulemaking found that in 2010, the HAC-POA program had a direct financial impact on only 3,572 discharges, saving Medicare only $21,450,095.[4] Although initial RTI estimates show minimal direct financial impact, the program may indirectly lead to lower expected revenues and profits for hospitals if the cost of care exceeds payments. Economic theory predicts a tipping point where expected losses in revenue are high enough to overcome the financial and organizational costs and trigger a change in hospital behavior. Factors that may lead indirectly to expected lower revenue include (1) the adoption of similar rules by private payers, Medicaid, or both and (2) potential loss of reputation if lack of adherence to quality protocols is publicly reported. It is also possible that hospitals choose to modify their behavior in anticipation of *future* increases in the penalties for poor-quality performance, as proposed in the Affordable Care Act of 2010.

In conducting this spillover analysis using secondary data sources, we do not observe the *actual incidence* of HACs but only the *reporting* of HACs. A second issue is that many HACs, including those for SSIs, do not manifest until after a patient is discharged from the hospital. To be consistent with the Medicare HAC-POA program, which requires clinical manifestation during the hospitalization, we use only inpatient data for this analysis. If a "true" HAC rate includes conditions that begin during the initial hospitalization but are not manifest until after discharge, our rates will be understated.

In this section, we address the following two questions:

- How much variation in the reporting of HACs is there across all payers?
- Has the HAC-POA program reduced the overall reporting of HACs for all payers; in other words, is there a positive spillover to all payers?

To answer these questions, we first compared the levels and variation in HACs across six types of payers before and after the implementation of the HAC-POA program by calculating 10 different HAC rates by payer and State from 2008 to 2010 and prepared descriptive tables showing the trend in rates from 2008 to 2010. We then used logistic regression to estimate the

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4 RTI analysis of MedPAR IPPS claims, October 2009 through September 2010, found in Table F of 2010 Charts_all_DRGs_072611.doc

log-likelihood of the occurrence of three HACs in a particular hospitalization as a function of patient, hospital, and geographic characteristics with policy-relevant payer status, year, and State variables to examine the degree of spillover effect on other payers. We restricted the multivariate analysis to those conditions that had a sufficiently high incidence of occurrence to produce reliable estimates. The remainder of this section presents the descriptive analyses (***Section 3.2***) and the multivariate analyses (***Section 3.3***). The section concludes with a discussion (***Section 3.4***) that summarizes the findings.

3.2 Descriptive Analysis: Rates of Hospital-Acquired Conditions Across Payers and Over Time

We begin with a descriptive analysis of variation in the reported HACs across payers and the changes in reporting from 2008 and 2010. All of the secondary diagnoses on the HCUP record are used to calculate HAC rates. Overall, the tables show that the reported rate of HACs varies across payers and States. Because of the differences across HACs, we discuss each separately. No statistical tests of differences are reported. Instead, testing is done later (see ***Section 3.3***) using logistic regression to control for differences in patient mix. Also, rates for self-pay, no charge, and the "other payer" category are based on too few observations to be considered meaningful.

Table 3.1 displays rates of hospital-acquired foreign object retained after surgery per 10,000 discharges by primary payer, State, and year. Across payers, less than 1 in 10,000 discharges results in a hospital-acquired foreign object retained after surgery. Although there are differences in the rate across payers, there is no pattern either across time or across States.

Table 3.1
Rates of hospital-acquired foreign object retained after surgery, per 10,000 discharges, by primary payer, State, and year

State	Year	Medicare rate per 10,000	Medicaid rate per 10,000	Private insurance rate per 10,000	Self-pay rate per 10,000	No charge rate per 10,000	Other rate per 10,000
Arizona	2008	0.54	0.29	0.82	0.62	0.00	0.37
Arizona	2009	0.40	0.86	0.54	1.95	0.00	0.34
Arizona	2010	0.26	0.92	0.86	0.63	0.00	1.12
California	2008	0.48	0.56	0.74	0.27	—	0.86
California	2009	0.44	0.22	0.56	0.35	—	0.33
California	2010	0.38	0.39	0.51	0.17	—	0.49
Florida	2008	0.36	0.46	0.57	0.23	0.00	0.66
Florida	2009	0.31	0.41	0.36	0.38	0.38	0.27
Florida	2010	0.33	0.20	0.24	0.23	0.26	0.69
New Jersey	2008	0.28	0.17	0.39	0.34	0.00	0.78
New Jersey	2009	0.19	0.32	0.36	0.45	0.00	0.00
New Jersey	2010	0.27	0.00	0.48	0.11	0.00	0.00

NOTE: "—" means there were no discharges for that cell. The number of instances in which the hospital-acquired condition occurred can be found in ***Table A.1*.**

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

Table 3.2 displays the rates of hospital-acquired falls and trauma per 10,000 discharges by primary payer, State, and year. Compared with Medicaid, privately insured, and self-pay discharges, the HAC rate for Medicare discharges is at least 50 percent higher across all States and years, which is not surprising given the greater likelihood of a fall among the elderly. In Arizona in 2008, the rate was 11.37/10,000 Medicare discharges, compared with 3.30/10,000 Medicaid discharges, 5.09/10,000 privately insured discharges, and 3.70/10,000 self-pay discharges. Similarly, in New Jersey in 2010, the rate for Medicare discharges was 8.42/10,000 Medicare discharges, compared with 3.48/10,000 Medicaid discharges, 2.87/10,000 privately insured discharges, and 2.77/10,000 self-pay discharges.

Table 3.2 also shows a strong downward trend in the HAC rates for falls and trauma across all payers from 2008 to 2010. The decline is most precipitous in all four States from 2008 to 2009, with a smaller decline from 2009 to 2010. One possible explanation for this downward trend is improved or enforced hospital protocols to reduce falls and trauma.

Table 3.2
Rates of hospital-acquired falls and trauma, per 10,000 discharges, by primary payer, State, and year

State	Year	Medicare rate per 10,000	Medicaid rate per 10,000	Private insurance rate per 10,000	Self-pay rate per 10,000	Other rate per 10,000	No charge rate per 10,000
Arizona	2008	11.37	3.30	5.09	3.70	0.00	9.55
Arizona	2009	10.13	3.17	3.90	1.95	0.00	2.71
Arizona	2010	9.25	3.18	3.92	1.25	15.82	3.36
California	2008	11.92	4.87	5.43	4.94	—	8.42
California	2009	8.41	3.50	3.20	2.96	—	3.26
California	2010	7.40	2.54	2.89	2.77	—	3.00
Florida	2008	10.73	4.69	3.75	2.67	4.26	4.63
Florida	2009	9.98	3.45	3.82	2.43	4.21	3.85
Florida	2010	8.45	3.30	3.60	3.60	2.32	4.72
New Jersey	2008	12.58	5.47	8.63	8.96	0.00	22.68
New Jersey	2009	8.07	2.87	3.06	2.34	0.00	3.10
New Jersey	2010	8.42	3.48	2.87	2.77	0.00	6.35

NOTE: "—" means there were no discharges for that cell. The number of instances in which the hospital-acquired condition occurred can be found in ***Table A.2***.

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

A necessary, but not sufficient, condition for POA reporting to be a contributing factor to the decline in the rate of hospital-acquired falls and trauma is for the percentage of discharges with a fall or trauma coded as POA to increase while the numbers of discharges with a fall or trauma remain constant or increase. ***Table 3.3*** shows the number of discharges with a fall or trauma (independent of POA status), and the percentage coded POA, by primary payer, State, and year. The number of discharges for falls and trauma was fairly constant from 2008 to 2010, but the percentage of discharges for falls and trauma coded POA increased from 2008 to 2010. It is therefore likely that the reductions in fall and trauma HAC rates in Table 3.3 are at least partially explained by an increase in POA reporting.

Table 3.3
Number of discharges with a fall or trauma and percentage coded present on admission, by primary payer and State, 2008–2010

State	Year	Medicare N (%)	Medicaid N (%)	Private insurance N (%)	Self-pay N (%)	No charge N (%)	Other N (%)
Arizona	2008	5,693 (95.6)	2,405 (98.6)	3,429 (97.5)	1,046 (99.4)	12 (100.0)	1,370 (98.1)
Arizona	2009	5,766 (96.0)	2,731 (98.6)	3,083 (98.1)	940 (99.7)	37 (100.0)	1,169 (99.3)
Arizona	2010	6,070 (96.4)	2,896 (98.7)	2,886 (98.1)	840 (99.8)	41 (95.1)	1,159 (99.2)
California	2008	24,525 (94.2)	7,090 (96.0)	15,767 (96.7)	4,504 (98.8)	—	7,581 (98.3)
California	2009	24,926 (96.0)	7,154 (97.1)	15,427 (98.1)	4,767 (99.3)	—	7,014 (99.3)
California	2010	23,544 (96.6)	6,913 (97.9)	13,913 (98.3)	5,038 (99.4)	—	6,554 (99.3)
Florida	2008	20,963 (94.7)	2,388 (94.9)	12,340 (98.3)	3,633 (99.0)	1,597 (98.7)	3,151 (98.9)
Florida	2009	21,721 (95.1)	2,827 (96.4)	11,556 (98.2)	3,504 (99.1)	1,435 (98.5)	2,782 (99.0)
Florida	2010	21,022 (95.9)	2,975 (96.7)	10,682 (98.4)	3,623 (98.7)	943 (99.0)	2,828 (98.8)
New Jersey	2008	7,197 (93.2)	419 (92.1)	5,042 (94.3)	2,041 (96.1)	1 (100.0)	756 (96.2)
New Jersey	2009	7,322 (95.8)	450 (96.)	5,212 (98.1)	1,921 (98.9)	—	624 (99.4)
New Jersey	2010	7,329 (95.7)	495 (95.4)	5,202 (98.3)	2,062 (98.8)	3 (100.0)	674 (98.8)

NOTE: "—" means there were no discharges for that cell.

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

Table 3.4 displays rates of hospital-acquired manifestations of poor glycemic control per 10,000 discharges, by primary payer, State, and year. In Arizona and California, with the exception of self-pay and "other" insured patients, who have relatively few discharges, the highest HAC rates for poor glycemic control are found for Medicaid patients. In Florida and New Jersey, there is less difference in hospital-acquired poor glycemic control rates across payers. In 2008 in Florida, the highest rate of hospital-acquired poor glycemic control is among Medicaid patients, but by 2010, the highest rate is among privately insured patients. Conversely, in New Jersey, the highest rate of hospital-acquired poor glycemic control is for privately insured patients in 2008, but the rate is highest among Medicaid patients in 2010. Table 3.4 also shows steadily declining rates in Arizona, California, and Florida from 2008 to 2010. The observed declines could have resulted from hospital improvements to monitor and control blood sugar or from improved diagnosis of poor glycemic control at admission. It is unclear why rates of hospital-acquired poor glycemic control would have fallen in New Jersey from 2008 to 2009 across the three major primary payers, only to increase again in 2010.

Table 3.4
Rates of hospital-acquired manifestations of poor glycemic control per 10,000 discharges, by primary payer, State, and year

State	Year	Medicare rate per 10,000	Medicaid rate per 10,000	Private insurance rate per 10,000	Self-pay rate per 10,000	Other rate per 10,000	No charge rate per 10,000
Arizona	2008	0.77	1.26	0.29	0.00	0.00	0.73
Arizona	2009	0.22	0.60	0.20	0.00	0.00	1.02
Arizona	2010	0.30	0.58	0.29	0.00	0.00	0.00
California	2008	0.91	1.27	0.93	2.11	—	1.51
California	2009	0.46	0.68	0.44	0.26	—	0.53
California	2010	0.40	0.42	0.38	0.61	—	0.42
Florida	2008	0.76	0.81	0.60	0.69	0.64	0.40
Florida	2009	0.55	0.48	0.49	0.38	0.00	0.41
Florida	2010	0.43	0.40	0.60	0.30	0.26	0.69
New Jersey	2008	0.85	0.50	0.90	0.90	0.00	1.56
New Jersey	2009	0.53	0.48	0.33	0.67	0.00	0.00
New Jersey	2010	0.48	1.21	0.55	0.22	0.00	0.79

NOTE: "—" means there were no discharges for that cell. The number of instances in which the hospital-acquired condition occurred can be found in *Table A.3*.

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

Table 3.5 displays the rates of hospital-acquired air embolism per 10,000 discharges by primary payer, State, and year. Rates of hospital-acquired air embolism are very low, occurring, on average, less than 1 time in every 100,000 discharges. There is no clear pattern in HAC rates across payers. There is also no trend in the rate of air embolism for any of the primary payers or States.

Table 3.5
Rates of hospital-acquired air embolism per 10,000 discharges, by primary payer, State, and year

State	Year	Medicare rate per 10,000	Medicaid rate per 10,000	Private insurance rate per 10,000	Self-pay rate per 10,000	Other rate per 10,000	No charge rate per 10,000
Arizona	2008	0.05	0.00	0.00	0.00	0.00	0.00
Arizona	2009	0.09	0.17	0.13	0.00	0.00	0.00
Arizona	2010	0.04	0.00	0.00	0.00	0.00	0.00
California	2008	0.07	0.03	0.06	0.00	—	0.07
California	2009	0.08	0.02	0.05	0.00	—	0.20
California	2010	0.07	0.02	0.05	0.00	—	0.07
Florida	2008	0.04	0.04	0.04	0.08	0.00	0.00
Florida	2009	0.02	0.03	0.02	0.00	0.19	0.00
Florida	2010	0.01	0.03	0.02	0.00	0.00	0.00
New Jersey	2008	0.00	0.00	0.00	0.11	0.00	0.00
New Jersey	2009	0.03	0.00	0.00	0.00	0.00	0.00
New Jersey	2010	0.03	0.00	0.00	0.00	0.00	0.00

NOTE: "—" means there were no discharges for that cell. The number of instances in which the hospital-acquired condition occurred can be found in ***Table A.4***.

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

Hospital-acquired blood incompatibility is also very rare. ***Table 3.6*** displays the rates of hospital-acquired blood incompatibility per 10,000 discharges by primary payer, State, and year. On average, less than 1 patient in 250,000 received the wrong blood type. It is therefore difficult to compare HAC rates across payers or over time.

Table 3.6
Rates of hospital-acquired blood incompatibility per 10,000 discharges by primary payer, State, and year

State	Year	Medicare rate per 10,000	Medicaid rate per 10,000	Private insurance rate per 10,000	Self-pay rate per 10,000	Other rate per 10,000	No charge rate per 10,000
Arizona	2008	0.00	0.00	0.00	0.00	0.00	0.00
Arizona	2009	0.00	0.00	0.00	0.00	0.00	0.00
Arizona	2010	0.00	0.08	0.07	0.00	0.00	0.00
California	2008	0.02	0.03	0.00	0.00	—	0.00
California	2009	0.01	0.00	0.01	0.00	—	0.00
California	2010	0.01	0.00	0.00	0.00	—	0.00
Florida	2008	0.02	0.12	0.04	0.00	0.00	0.00
Florida	2009	0.01	0.10	0.04	0.08	0.00	0.00
Florida	2010	0.00	0.13	0.04	0.00	0.00	0.00
New Jersey	2008	0.05	0.00	0.03	0.00	0.00	0.00
New Jersey	2009	0.00	0.00	0.00	0.00	0.00	0.00
New Jersey	2010	0.03	0.00	0.03	0.00	0.00	0.00

NOTE: "—" means there were no discharges for that cell. The number of instances in which the hospital-acquired condition occurred can be found in ***Table A.5***.

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

Table 3.7 displays the 2009 and 2010 rates of hospital-acquired stage III and IV pressure ulcer per 10,000 discharges by primary payer and State. It was not possible to calculate rates for earlier years because the ICD-9-CM diagnosis codes used to identify the different pressure ulcer stages were not implemented until October 2008. Across all four States, rates of hospital-acquired stage III and IV pressure ulcer were highest among Medicare discharges, followed by Medicaid discharges, with rates for Medicare discharges more than twice the rate for privately insured discharges. From 2009 to 2010, rates fell in Arizona and California but increased in Florida and New Jersey. In fact, the rate more than doubled across all payers in Florida.

Table 3.7
Rates of hospital-acquired stage III and IV pressure ulcers per 10,000 discharges, by primary payer, State, and year

State	Year	Medicare rate per 10,000	Medicaid rate per 10,000	Private insurance rate per 10,000	Self-pay rate per 10,000	Other rate per 10,000	No charge rate per 10,000
Arizona	2009	1.54	0.94	0.60	0.65	6.40	3.38
Arizona	2010	1.41	0.42	0.64	0.00	0.00	1.86
California	2009	2.94	2.67	0.82	0.44	—	0.87
California	2010	2.01	1.76	0.77	0.78	—	0.70
Florida	2009	0.85	0.54	0.14	0.30	0.43	0.53
Florida	2010	2.79	2.39	1.25	1.14	1.34	1.10
New Jersey	2009	3.52	2.71	1.03	0.33	0.00	0.77
New Jersey	2010	3.66	2.88	1.06	1.55	0.00	2.38

NOTE: "—" means there were no discharges for that cell. The number of instances in which the hospital-acquired condition occurred can be found in ***Table A.6***.

SOURCE: RTI analysis of 2009–2010 Healthcare Cost and Utilization Project State inpatient databases.

Table 3.8 displays the rates of hospital-acquired CAUTIs per 10,000 discharges by primary payer, State, and year. Medicare patients were more than twice as likely as all other patients to acquire a CAUTI in an acute care hospital, which likely reflects greater usage of indwelling urinary catheters. Unfortunately, insertion of indwelling catheters is seldom reported on the MedPAR record; therefore, we cannot restrict our analyses to patients with an indwelling urinary catheter. Rates for Medicare discharges ranged from a low of 3.98/10,000 discharges in New Jersey in 2008 to 6.15/10,000 discharges in California in 2010. In comparison, in all four States, the rate for Medicaid and privately insured patients did not exceed 2.57/10,000 discharges. There is no consistent pattern in rates across States and over time. From 2008 to 2010, the rate of hospital-acquired CAUTI fell slightly for Medicare and Medicaid discharges in Arizona. In California, the rate increased for Medicare and Medicaid patients from 2008 to 2009 before falling slightly for Medicaid patients in 2010. However, in Florida, rates increased for all payers from 2008 to 2009, but then fell for Medicare and privately insured discharges from 2009 to 2010, while the rate for Medicaid discharges continued to increase.

Table 3.8
Rates of hospital-acquired catheter-associated urinary tract infection per 10,000 discharges, by primary payer, State, and year

State	Year	Medicare rate per 10,000	Medicaid rate per 10,000	Private insurance rate per 10,000	Self-pay rate per 10,000	Other rate per 10,000	No charge rate per 10,000
Arizona	2008	6.14	1.94	2.40	1.23	8.31	1.47
Arizona	2009	5.42	1.89	1.75	0.65	12.80	3.38
Arizona	2010	5.88	1.34	2.57	1.88	7.91	2.61
California	2008	5.64	1.88	2.07	0.92	—	2.11
California	2009	6.10	2.13	2.03	2.01	—	1.86
California	2010	6.15	1.78	1.88	1.38	—	1.19
Florida	2008	4.68	1.11	1.49	1.07	1.70	2.11
Florida	2009	5.12	1.64	1.89	0.91	0.38	1.24
Florida	2010	4.44	2.33	1.49	0.90	1.55	1.80
New Jersey	2008	3.98	1.16	1.35	0.67	0.00	1.56
New Jersey	2009	4.34	0.95	1.06	0.89	0.00	2.32
New Jersey	2010	4.14	0.61	1.45	1.11	0.00	0.79

NOTE: "—" means there were no discharges for that cell. The number of instances in which the hospital-acquired condition occurred can be found in ***Table A.7***.

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

Table 3.9 displays rates of hospital-acquired vascular catheter-associated infection per 10,000 discharges by primary payer, State, and year. Rates for Medicare discharges were higher than for all other payers. Of more significance, the Medicare HAC rate was only slightly higher than for Medicaid discharges. Rates of hospital-acquired vascular catheter-associated infection fell steadily for Medicare, Medicaid, and privately insured discharges from 2008 to 2010 in all States except New Jersey.

Table 3.9
Rates of hospital-acquired vascular catheter-associated infection per 10,000 discharges by primary payer, State, and year

State	Year	Medicare rate per 10,000	Medicaid rate per 10,000	Private insurance rate per 10,000	Self-pay rate per 10,000	Other rate per 10,000	No charge rate per 10,000
Arizona	2008	12.68	9.60	8.71	4.32	8.31	11.01
Arizona	2009	9.69	7.81	9.00	4.54	19.21	5.08
Arizona	2010	8.02	7.44	6.91	3.13	15.82	8.95
California	2008	12.31	10.27	7.78	6.68	—	8.75
California	2009	10.81	9.83	6.90	6.28	—	7.79
California	2010	7.90	6.39	5.10	3.03	—	4.95
Florida	2008	15.16	14.65	11.07	8.00	14.47	12.55
Florida	2009	13.53	14.67	10.01	6.90	8.42	7.14
Florida	2010	8.93	11.23	7.09	4.96	6.19	7.63
New Jersey	2008	11.54	10.27	6.73	5.82	0.00	7.04
New Jersey	2009	12.46	10.82	7.70	4.24	0.00	5.42
New Jersey	2010	12.85	10.45	7.92	5.86	0.00	4.77

NOTE: "—" means there were no discharges for that cell. The number of instances in which the hospital-acquired condition occurred can be found in ***Table A.8***.

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

Table 3.10 displays the rate of hospital-acquired DVT/PE following certain orthopedic procedures per 10,000 discharges, by primary payer, State, and year. The rate of hospital-acquired DVT/PE following certain orthopedic procedures is high, occurring more than 20 times per 10,000 discharges regardless of payer and more than 54 times per 10,000 Medicare discharges. Although there was no consistent pattern in rates across payers, the rate was more than 40 percent higher in New Jersey than in the other three States and did decline by approximately one-third from 2008 to 2010.

Table 3.10
Rates of hospital-acquired deep vein thrombosis or pulmonary embolism following certain orthopedic procedures per 10,000 discharges, by primary payer, State, and year

State	Year	Medicare rate per 10,000	Medicaid rate per 10,000	Private insurance rate per 10,000	Self-pay rate per 10,000	Other rate per 10,000	No charge rate per 10,000
Arizona	2008	54.35	25.61	40.26	0.00	0.00	57.95
Arizona	2009	61.02	92.98	31.82	0.00	0.00	83.74
Arizona	2010	65.90	25.19	12.91	344.83	0.00	54.45
California	2008	58.50	69.78	46.29	37.74	—	37.64
California	2009	57.90	54.59	40.87	55.56	—	27.37
California	2010	55.90	65.08	33.00	31.06	—	26.64
Florida	2008	79.73	116.28	46.10	97.40	132.45	65.90
Florida	2009	69.69	37.21	53.94	133.33	0.00	58.71
Florida	2010	66.30	76.53	48.42	105.63	170.46	106.64
New Jersey	2008	150.56	161.29	129.89	156.25	0.00	86.71
New Jersey	2009	114.53	95.69	107.38	319.15	0.00	56.82
New Jersey	2010	94.48	111.11	83.74	117.19	0.00	103.09

NOTE: "—" means there were no discharges for that cell. The number of instances in which the hospital-acquired condition occurred can be found in ***Table A.9***.

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

Table 3.11a displays the rates of hospital-acquired infection following certain orthopedic procedures per 10,000 discharges by primary payer, State, and year. With the exception of Arizona and New Jersey in 2010, Medicaid discharges had the highest probability of acquiring a SSI following certain orthopedic procedures. Overall, privately insured discharges had the lowest rates of hospital-acquired SSIs following certain orthopedic procedures, typically less than one-half of the rate for Medicaid discharges. Looking over time, in all four States, the rate for privately insured and Medicaid discharges was less in 2010 than in 2008. Among Medicare discharges, the 2010 rate was lower than the 2008 rate in Arizona, California, and Florida, but higher in New Jersey. In New Jersey, the rate increased from 47.01/10,000 Medicare discharges in 2008 to 59.56/10,000 Medicare discharges in 2010. However, the rate of 59.56/10,000 Medicare discharges was a decline from the rate of 65.17/10,000 Medicare discharges in New Jersey in 2009.

Table 3.11a
Rates of hospital-acquired surgical site infection following certain orthopedic procedures per 10,000 discharges, by primary payer, State, and year

State	Year	Medicare rate per 10,000	Medicaid rate per 10,000	Private insurance rate per 10,000	Self-pay rate per 10,000	Other rate per 10,000	No charge rate per 10,000
Arizona	2008	44.64	109.69	27.56	0.00	0.00	49.69
Arizona	2009	15.09	83.83	13.59	0.00	0.00	11.89
Arizona	2010	39.45	21.01	30.14	0.00	0.00	0.00
California	2008	66.85	152.38	25.88	104.17	—	60.77
California	2009	67.17	93.84	29.52	127.80	—	47.91
California	2010	40.04	117.58	24.77	31.85	—	27.14
Florida	2008	31.70	102.56	19.54	94.70	112.36	44.93
Florida	2009	35.65	60.30	15.22	0.00	0.00	31.61
Florida	2010	21.61	42.55	13.62	0.00	0.00	16.84
New Jersey	2008	47.02	105.26	44.09	208.33	0.00	20.53
New Jersey	2009	65.17	95.24	37.32	66.67	0.00	19.88
New Jersey	2010	59.56	0.00	37.95	139.86	0.00	19.86

NOTE: "—" means there were no discharges for that cell. The number of instances in which the hospital-acquired condition occurred can be found in ***Table A.11***.

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

Table 3.11b displays the rates of hospital-acquired mediastinitis following CABG per 10,000 discharges by primary payer, State, and year. Because of the relatively few CABG discharges (see Table 2.2), particularly for non-Medicare payers, the HAC rates are more volatile and difficult to compare across payers and years. Table 3.11b shows a wide variation in HAC rates across payers, years, and States, ranging from a low of 0 in several instances to a high of 42/10,000 Medicaid discharges in Florida in 2008.

Table 3.11b
Rates of hospital-acquired surgical site infection—mediastinitis following coronary artery bypass graft per 10,000 discharges, by primary payer, State, and year

State	Year	Medicare rate per 10,000	Medicaid rate per 10,000	Private insurance rate per 10,000	Self-pay rate per 10,000	Other rate per 10,000	No charge rate per 10,000
Arizona	2008	6.22	0.00	0.00	0.00	0.00	0.00
Arizona	2009	0.00	0.00	7.48	0.00	0.00	0.00
Arizona	2010	7.08	0.00	0.00	0.00	0.00	0.00
California	2008	13.68	22.62	12.03	0.00	—	0.00
California	2009	8.61	22.17	1.93	30.40	—	0.00
California	2010	9.08	7.43	4.19	0.00	—	31.40
Florida	2008	6.35	42.02	2.00	0.00	32.79	19.01
Florida	2009	2.85	11.86	4.54	0.00	0.00	0.00
Florida	2010	5.86	21.93	7.79	41.90	0.00	18.87
New Jersey	2008	8.70	0.00	4.50	29.94	—	0.00
New Jersey	2009	11.78	0.00	4.75	0.00	—	0.00
New Jersey	2010	18.47	0.00	0.00	0.00	—	0.00

NOTE: "—" means there were no discharges for that cell. The number of instances in which the hospital-acquired condition occurred can be found in ***Table A.10***.

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

Table 3.11c shows the rates of hospital-acquired infection following bariatric surgery per 10,000 discharges by primary payer, State, and year. The rate is zero, with only one exception. In 2009, California Medicare discharges had a rate of 5.3/10,000 bariatric surgery discharges. The reasons that the rate for the remaining payer-year-State combinations' being zero are likely that (1) there are so few bariatric procedures (see Table 2.2) and (2) the probability of a HAC is relatively low in the population, so that the sample size was too small for the adverse event (the HAC) to occur.

Table 3.11c
Rates of hospital-acquired surgical site infection following bariatric surgery for obesity per 10,000 discharges, by primary payer, State, and year

State	Year	Medicare rate per 10,000	Medicaid rate per 10,000	Private insurance rate per 10,000	Self-pay rate per 10,000	Other rate per 10,000	No charge rate per 10,000
Arizona	2008	0.00	0.00	0.00	0.00	0.00	—
Arizona	2009	0.00	0.00	0.00	0.00	0.00	0.00
Arizona	2010	0.00	0.00	0.00	0.00	0.00	0.00
California	2008	0.00	0.00	0.00	0.00	0.00	—
California	2009	5.33	0.00	0.00	0.00	0.00	—
California	2010	0.00	0.00	0.00	0.00	0.00	—
Florida	2008	0.00	0.00	0.00	0.00	0.00	0.00
Florida	2009	0.00	0.00	0.00	0.00	0.00	0.00
Florida	2010	0.00	0.00	0.00	0.00	0.00	0.00
New Jersey	2008	0.00	0.00	0.00	0.00	0.00	0.00
New Jersey	2009	0.00	0.00	0.00	0.00	0.00	0.00
New Jersey	2010	0.00	0.00	0.00	0.00	0.00	0.00

NOTE: "—" means there were no discharges for that cell. The number of instances in which the hospital-acquired condition occurred can be found in ***Table A.12***.

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

3.3 Logistic Analysis of Rates of Hospital-Acquired Conditions

We examined econometrically whether the HAC-POA program reduced the overall reporting of HACs for all payers, controlling for patient, hospital, and geographic characteristics that may affect the probability of acquiring a HAC. For example, large hospitals and AMCs invariably perform more orthopedic surgeries on sicker patients. Experience with the surgery, particularly among nursing staff, may result in fewer patients' developing a DVT or PE. However, large hospitals may also have better reporting systems in place than smaller hospitals and therefore have higher reported rates of HACs. It is also possible that hospitals with larger Medicare populations, with potentially more at stake, would react more to the HAC-POA program, resulting in a larger spillover onto other payers. To control for this, we created a variable to capture the share of a hospital's discharges in which the primary payer was Medicare. Finally, we created a variable, DRG average length of stay (ALOS), which is the arithmetic mean length of stay associated with the DRG to which that case would have been assigned under version 24 of the 3M grouper (which was in effect before the implementation of MS-DRGs in October 2007). The V24 DRG assignment is a variable available in the HCUP files. We use the

V24 DRG ALOS to instrument for length of stay in the hospital. We cannot use the actual length of stay because of the endogeneity of length of stay with a HAC—that is, not only does a longer length of stay theoretically increase the likelihood of a HAC, but also patients with a HAC will need to stay in the hospital longer. Similarly, we decided on V24 DRGs rather than MS-DRGs because the presence of the HAC often causes a patient to be assigned to a higher severity level of the DRG family (one with "CCs" or "MCCs") that will have a longer expected length of stay; thus the HAC would be both a cause and an effect of longer MS-DRG ALOS.

We performed logistic regressions on hospital discharges from 2008 through 2010. We focused our analysis on three HACs: falls and trauma, CAUTI, and DVT/PE following certain orthopedic procedures. We selected these HACs because they occur with high enough frequency across all payers to estimate a maximum likelihood model. In contrast, HACs such as blood incompatibility or bariatric surgery, which almost never occur, cannot be estimated using the logistic model.[5] Furthermore, we limited the analysis of spillovers to Medicare, Medicaid, and private insurance given small HAC rates and numbers of discharges for other payers.

We estimated separate logistic regressions for each of the three HACs for which the dependent variable was 1 if the admission had that particular HAC and 0 otherwise. For each of the regression models, variables used to control for patient, hospital, and geographic characteristics are as follows (with the reference group indicated by "ref").

Patient Characteristics

- Age groups (AGEGROUP): 4 categories: 19–44, 45–64, 65–79 (ref), and 80+. Source: SID.
- RACE: 6 categories: White (ref), Black, Hispanic, Asian or Pacific Islander, Native American, and Other. Source: SID.
- FEMALE: 1 if female; 0 if male (ref). Source: SID.
- DRG ALOS: the version 24 DRG arithmetic mean ALOS was used to "instrument" for the patient's own LOS. An instrument was needed because a HAC may lead to a longer LOS, and a longer LOS can lead to a HAC. The 2008–2010 SIDs include a V24 DRG, which is calculated based on the claim diagnoses and procedures. Note: V24 DRGs are not MS-DRGs. Sources: SID and CMS.

Hospital Characteristics

- AMC: 0 if the hospital is not an AMC (ref), 1 if an AMC. Source: UHC.
- BEDS: The number of certified beds in the hospital. Source: Medicare POS.

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[5] When too few positive instances of the event occur, the maximum likelihood does not converge in the logistic model.

- Ownership status (OWNERSHIP): HAC rates may be affected by whether a hospital is for-profit, private nonprofit (ref), other government, or State/local government. Source: POS.

- Medicare_Q: Hospitals were divided into four quartiles on the basis of their share of discharges for which Medicare was the primary payer. Hospitals with the lowest share were in the first quartile and hospitals with the highest share in the fourth quartile. This value was recalculated for each year, so hospitals could switch quartiles from year to year if their Medicare populations changed. Quartile 1 (ref). Source: SID.

Geographic Characteristics

- Urbanicity (URBAN): 3 categories: rural, small urban (ref), and large urban. Source: Census.

The model specification of the logistic is as follows:

1. $Pb[HAC_{pt}] = e^L/(1 + e^L)$

2. $L = a + \Sigma b_u URBAN_{ptu} + \Sigma b_o OWNERSHIP_{ptod} + \Sigma b_y YEAR_{pty} + \Sigma b_j PAY1_{ptj} + \Sigma\Sigma b_{yj} YEAR*PAY1_{ptyj} + \Sigma b_a AGEGRP_{pta} + \Sigma b_r RACE_{ptr} + b_f FEMALE_{ptf} + b_l ALOS_{ptl} + b_m AMC_{ptm} + b_b BEDS_{ptb} + \Sigma b_s STATE_{pts} + \Sigma\Sigma b_{sy} STATE*YEAR_{ptsy} + \Sigma b_m MEDICARE\_Q_{ptb} + e_{pt},$

where $pb[HAC_{pt}]$ = the probability (0,1) of a patient admitted in the *t*th period incurring a HAC, and L = the logit function. For presentation, the vector of logit coefficients is converted into odds ratios relative to the reference group. For very rare events, odds ratios can be interpreted as relative risks. For instance, an odds ratio of 1.2 for one of the primary payer variables would be interpreted as a 20 percent increase in the likelihood of the HAC for the payer relative to Medicare. Odds ratios less than 1 would mean a lower probability of the HAC relative to Medicare.

In the regression models, PAY1 is the vector of primary payers in the data. Medicare is the reference category, so that the vector of PAY1 odds ratios (ORs) will capture the magnitude and direction of the incremental differences by primary payer relative to Medicare. The vector of odds ratios on the YEAR indicator captures the changes in HAC rates over time relative to 2008, the reference year, and controls for changes in the mix of patient and hospital characteristics. The odds ratios on the PAY1*YEAR interaction terms capture the incremental difference in the year-to-year changes in HAC rates for other payers relative to Medicare. STATE is the vector of States Arizona (AZ), California (CA), and Florida (FL), with New Jersey as the reference. The STATE variables' odds ratios have an interpretation similar to that of the odds ratios for the PAY1 variables and STATE*YEAR interactions' odds ratios as PAY1*Year interactions' odds ratios.

Table 3.12 shows the odds ratios and *p*–value for falls and trauma, CAUTI, and DVT/PE following certain orthopedic procedures. Although care should be taken in generalizing from the experience of just four States, Arizona, California, Florida, and New Jersey provide some geographic dispersion and relatively different baseline HAC rates. Holding many beneficiary, hospital, and geographic characteristics constant, we find that Medicaid and private insurance patients had a lower likelihood than Medicare patients of experiencing a fall or trauma (ORs=0.852, 0.829, respectively) or developing a CAUTI (ORs=0.842, 0.789, respectively) in the year before implementation of the HAC-POA program (2008 is the reference year). Non-Medicare payers' patients had no difference in the likelihood of developing a DVT/PE following certain orthopedic procedures in 2008.

Table 3.12
Odds ratios for selected hospital-acquired conditions

Parameter	Falls and trauma odds ratio	Falls and trauma p-value	CAUTI odds ratio	CAUTI p-value	DVT/PE odds ratio	DVT/PE p-value
Payer						
Medicaid	0.852	0.004	0.842	0.0571	1.289	0.1662
Private insurance	0.829	<.0001	0.789	0.0003	1.022	0.792
Year						
2009	0.537	<.0001	1.053	0.6025	0.794	0.0191
2010	0.541	<.0001	1.043	0.6737	0.664	<.0001
Payer/Year Interaction						
Medicaid*2009	0.916	0.2511	1.079	0.5027	0.837	0.4939
Medicaid*2010	0.874	0.0951	1.067	0.5732	0.906	0.6978
Private insurance*2009	0.809	0.0002	0.920	0.3228	1.017	0.8617
Private insurance*2010	0.831	0.002	0.916	0.3132	0.860	0.1408
State						
Arizona	0.698	<.0001	1.761	<.0001	0.382	<.0001
California	0.752	<.0001	1.447	<.0001	0.376	<.0001
Florida	0.656	<.0001	1.170	0.0603	0.545	<.0001
State/Year Interaction						
AZ*2009	1.650	<.0001	0.830	0.1882	1.409	0.046
AZ*2009	1.551	<.0001	0.925	0.5776	1.523	0.0174
CA*2009	1.336	<.0001	1.021	0.8438	1.202	0.1174
CA*2010	1.174	0.0192	1.052	0.6377	1.376	0.0091
FL*2009	1.866	<.0001	1.068	0.5555	1.140	0.2657
FL*20010	1.684	<.0001	1.011	0.9229	1.368	0.0102
N	18,596,830	N/A	18,596,830	N/A	517,936	N/A
Likelihood ratio	8054	N/A	7083	N/A	728	N/A
Max–rescaled r–square	0.0402	N/A	0.0641	N/A	0.0189	N/A

NOTE: CAUTI = catheter-associated urinary tract infection, DVT/PE = deep vein thrombosis or pulmonary embolism following certain orthopedic procedures, N/A = not applicable.

Program: Final_core_ahal_db28_regr.xls

We observe for all payers a decline in 2009 in the likelihood of experiencing a fall or trauma in 2009 (OR=0.537), with an incrementally greater decline for privately insured patients (OR=0.809), but no further decline in 2010 for any payer. We also observe a decline in 2009 in the likelihood of developing a DVT/PE following certain orthopedic procedures in 2009 (OR=0.794), with an incrementally greater decline in 2010 (OR=0.664), but no incremental difference across payers. In 2009 and 2010, there was no change in the likelihood of developing a CAUTI for any payer; the odds ratios for 2009 and 2010 and the odds ratios for the interactions of YEAR and PAYER show no trend either up or down.

New Jersey exhibited high rates of falls and trauma and DVT/PE following certain orthopedic procedures and low rates for CAUTI in the baseline 2008 year relative to Arizona, California, and Florida. Rates of falls and trauma and DVT/PE for hospitalized New Jersey Medicare beneficiaries fell by nearly 50 percent and 20 percent, respectively, in 2009, the first year of the HAC-POA program. Rates for these two conditions also fell in the other three States but by a smaller percentage amount. Thus, patients in Arizona, California, and Florida hospitals did not benefit as much in the first year of the HAC-POA program as patients in New Jersey.

3.4 Summary

In this section, we studied two questions related to the potential spillover of the Medicare HAC–POA program on other payers. The first question was whether the reported rate for the 10 Medicare HACs varied across payers. The second question considered whether the Medicare HAC–POA program had a spillover effect on the reported incidence of HACs for other payers.

We began our analysis by analyzing the reported rates of HACs by primary payer, year, and State using descriptive tables. We did not find any consistent pattern in the reporting of the rates of HACs across time or payer. Comparing across payers, we found that Medicare had the highest rates of hospital-acquired falls and trauma, stage III and IV pressure ulcer, CAUTI, and vascular catheter-associated infections, whereas Medicaid had the highest rates of hospital-acquired mediastinitis following CABG surgery and SSI following certain orthopedic procedures. It is not possible to draw any conclusions for air embolism, blood incompatibility, or for SSI following bariatric surgery because they occurred too infrequently. One possible explanation for these findings may be that each of the payers serves a very different population.

Comparing rates of HACs from 2008 through 2010, we observe a general decline in the rate for several HACs: falls and trauma, CAUTI, DVT/PE following certain orthopedic procedures, and SSI following certain orthopedic procedures. However, in most cases, the rate actually increased in 2009 compared with 2008 before declining again in 2010. We found two different trends when we analyzed stage III and IV pressure ulcer. Between 2009 and 2010, rates fell in Arizona and California but increased in Florida and New Jersey. One explanation is that some hospitals were still "learning" how to recognize and code the stages of pressure ulcers, a new requirement under the Medicare HAC-POA program.

The second part of our analysis consisted of estimating logistic regression models of the likelihood of developing one of three HACs: falls and trauma, CAUTI, and DVT/PE following certain orthopedic procedures. We estimated separate logistic regressions for each HAC, modeling whether the condition was reported during the inpatient stay or not after controlling for patient, hospital, and geographic characteristics with policy-relevant variables of payer type, year, and State. We found no evidence that the HAC-POA program had any effect on the rate of CAUTI for the three payers: Medicare, Medicaid, and private insurance. We observed a decline in 2009 in the likelihood of experiencing a fall or trauma in 2009 for all three of these payers, with an incrementally greater decline for privately insured patients, but no further decline in 2010 for any payer. This indicates a positive spillover effect to private insurance patients. We also observe a decline in 2009 in the likelihood of developing a DVT/PE following certain orthopedic procedures in 2009, with an incrementally greater decline in 2010, but no incremental difference across payers. Two interpretations are possible. One interpretation is that there was an overall secular trend in DVT/PE rates independent of the HAC-POA program. A second interpretation is that the HAC–POA program has had a positive spillover effect on other payers (i.e., a "rising tide lifts all boats" phenomenon).

Combined, these results provide some limited evidence of positive spillover effects on other payers, primarily in the first year of the Medicare HAC-POA program, for two of the three conditions. But, we can also interpret the results to mean that there was no impact of the Medicare HAC-POA program on the three studied HACs. There was no decline in the rate of CAUTI, and the observed decline in the rates of falls and trauma and DVT/PE following certain orthopedic procedures across all payers could be a naturally occurring secular trend as the benefit appeared to be greatest in hospitals with initially highest rates.

There are two caveats to RTI's all-payer analyses. *First,* we can analyze only the reported rate of the HACs and not their actual incidence. The actual incidence of HACs may be higher than the reported rate for three reasons: the condition may not manifest while the patient is in the hospital, as can happen with SSIs; hospitals may not code the condition if it does not affect their payment; and the HAC may not be reported if the patient has more secondary diagnoses than are captured on the claim. In the next section, we explore the relationship between the number of secondary diagnoses on the claim, the number captured by Medicare, and the impact on reported rates of HACs. Second, we could not measure any changes in individual hospital quality over time with changes in the rates of the studied HACs.

SECTION 4
ALL-PAYER ANALYSIS: UNINTENDED CONSEQUENCES OF HOSPITAL CODING PRACTICES

4.1 Introduction

As with any new policy, there may be unintended consequences of the HAC-POA program. Examples that have been suggested to CMS in public comments include altering admission patterns to avoid patients at higher risk of complications, ordering more laboratory tests to help identify asymptomatic POA conditions, discharging patients early to avoid the manifestation of the HAC, or simply not recording HACs in the observable medical record.

HACs must be identified through the secondary diagnosis codes on the universal billing form, which in its current format can accommodate up to 30 ICD-9-CM diagnosis codes. Unfortunately, not all administrative compilations of claims data retain that much information. When working with HACs as reported in the Medicare claims files, before January 2011 hospitals could submit up to 25 diagnosis codes; however, CMS's data system limitations allowed for the processing of only the first 9 diagnosis codes. Beginning in January 2011, CMS began processing data for up to 25 diagnosis fields for all hospitals when submitted in the version 5010 format.

Health care providers are instructed to code any secondary diagnosis that can affect treatment decisions or costs, but no rules govern the order in which the codes appear. It is therefore quite possible that the same medical chart could be coded differently at two hospitals, with one hospital reporting a HAC in the first eight secondary diagnosis fields and the other reporting the HAC in the ninth or subsequent diagnosis fields. Which secondary diagnoses are coded in the first eight fields can tell us about hospital behavior and whether hospitals are coding strategically.

We predict that "strategic coding" is possible for HACs. Under Medicare's HAC-POA program, there is *no direct financial incentive* for hospitals to move the reporting of the HAC earlier on the claim because the MS-DRG payment can never be any lower than what it would have been if the HAC were not documented at all. At least one article raised concerns that coders may not list codes that will result in nonpayment (Saint et al., 2009). There are potential *disincentives* to coding a HAC earlier on the claim. A HAC could replace a secondary diagnosis that would lead to a different MS-DRG and higher payment. Coding the HAC earlier will also increase the hospital's HAC rates in published sources such as the Hospital Compare Web site. Consequently, hospitals may have both financial and reputational incentives to use code sequencing to their advantage.

In this section, we explore hospital changes in coding and billing strategies in response to the HAC-POA program to answer the following questions:

1. Have hospitals failed to identify HACs by not recording the relevant conditions in the first eight secondary diagnosis codes?

2. How does the coding of secondary diagnosis codes and location of HACs among the secondary diagnosis codes vary by hospital characteristics such as for-profit status, teaching status, and location?

To answer these questions, we compared HAC rates for hospitals using the first eight secondary diagnosis codes and using all available codes on the claim. The descriptive analyses and tables are presented in ***Section 4.2. Section 4.3*** concludes the section with a summary of the results and discussion.

4.2 Descriptive Analysis

State inpatient datasets vary in the number of secondary diagnosis codes that they choose to retain. Of the four States in this study, California and Arizona report up to 24 secondary diagnosis codes per claim, whereas Florida reports up to 30. New Jersey reported up to 23 secondary diagnosis codes in 2008 and up to 24 in 2009 and 2010. We calculated a second set of "HAC8" rates for each State for 2010, based on only the information in the first eight HCUP secondary diagnosis fields. This allowed us to compare rates computed using every available secondary diagnosis with rates computed using a subset equivalent to what CMS would use. In ***Table 4.1***, we show the ratios of HAC rates computed from the first eight secondary diagnoses alone to rates computed using all secondary diagnoses appearing on the State's HCUP file. Because the table shows ratios, they can be interpreted as percentages; for example, 0.83 means 83 percent of HACs were actually reported in the first eight secondary diagnosis fields.

We begin with a descriptive analysis of the difference in reported HAC rates using only the first eight secondary diagnoses ("HAC8") rate and the reported HAC rate using all available secondary diagnosis codes on the claim. For these analyses, we used HCUP SID for Arizona, California, Florida, and New Jersey for the years 2008–2010. A lower ratio means that more HACs are reported past the 8th secondary diagnosis and thus likely omitted in the MedPAR dataset. The table shows that a nontrivial number of HACs are coded in the 9th and subsequent secondary diagnosis code fields. Take, for example, vascular catheter-associated infections among Medicare beneficiaries. In California, with 24 secondary diagnosis code fields on the claim, only 48 percent of the HACs were captured in the first 8 secondary diagnosis code fields, whereas in Florida the first 8 codes capture only 38 percent of hospital-acquired vascular catheter-associated infections. The data demonstrate that Medicare HACs as computed from MedPAR are understated by more than a factor of two. An earlier study found that increasing the number of secondary diagnosis codes from 14 to 24 for analysis did increase the HAC rate (Healy, Cromwell, and Spain, 2011). However, Table 4.1 shows no pattern in ratios among the four States, suggesting that there are few advantages to coding more than 24 secondary diagnosis codes. If more than 24 diagnosis codes did make a difference, then we would expect that Florida would have significantly lower ratios than the other three States in our study.

Table 4.1
Ratio of 2010 HAC rates based on the first eight secondary diagnoses ("HAC8 rate") to 2010 HAC rates based on all reported HCUP secondary diagnoses, by HAC, State, and primary payer

HAC	State	Medicare	Medicaid	Private insurance	Self-pay	Other
Foreign object retained after surgery	AZ	0.83	0.82	0.83	1.00	1.00
Foreign object retained after surgery	CA	0.68	0.82	0.90	1.00	0.71
Foreign object retained after surgery	FL	0.97	1.00	0.91	1.00	1.00
Foreign object retained after surgery	NJ	0.90	—	0.93	1.00	—
Falls and trauma	AZ	0.79	0.71	0.80	0.50	0.89
Falls and trauma	CA	0.64	0.65	0.73	0.69	0.81
Falls and trauma	FL	0.75	0.60	0.74	0.75	0.76
Falls and trauma	NJ	0.76	0.78	0.79	0.84	0.75
Manifestations of poor glycemic control	AZ	0.86	0.86	0.75	—	—
Manifestations of poor glycemic control	CA	0.51	0.50	0.58	1.00	—
Manifestations of poor glycemic control	FL	0.84	0.75	0.89	1.00	0.00
Manifestations of poor glycemic control	NJ	0.83	0.75	0.94	1.00	—
Stage III or IV pressure ulcer	AZ	0.64	0.20	0.67	—	—
Stage III or IV pressure ulcer	CA	0.46	0.48	0.44	0.33	—
Stage III or IV pressure ulcer	FL	0.51	0.23	0.20	0.00	0.00
Stage III or IV pressure ulcer	NJ	0.65	0.68	0.45	0.71	—
CAUTI	AZ	0.72	0.62	0.58	0.67	0.00
CAUTI	CA	0.54	0.57	0.55	0.69	—
CAUTI	FL	0.73	0.48	0.75	0.67	1.00
CAUTI	NJ	0.75	0.50	0.56	0.60	—

(continued)

Table 4.1 (continued)
Ratio of 2010 HAC rates based on the first eight secondary diagnoses ("HAC8 rate") to 2010 HAC rates based on all reported HCUP secondary diagnoses, by HAC, State, and primary payer

HAC	State	Medicare	Medicaid	Private insurance	Self-pay	Other
Vascular catheter associated infections	AZ	0.32	0.45	0.43	0.40	0.00
Vascular catheter - associated infection	CA	0.48	0.55	0.51	0.63	—
Vascular catheter-associated infection	FL	0.38	0.42	0.46	0.53	0.46
Vascular catheter-associated infection	NJ	0.47	0.80	0.53	0.68	—
DVT/PE following orthopedic procedures	AZ	0.95	1.00	1.00	1.00	—
DVT/PE following orthopedic procedures	CA	0.62	0.65	0.65	0.00	—
DVT/PE following orthopedic procedures	FL	0.93	1.00	0.97	1.00	1.00
DVT/PE following orthopedic procedures	NJ	0.96	1.00	0.97	1.00	—
SSI—mediastinitis following CABG surgery	AZ	0.50	—	—	—	—
SSI—mediastinitis following CABG surgery	CA	0.50	0.00	0.00	—	—
SSI—mediastinitis following CABG surgery	FL	0.17	1.00	0.33	0.67	—
SSI—mediastinitis following CABG surgery	NJ	0.33	—	—	—	—

(continued)

Table 4.1 (continued)
Ratio of 2010 HAC rates based on the first eight secondary diagnoses (“HAC8 rate”) to 2010 HAC rates based on all reported HCUP secondary diagnoses, by HAC, State, and primary payer

HAC	State	Medicare	Medicaid	Private insurance	Self-pay	Other
SSI following certain orthopedic procedures	AZ	0.73	0.50	0.78	—	—
SSI following certain orthopedic procedures	CA	0.52	0.48	0.58	0.00	—
SSI following certain orthopedic procedures	FL	0.57	0.60	0.53	—	—
SSI following certain orthopedic procedures	NJ	0.78	—	0.79	1.00	—

NOTES: “—” means either there were no discharges or that the HAC rate was zero so that division was not possible. Ratios for air embolism, blood incompatibility, and SSI following bariatric surgery are not shown because occurrences were so rare across all payers and States that most ratios were either zero or undefined. AZ = Arizona; CA = California; FL = Florida; NJ = New Jersey. CABG = coronary artery bypass graft; CAUTI = catheter-associated urinary tract infection; DVT/PE = deep vein thrombosis/pulmonary embolism; HAC = hospital-acquired condition; HCUP = Healthcare Cost and Utilization Project; SSI = surgical site infection.

SOURCE: RTI analysis of 2008–2010 HCUP state inpatient databases.

Next, we determined the overall number of times each HAC was coded in the ninth and subsequent secondary diagnosis code fields. We concentrate on this subset of discharges because, by definition, the HAC8-to-HAC ratio for claims with eight or fewer secondary diagnosis codes is 1. Because a hospital’s ability to code strategically is limited if fewer than nine secondary diagnoses are reported, we also calculated the ratio of the HAC8 rate to the overall HAC rate using only those discharges with nine or more valid secondary diagnosis codes. ***Table 4.2*** shows the number of discharges for each HAC, the number of instances in which the HAC was coded in the first eight secondary diagnosis code fields, and the ratio of the HAC8 to HAC rate, both overall and for claims with nine or more secondary diagnosis codes. The numbers in the table aggregate all four States (Arizona, California, Florida, and New Jersey). The fourth column of the table shows the simple ratio of the HAC rate using all secondary diagnosis fields to the rate using just the first eight fields (e.g., 62 percent across all HACs). The last column of the table shows the HAC8-to-HAC ratios for just those claims with nine or more secondary diagnosis codes (e.g., 52 percent across all HACs).

Among claims with nine or more secondary diagnosis codes, the HAC8-to-HAC ratios range from a low of 0.41 for mediastinitis following CABG surgery to a high of 0.73 for DVT/PE following certain orthopedic procedures. The simple ratio in column 4 shows the amount that HACs are underreported in MedPAR and other claims that capture only the first eight secondary diagnosis codes. For example, the all-discharge HAC8-to-HAC ratio for falls and trauma is 0.73, implying that the HAC is underreported by 27 percent. However, this understates the true coding sequence problem by 23.7 percent (0.73/0.59). This translates into a 52 percent higher missed HAC rate for hospital-acquired falls and trauma (1 - 0.73/0.59). In contrast, for hospital-acquired mediastinitis following CABG, the ratios using all discharges are similar to the ratio among discharges with nine or more secondary diagnosis codes (0.41/0.44). These are sicker patients with many serious secondary diagnoses. Consequently, these discharges are likely to have more than nine secondary diagnoses (only five of the discharges with hospital-acquired mediastinitis had eight or fewer secondary diagnosis codes). As a result, the ratios using all discharges and just those with more than nine secondary diagnosis codes are similar.

Table 4.2
Number of HACs and ratio of HAC rates based on the first eight secondary diagnoses ("HAC8 rate") to HAC rates based on all reported HCUP secondary diagnosis, all discharges, and discharges with more than nine valid secondary diagnoses

HAC	All discharges: number of HACs	All discharges: number of "HAC8s"	All discharges: HAC8-to-HAC ratio	Discharges with 9 or more secondary diagnosis codes: number of HACs	Discharges with 9 or more secondary diagnosis codes: number of "HAC8s"	Discharges with 9 or more secondary diagnosis codes: HAC8-to-HAC ratio
All HACs	46,105	28,453	0.62	37,028	19,376	0.52
Foreign object retained after surgery	692	561	0.81	382	251	0.66
Falls and trauma	12,328	8,946	0.73	8,200	4,818	0.59
Poor glycemic control	1,160	795	0.69	874	509	0.58
Air embolism	75	52	0.69	49	26	0.53
Blood incompatibility	34	24	0.71	26	16	0.62
Stage III or IV pressure ulcer	2,722	1,292	0.47	2,534	1,104	0.44
CAUTI	6,268	3,889	0.62	5,637	3,258	0.58
Vascular catheter-associated infection	18,523	9,383	0.51	16,887	7,747	0.46
DVT/PE following certain orthopedic procedures	3,371	2,916	0.87	1,712	1,257	0.73
SSI—mediastinitis following CABG surgery	104	46	0.44	99	41	0.41
SSI following certain orthopedic procedures	827	549	0.66	627	349	0.56
SSI following bariatric surgery	1	0	0.00	1	0	0

NOTES: CABG = coronary artery bypass graft; CAUTI = catheter-associated urinary tract infection; DVT/PE = deep vein thrombosis/pulmonary embolism; HAC = hospital-acquired condition; HCUP = Healthcare Cost and Utilization Project; SSI = surgical site infection.

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases

Different types of hospitals may have different incentives for coding HACs in the ninth or subsequent secondary diagnosis code fields. We would predict that for-profit hospitals, who want to maximize profits, would have more of an incentive than nonprofit hospitals to code revenue-enhancing diagnoses in the first eight secondary diagnosis code fields, relegating HACs to the ninth or subsequent fields. If true, then we would expect lower HAC8-to-HAC ratios at for-profit hospitals that at nonprofit hospitals. Furthermore, we expect that if for-profit hospitals are coding strategically, then their HAC8-to-HAC ratios should decline in 2009 and 2010 after implementation of the HAC-POA program. AMCs, on average, see sicker patients than non-AMCs and have a higher severity case. Patients at AMCs often have more serious complications than at non-AMCs, and these complications may even be more serious than some of the HACs, such as falls and trauma or pressure ulcers. We would then hypothesize that at an AMC with a very sick patient, the more serious complications would be placed in the first eight secondary diagnosis fields, pushing the HAC to the ninth or subsequent secondary diagnosis code fields. This would result in lower HAC8-to-HAC ratios at AMCs than at non-AMCs. This type of coding behavior should not be affected by the HAC-POA program; therefore, we would not expect any changes in the HAC8-to-HAC ratio at AMCs in 2009 and 2010 after implementation of the HAC-POA program.

In the next set of tables, we determine whether the share of HACs reported in the first eight secondary diagnosis code fields have declined over time and whether they vary with hospital characteristics. Because we are interested in the extent to which hospitals are coding strategically when they have the opportunity, we limit this analysis to just those discharges with nine or more secondary diagnosis codes. We further exclude from our remaining analyses the following HACs, for which the numbers are too small to draw any conclusions: foreign object retained after surgery, manifestations of poor glycemic control, air embolism, blood incompatibility, mediastinitis following CABG surgery, SSI following certain orthopedic procedures, and SSI following bariatric surgery. We also exclude State, local, and other government hospitals from the tables because of their small numbers.

Tables 4.3 to 4.7 display the ratio of the HAC8 rate to HAC rate for different HACs by State, year, and hospital characteristic. The last three rows of the table show the weighted mean of the ratios across the four States. In the tables, a ratio of 0.00 means that no HACs were coded in the first eight secondary diagnosis code fields. A ratio of "—" means that there were no HACs in any of the secondary diagnosis code fields, making the calculation of a ratio impossible. This could occur for two reasons: either no HACs were coded or there are no eligible discharges, as is the case for rural New Jersey hospitals. There are no rural hospitals in New Jersey and consequently no eligible discharges in this category.

Table 4.3 displays the ratio of the HAC8 rate to the HAC rate for hospital-acquired falls and trauma by State, year, and hospital characteristic. With the exception of California, the ratio of the HAC8 to HAC for AMCs is lower than for non-AMCs. In Arizona, the ratio at AMCs ranges from 0.56 to 0.60 and for non-AMCs from 0.60 to 0.76. In contrast, in California, the ratio ranges from 0.53 to 0.60 at AMCs, but from only 0.42 to 0.55 at non-AMCs. When hospitals are aggregated across States, the differences between AMCs and non-AMCs disappear. The aggregated numbers also show no difference in the HAC8-to-HAC ratios between hospitals located in large urban areas compared with hospitals located in small urban or rural areas or between for profit and nonprofit hospitals.

Table 4.3
Hospital-acquired falls and trauma: Ratio of HAC8 rate to HAC rate, State, year, and hospital characteristics

State	Year	Academic medical center	Not an academic medical center	For profit hospital	Nonprofit hospital	Hospital in large urban area	Hospital in a small urban area	Hospital in a rural area
Arizona	2008	0.56	0.76	0.67	0.78	0.74	0.79	0.76
Arizona	2009	0.57	0.60	0.56	0.62	0.59	0.57	0.76
Arizona	2010	0.60	0.73	0.69	0.74	0.72	0.68	0.89
California	2008	0.53	0.42	0.44	0.41	0.42	0.43	0.50
California	2009	0.58	0.54	0.51	0.55	0.53	0.60	0.51
California	2010	0.60	0.55	0.58	0.54	0.55	0.56	0.42
Florida	2008	0.53	0.71	0.68	0.70	0.70	0.71	0.67
Florida	2009	0.49	0.61	0.60	0.59	0.59	0.65	0.55
Florida	2010	0.51	0.68	0.70	0.65	0.65	0.71	0.66
New Jersey	2008	0.71	0.75	0.00	0.75	0.75	0.74	N/A
New Jersey	2009	0.55	0.68	—	0.67	0.66	0.76	N/A
New Jersey	2010	0.81	0.66	0.00	0.67	0.70	0.53	N/A
Combined	2008	0.68	0.72	0.71	0.72	0.71	0.72	0.76
Combined	2009	0.66	0.69	0.67	0.69	0.67	0.73	0.67
Combined	2010	0.69	0.72	0.74	0.71	0.71	0.74	0.75

NOTES: "—" means that either there were no discharges or the HAC rate was zero so that division was not possible. New Jersey has no rural counties. HAC = hospital-acquired condition.

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

Table 4.4 displays the ratio of the HAC8 rate to the HAC rate for hospital-acquired stage III or IV pressure ulcer by State, year, and hospital characteristic. Table 4.4 does not show ratios for 2008 because the ICD-9-CM codes for staging pressure ulcers did not exist until FY 2009. Aggregating ratios across all States in the "combined" rows, AMCs have a lower ratio than non-AMCs. The HAC8 ratio for AMCs ranged from 0.35 to 0.40, whereas the ratio for non-AMCs ranged from 0.44 to 0.50. The combined rows also show a difference between for-profit and nonprofit hospitals. For-profit hospitals had lower ratios than nonprofit hospitals. In 2009, the ratio at for-profit hospitals was 0.39, but it was 0.46 at nonprofit hospitals. In 2010, the ratios at for-profit and nonprofit hospitals were 0.41 and 0.52, respectively. Table 4.4 also shows that, with the exception of AMCs, the ratio increased between 2009 and 2010 across all States and hospital characteristics. At AMCs, the ratio fell from 0.40 in 2009 to 0.35 in 2010.

Table 4.4
Hospital-acquired stage III or IV pressure ulcers: Ratio of HAC8 rate to HAC rate, State, year, and hospital characteristics

State	Year	Academic medical center	Not an academic medical center	For profit hospital	Nonprofit hospital	Hospital in large urban area	Hospital in a small urban area	Hospital in a rural area
Arizona	2009	0.00	0.34	0.20	0.39	0.27	0.41	0.67
Arizona	2010	0.33	0.61	0.55	0.69	0.48	0.81	0.00
California	2009	0.47	0.44	0.43	0.44	0.43	0.50	0.00
California	2010	0.46	0.45	0.30	0.48	0.44	0.48	0.33
Florida	2009	0.25	0.36	0.33	0.35	0.27	0.48	0.32
Florida	2010	0.29	0.40	0.41	0.38	0.29	0.53	0.42
New Jersey	2009	0.67	0.58	0.75	0.58	0.58	0.73	N/A
New Jersey	2010	0.20	0.65	1.00	0.63	0.61	0.65	N/A
Combined	2009	0.40	0.44	0.39	0.46	0.44	0.50	0.33
Combined	2010	0.35	0.50	0.41	0.52	0.47	0.55	0.42

NOTES: "—" means that either there were no discharges or the HAC rate was zero so that division was not possible. New Jersey has no rural counties.

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

Table 4.5 displays the ratio of the HAC8 rate to the HAC rate for hospital-acquired CAUTI by State, year, and hospital characteristic. There is no observable pattern in the ratio of HAC8 to HAC rate for hospital-acquired CAUTI between AMCs and non-AMCs, for-profit and nonprofit hospitals, or hospitals in large urban areas compared with those in small urban or rural areas. However, comparing the HAC8-to-HAC ratios for 2008 and 2010, in aggregate, the ratios for CAUTI fell dramatically for all hospitals from 2008 to 2009 before increasing again (with the exception of AMCs) in 2010. The HAC8-to-HAC ratios in for-profit hospitals (and non-profit hospitals) fell from 2008 to 2009 from 0.72 to 0.48 (0.63 to 0.55), then increased from 2009 to 2010 from 0.48 to 0.69 (0.55 to 0.63).

Table 4.5
Hospital-acquired CAUTIs: Ratio of HAC8 rate to HAC rate, State, year, and hospital characteristics

State	Year	Academic medical center	Not an academic medical center	For profit hospital	Nonprofit hospital	Hospital in large urban area	Hospital in a small urban area	Hospital in a rural area
Arizona	2008	0.80	0.76	0.79	0.75	0.74	0.80	0.75
Arizona	2009	0.40	0.54	0.50	0.55	0.47	0.66	0.67
Arizona	2010	1.00	0.66	0.65	0.66	0.54	0.93	0.70
California	2008	0.62	0.50	0.54	0.50	0.51	0.53	0.43
California	2009	0.58	0.51	0.38	0.53	0.52	0.49	0.69
California	2010	0.52	0.52	0.49	0.54	0.53	0.50	0.56
Florida	2008	0.72	0.73	0.77	0.72	0.71	0.75	0.72
Florida	2009	0.29	0.54	0.47	0.45	0.46	0.59	0.51
Florida	2010	0.36	0.71	0.78	0.67	0.66	0.69	0.80
New Jersey	2008	0.90	0.73	—	0.74	0.75	0.70	N/A
New Jersey	2009	0.60	0.60	1.00	0.59	0.59	0.68	N/A
New Jersey	2010	0.22	0.67	—	0.66	0.65	0.65	N/A
Combined	2008	0.73	0.64	0.72	0.63	0.63	0.70	0.71
Combined	2009	0.51	0.56	0.48	0.55	0.54	0.59	0.58
Combined	2010	0.49	0.63	0.69	0.63	0.60	0.67	0.76

NOTES: "—" means that either there were no discharges or that the HAC rate was zero so that division was not possible. New Jersey has no rural counties. CAUTI = catheter-associated urinary tract infection; HAC = hospital-acquired condition.

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

Table 4.6 displays the ratio of the HAC8 rate to the HAC rate for vascular catheter-associated infection by State, year, and hospital characteristic. The HAC8-to-HAC ratios were quite similar across hospital characteristics in 2008. There is a general decline across all States and hospital characteristics, with a large decline from 2008 to 2009. Rates of decline in using the first eight fields were greater for AMCs and for-profit hospitals.

Table 4.6
Hospital-acquired vascular catheter-associated infections: Ratio of HAC8 rate to HAC rate, by State, year, and hospital characteristics

State	Year	Academic medical center	Not an academic medical center	For profit hospital	Nonprofit hospital	Hospital in large urban area	Hospital in a small urban area	Hospital in a rural area
Arizona	2008	0.50	0.60	0.55	0.62	0.58	0.67	0.58
Arizona	2009	0.33	0.37	0.41	0.36	0.34	0.43	0.44
Arizona	2010	0.30	0.39	0.34	0.40	0.35	0.48	0.50
California	2008	0.55	0.51	0.53	0.51	0.52	0.50	0.54
California	2009	0.47	0.46	0.45	0.46	0.46	0.43	0.60
California	2010	0.50	0.49	0.42	0.48	0.50	0.46	0.43
Florida	2008	0.60	0.57	0.55	0.60	0.59	0.59	0.53
Florida	2009	0.20	0.31	0.27	0.31	0.29	0.33	0.24
Florida	2010	0.33	0.41	0.40	0.41	0.38	0.44	0.40
New Jersey	2008	0.63	0.64	1.00	0.64	0.63	0.68	N/A
New Jersey	2009	0.22	0.50	0.83	0.45	0.44	0.57	N/A
New Jersey	2010	0.30	0.52	0.31	0.49	0.48	0.47	N/A
Combined	2008	0.61	0.58	0.56	0.59	0.58	0.59	0.56
Combined	2009	0.35	0.42	0.37	0.44	0.42	0.41	0.29
Combined	2010	0.42	0.48	0.41	0.48	0.47	0.48	0.41

NOTES: "—" means that either there were no discharges or the HAC rate was zero so that division was not possible. New Jersey has no rural counties.

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

Table 4.7 displays the ratio of the HAC8 rate to the HAC rate for hospital-acquired DVT/PE following certain orthopedic procedures by State, year, and hospital characteristic. There is no observable pattern in the ratio of the HAC8-to-HAC rate following certain orthopedic procedures in 2008 between AMCs and non-AMCs or for-profit and nonprofit hospitals. There is also no observable change in the ratio from 2008 to 2010.

Table 4.7
Hospital-acquired deep vein thrombosis or pulmonary embolism following certain orthopedic procedures: Ratio of HAC8 rate to HAC rate, by State, year, and hospital characteristics

State	Year	Academic medical center	Not an academic medical center	For profit hospital	Nonprofit hospital	Hospital in large urban area	Hospital in a small urban area	Hospital in a rural area
Arizona	2008	1.00	0.95	1.00	0.96	0.98	1.00	0.60
Arizona	2009	1.00	0.87	0.88	0.86	0.80	1.00	0.83
Arizona	2010	—	0.95	0.94	0.95	0.94	0.95	1.00
California	2008	0.57	0.39	0.28	0.41	0.43	0.24	0.33
California	2009	0.27	0.46	0.37	0.44	0.44	0.33	0.75
California	2010	0.54	0.43	0.47	0.44	0.47	0.36	0.00
Florida	2008	1.00	0.95	0.97	0.94	0.94	0.95	0.94
Florida	2009	0.94	0.84	0.85	0.83	0.83	0.87	0.79
Florida	2010	0.93	0.91	0.93	0.88	0.91	0.92	0.88
New Jersey	2008	0.87	0.89	—	0.89	0.86	1.00	N/A
New Jersey	2009	0.80	0.89	—	0.88	0.86	1.00	N/A
New Jersey	2010	0.85	0.95	—	0.95	0.93	0.96	N/A
Combined	2008	0.85	0.86	0.87	0.85	0.84	0.90	0.86
Combined	2009	0.72	0.84	0.85	0.82	0.81	0.89	0.87
Combined	2010	0.81	0.83	0.88	0.82	0.82	0.86	0.86

NOTES: "—" means that either there were no discharges or the HAC rate was zero so that division was not possible. New Jersey has no rural counties. HAC = hospital-acquired condition.

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

4.3 Conclusions and Discussion

We began our analysis of the unintended consequences of hospital coding practices by determining the correlation between the numbers of secondary diagnosis codes reported on the claim and reported HAC rates. We compared the HAC rates using all secondary diagnosis codes on the claim with the HAC rates calculated using just the first eight secondary diagnosis codes. We found that HACs are indeed coded past the eighth secondary diagnosis code field, suggesting that historical MedPAR rates understate the true incidence of HACs.

To ascertain the degree to which HAC rates may be understated, we then compared the HAC8-to-HAC ratio for all discharges with the ratio for discharges with nine or more secondary diagnosis codes on the claim. We found a higher percentage of missed HACs among discharges with more than eight secondary diagnoses; however, the degree varied by HAC. The share of missed HACs was similar for all discharges and discharges with nine or more diagnosis codes for stage III or IV pressure ulcer, vascular catheter-associated infection, and mediastinitis following CABG surgery, but there were large differences for other HACs, including falls and trauma and DVT/PE following certain orthopedic procedures. This variation is being driven in part by the percentage of HACs recorded on discharges with fewer than nine secondary diagnosis codes that have a ratio of 1, so *ceteris paribus,* the larger their share of discharges reporting fewer than nine secondary codes, the larger the difference in the ratios will be.

We hypothesized that for-profit hospitals, to maximize revenues, may place HACs in the ninth or subsequent secondary diagnosis fields, lowering their ratios relative to nonprofit hospitals. Furthermore, we hypothesized that if for-profit hospitals are coding strategically, then their HAC8-to-HAC ratio should decline in 2009 and 2010 after implementation of the HAC-POA program. We also hypothesized that at an AMC with a very sick patient case mix, the more serious complications would be placed in the first eight secondary diagnosis fields, pushing the HAC to the ninth or subsequent fields. This would result in lower HAC8-to-HAC ratios at AMCs than at non-AMCs. This type of coding behavior should not be affected by the HAC-POA program; therefore, we hypothesized no changes in the HAC8-to-HAC ratio at AMCs in 2009 and 2010 after implementation of the HAC-POA program. Limiting our analysis to just those discharges with nine or more secondary diagnosis codes, we did not find any consistent pattern in coding across HACs. However, we did find large decreases across all hospitals in the ratios from 2008 to 2009 for hospital-acquired stage III or IV pressure ulcer, CAUTI, and vascular catheter-associated infection.

Beginning in January 2011, CMS began processing data for up to 25 diagnosis fields for all hospitals when submitted in the version 5010 format, which may increase reported rates for some HACs and will improve accuracy. For example, the reported rate for hospital-acquired stage III or IV pressure ulcer could more than double, and the rate for hospital-acquired falls and trauma could increase by 20 percent. The actual change may be more or less depending on hospital changes in quality in the interim. However, some HACs may still be missed to the extent that HACs do not manifest in the hospital or are coded POA on the admission, not coded at all, or coded in the 26th–30th secondary diagnosis fields.

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SECTION 5
SUMMARY AND CONCLUSIONS

This report explored the following research questions:

1. How much variation in the reporting of HACs is there across all payers?

2. Has the HAC-POA program reduced the overall reporting of HACs for all payers; in other words, is there a positive spillover to all payers?

3. Have hospitals failed to identify HACs by not recording the relevant conditions in the first eight secondary diagnosis codes?

4. How does the coding of secondary diagnosis codes and location of HACs among the secondary diagnosis codes vary by hospital characteristics such as for-profit status, teaching status, and location?

The first two questions ask whether any changes in hospital coding of HACs or reported quality changes have a spillover onto other payers. The last two questions quantify the downward bias of limiting HAC counts to the first eight secondary diagnosis code fields.

5.1 Findings From the Spillover Analysis

We did not find any consistent pattern in the reporting of the rates of HACs across 3 years or type of payer. Medicare had the highest rates of hospital-acquired falls and trauma, stage III and IV pressure ulcer, CAUTI, and vascular catheter-associated infection. Medicaid had the highest rates of hospital-acquired mediastinitis following CABG surgery and SSI following certain orthopedic procedures. It is not possible to draw any conclusions for air embolism, blood incompatibility, or SSI following bariatric surgery because they occurred too infrequently.

We saw a general decline in the HAC rate from 2008 through 2010 for several HACs: falls and trauma, vascular catheter-associated infection, DVT/PE following certain orthopedic procedures, and SSI following certain orthopedic procedures. However, in most cases, the rate actually increased in 2009 compared with 2008 before declining again in 2010. We found two different trends by State for stage III and IV pressure ulcer. From 2009 to 2010, rates fell in Arizona and California but increased in Florida and New Jersey. One explanation is that some hospitals were still learning how to code the stages of pressure ulcers.

We found no evidence that the HAC-POA program had any effect on the rate of CAUTI for the three payers: Medicare, Medicaid, and private insurance. We observed a decline in 2009 in the likelihood of experiencing a fall or trauma for all three payers, with an incrementally greater decline for privately insured patients, but no further decline in 2010 for any payer. This indicates a positive spillover effect to private insurance patients. We also observed a decline in 2009 in the likelihood of developing a DVT/PE following certain orthopedic procedures, with an incrementally greater decline in 2010, but no incremental difference across payers. Two interpretations are possible. One interpretation is that there was an overall secular trend in DVT/PE rates independent of the HAC-POA program. A second interpretation is that the HAC–

POA program has had a positive spillover effect on other payers (i.e., a "rising tide lifts all boats" phenomenon).

Combined, these results provide some limited evidence of positive spillover effects on other payers, primarily in the first year of the Medicare HAC-POA program, for two of the these three conditions. But we can also interpret the results to mean that the Medicare HAC-POA program had no impact on the three studied HACs. There was no decline in the rate of CAUTI, and the observed decline in the rates of falls and trauma and DVT/PE following certain orthopedic procedures across all payers could be a naturally occurring secular trend, as the benefit appeared to be greatest in hospitals with initially highest rates.

RTI's all-payer analyses have two caveats. First, we can analyze only the reported rate of the HACs and not the actual incidence of HACs. The actual incidence of HACs may be higher than the reported rate for three reasons: the condition may not manifest while the patient is in the hospital, as can happen with SSIs; hospitals may not code the condition if it does not affect their payment; and the HAC may not be reported if the patient has more secondary diagnoses than are captured on the claim. In the next section, we explore the relationship between the number of secondary diagnoses on the claim, the number captured by Medicare, and the impact on reported rates of HACs. Second, we could not measure any changes in individual hospital quality over time with changes in the rates of the studied HACs.

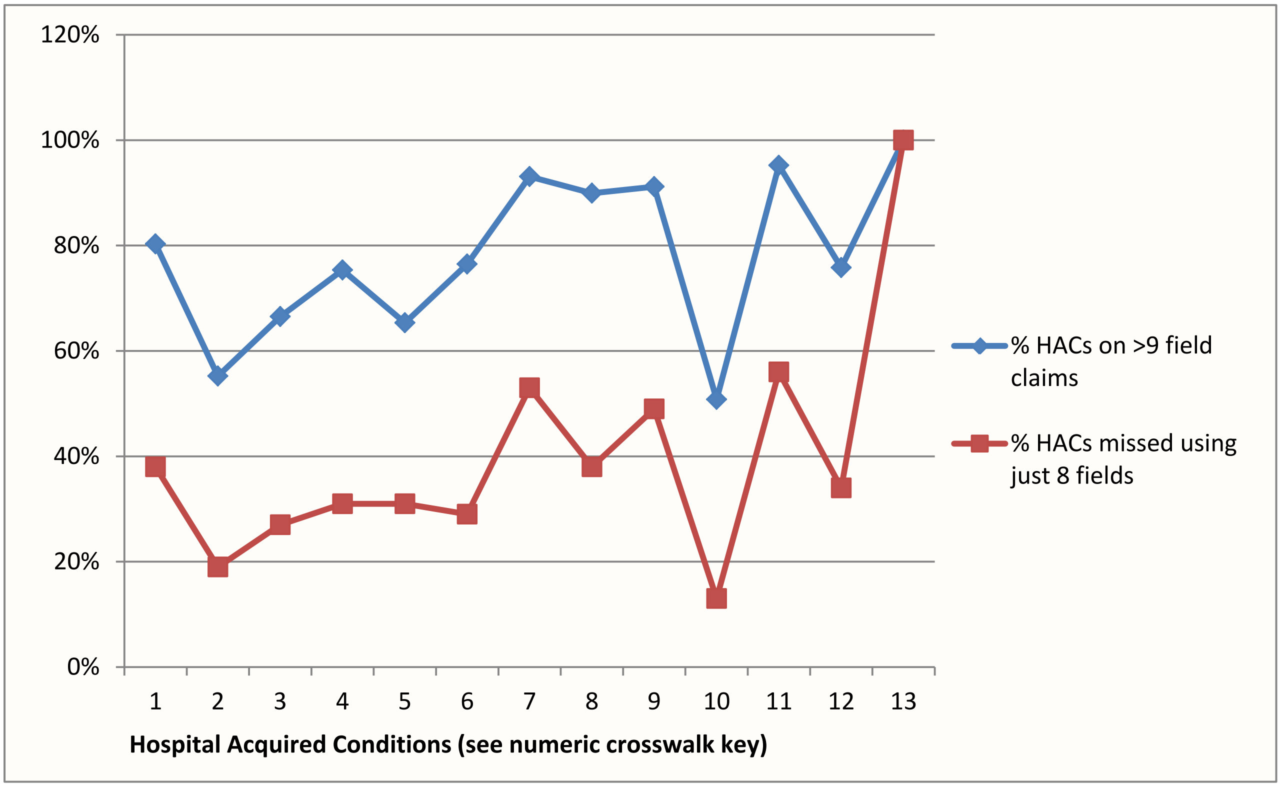
5.2 Findings From the Analysis of Unintended Consequences of Hospital Coding Practices

We began our analysis of the unintended consequences of hospital coding practices by determining the correlation between the numbers of secondary diagnosis codes reported on the claim and reported HAC rates. Using State HCUP claims, we compared the HAC rates using all secondary diagnosis fields on the claim with HAC rates using just the first eight secondary diagnosis fields. For the 46,105 HACs reported in four States from 2008 to 2010 using all available diagnosis fields, only 62 percent were captured in the first eight fields; 38 percent of HACs were coded in the ninth or greater fields.

Across public and private payers, counting all secondary diagnosis codes had the greatest positive effect in raising HAC rates for Medicare and Medicaid beneficiaries. One possible explanation for this finding is that Medicare and Medicaid patients are more likely to have multiple comorbidities or complications due to greater severity of illness, which increases the likelihood that more than eight secondary diagnosis code fields are needed to code them all. Reporting more than eight diagnoses, in turn, provides more opportunity, intended or otherwise, to put HAC codes in the ninth or later fields. This observation prompted a more detailed study of the share of claims with more than eight secondary diagnoses by individual HAC.

To ascertain the degree to which HAC rates may be understated, we first calculated the share of all HACs appearing in the first eight secondary diagnosis code fields on the claim. In ***Figure 5.1***, the type of HAC appears along the horizontal axis (all HACs = 1, foreign body retained after surgery = 2, falls and trauma = 3, etc.). Missed HACs using just eight codes

Figure 5.1
Effect of claims with nine or more secondary diagnoses on percentage of HACs missed using only eight secondary diagnosis fields



Numeric Crosswalk Key

HAC #	Hospital-Acquired Condition (HAC)
1	All HACs
2	Foreign object retained after surgery
3	Falls and trauma
4	Manifestations of poor glycemic control
5	Air embolism
6	Blood incompatibility
7	Stage III and IV pressure ulcer
8	Catheter-associated urinary tract infection
9	Vascular catheter-associated infection
10	Deep vein thrombosis/pulmonary embolism following certain orthopedic procedures
11	Surgical site infection (SSI)—Mediastinitis
12	SSI following certain orthopedic procedures
13	SSI following bariatric surgery

ranged from 13 percent for DVT/PE following certain orthopedic procedures (HAC #10) to 53 and 56 percent for Stage III and IV pressure ulcer (HAC #7) and mediastinitis following CABG (HAC #11), respectively. (HAC #13, SSI following bariatric surgery, is based on only one instance in 2009.) We found a consistent pattern for HACs in the first eight secondary diagnosis code fields and patients having nine or more secondary diagnosis code fields reported. The upper blue line reports the percentage of HACs that appear in any secondary diagnosis code field on claims with nine or more reported secondary diagnoses. The lower red line gives the percentage of HACs missed using just eight fields on any claim. When a HAC is reported, higher proportions of discharges with nine or more secondary diagnoses are positively associated with higher percentages of HACs missed using just eight fields. DVT/PE with certain orthopedic procedures (HAC #10) shows a strong negative spike. The fact that only 51 percent of HACs are reported on claims with nine or more secondary diagnoses produces a missed HAC rate of 13 percent using just eight codes. Conversely, HACs #7 and 11, Stage III and IV pressure ulcer and mediastinitis following CABG surgery, respectively, which have very high shares of claims with nine or more secondary codes, also have the highest percentage of HACs missed using the first eight diagnosis fields. Therefore, limiting HAC identification to just a few secondary diagnosis code fields can produce systematic downward bias in reported HACs, depending upon the extent of comorbidity associated with the HAC.

We next stratified HAC8 to total HAC ratios by hospital characteristics and over years. Because we were interested in the extent to which hospitals with the *ability* to code strategically *are* coding strategically, we limited our analysis to just those discharges with nine or more secondary diagnosis codes**.** We did not find any consistent pattern in coding across HACs. However, we did find large decreases across all hospitals in the ratios from 2008 to 2009 for hospital-acquired stage III or IV pressure ulcer, CAUTI, and vascular catheter-associated infection.

Beginning in January 2011, CMS began processing data for up to 25 diagnosis fields for all hospitals when submitted in the version 5010 format. This may increase reported rates for some HACs and will improve accuracy. For example, the reported rate for hospital-acquired stage III or IV pressure ulcer could more than double and the rate for hospital-acquired falls and trauma could increase by 20 percent. The actual change may be more or less depending on hospital changes in quality in the interim. However, some HACs may still be missed to the extent that HACs do not manifest in the hospital or are coded POA on another admission, not coded at all, or coded in the 26th–30th secondary diagnosis fields.

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APPENDIX A:
TABLES OF THE NUMBER OF DISCHARGES WITH HOSPITAL-ACQUIRED DIAGNOSIS

LIST OF TABLES IN APPENDIX A

Table A.1
Number of discharges with hospital-acquired foreign object retained after surgery, by primary payer, State, and year

State	Year	Medicare	Medicaid	Private insurance	Self-pay	No charge	Other
Arizona	2008	11	3	12	1	0	0
Arizona	2009	9	9	8	2	0	1
Arizona	2010	6	8	12	1	0	3
California	2008	42	26	56	2	—	11
California	2009	46	9	42	4	—	5
California	2010	39	21	40	2	—	7
Florida	2008	32	11	26	1	0	5
Florida	2009	25	10	16	3	1	2
Florida	2010	31	4	9	2	1	5
New Jersey	2008	9	1	12	2	0	1
New Jersey	2009	7	2	10	3	0	0
New Jersey	2010	8	0	14	1	0	0

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

Table A.2
Number of discharges with a hospital-acquired fall or trauma, by primary payer, State, and year

State	Year	Medicare	Medicaid	Private insurance	Self-pay	No charge	Other
Arizona	2008	252	34	87	6	0	26
Arizona	2009	230	37	58	3	0	8
Arizona	2010	217	38	55	2	2	9
California	2008	1,413	287	513	54	—	128
California	2009	1,003	210	294	34	—	49
California	2010	795	144	236	32	—	43
Florida	2008	1,118	122	211	35	20	35
Florida	2009	1,065	101	204	32	22	28
Florida	2010	856	98	167	48	9	34
New Jersey	2008	487	33	287	80	0	29
New Jersey	2009	305	18	101	21	0	4
New Jersey	2010	313	23	89	25	0	8

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

Table A.3
Number of discharges with hospital-acquired manifestations of poor glycemic control, by primary payer, State, and year

State	Year	Medicare	Medicaid	Private insurance	Self-pay	No charge	Other
Arizona	2008	17	13	5	0	0	2
Arizona	2009	5	7	3	0	0	3
Arizona	2010	7	7	4	0	0	0
California	2008	108	75	88	23	—	23
California	2009	55	41	40	3	—	8
California	2010	43	24	31	7	—	6
Florida	2008	79	21	34	9	3	3
Florida	2009	59	14	26	5	0	3
Florida	2010	44	12	28	4	1	5
New Jersey	2008	33	3	30	8	0	2
New Jersey	2009	20	3	11	6	0	0
New Jersey	2010	18	8	17	2	0	1

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

Table A.4
Number of discharges with hospital-acquired air embolism following certain orthopedic procedures, by primary payer, State, and year

State	Year	Medicare	Medicaid	Private insurance	Self-pay	No charge	Other
Arizona	2008	1	0	0	0	0	0
Arizona	2009	2	2	2	0	0	0
Arizona	2010	1	0	0	0	0	0
California	2008	8	2	6	0	—	1
California	2009	9	1	5	0	—	3
California	2010	7	1	4	0	—	1
Florida	2008	4	1	2	1	0	0
Florida	2009	2	1	1	0	1	0
Florida	2010	1	1	1	0	0	0
New Jersey	2008	0	0	0	1	0	0
New Jersey	2009	1	0	0	0	0	0
New Jersey	2010	1	0	0	0	0	0

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

Table A.5
Number of discharges with hospital-acquired blood incompatibility, by primary payer, State, and year

State	Year	Medicare	Medicaid	Private insurance	Self-pay	No charge	Other
Arizona	2008	0	0	0	0	0	0
Arizona	2009	0	0	0	0	0	0
Arizona	2010	0	1	1	0	0	0
California	2008	2	2	0	0	—	0
California	2009	1	0	1	0	—	0
California	2010	1	0	0	0	—	0
Florida	2008	2	3	2	0	0	0
Florida	2009	1	3	2	1	0	0
Florida	2010	0	4	2	0	0	0
New Jersey	2008	2	0	1	0	0	0
New Jersey	2009	0	0	0	0	0	0
New Jersey	2010	1	0	1	0	0	0

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

Table A.6
Number of discharges with hospital-acquired stage III and IV pressure ulcers, by primary payer, State, and year

State	Year	Medicare	Medicaid	Private insurance	Self-pay	No charge	Other
Arizona	2008	6	1	2	0	0	2
Arizona	2009	35	11	9	1	1	10
Arizona	2010	33	5	9	0	0	5
California	2008	101	46	26	5	—	5
California	2009	351	160	75	5	—	13
California	2010	216	100	63	9	—	10
Florida	2008	89	14	8	4	2	4
Florida	2009	298	70	67	15	7	8
Florida	2010	190	75	45	3	1	10
New Jersey	2008	64	11	19	10	0	0
New Jersey	2009	133	17	34	3	0	1
New Jersey	2010	136	19	33	14	0	3

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

Table A.7
Number of discharges with a hospital-acquired catheter-associated urinary tract infection, by primary payer, State, and year

State	Year	Medicare	Medicaid	Private insurance	Self-pay	No charge	Other
Arizona	2008	136	20	41	2	1	4
Arizona	2009	123	22	26	1	2	10
Arizona	2010	138	16	36	3	1	7
California	2008	668	111	196	10	—	32
California	2009	727	128	186	23	—	28
California	2010	661	101	154	16	—	17
Florida	2008	488	29	84	14	8	16
Florida	2009	547	48	101	12	2	9
Florida	2010	450	69	69	12	6	13
New Jersey	2008	154	7	45	6	0	2
New Jersey	2009	164	6	35	8	0	3
New Jersey	2010	154	4	45	10	0	1

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

Table A.8
Number of discharges with a hospital-acquired vascular catheter infection, by primary payer, State, and year

State	Year	Medicare	Medicaid	Private insurance	Self-pay	No charge	Other
Arizona	2008	281	99	149	7	1	30
Arizona	2009	220	91	134	7	3	15
Arizona	2010	188	89	97	5	2	24
California	2008	1459	605	735	73	—	133
California	2009	1288	590	633	72	—	117
California	2010	848	363	417	35	—	71
Florida	2008	1579	381	622	105	68	95
Florida	2009	1444	430	535	91	44	52
Florida	2010	905	333	329	66	24	55
New Jersey	2008	447	62	224	52	0	9
New Jersey	2009	471	68	254	38	0	7
New Jersey	2010	478	69	246	53	0	6

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

Table A.9
Number of discharges with a hospital-acquired deep vein thrombosis/pulmonary embolism following certain orthopedic procedures, by primary payer, State, and year

State	Year	Medicare	Medicaid	Private insurance	Self-pay	No charge	Other
Arizona	2008	59	2	22	0	0	7
Arizona	2009	71	9	17	0	0	12
Arizona	2010	82	3	7	2	0	6
California	2008	267	19	118	1	—	12
California	2009	275	15	107	2	—	9
California	2010	273	17	89	1	—	9
Florida	2008	316	10	71	3	2	12
Florida	2009	287	4	85	5	0	9
Florida	2010	280	9	76	3	3	18
New Jersey	2008	169	3	89	3	0	3
New Jersey	2009	128	2	77	6	0	2
New Jersey	2010	108	3	65	3	0	4

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

Table A.10
Number of discharges with a hospital-acquired mediastinitis following coronary artery bypass graft surgery, by primary payer, State, and year

State	Year	Medicare	Medicaid	Private insurance	Self-pay	No charge	Other
Arizona	2008	2	0	0	0	0	0
Arizona	2009	0	0	1	0	0	0
Arizona	2010	2	0	0	0	0	0
California	2008	13	3	7	0	—	0
California	2009	8	3	1	1	—	0
California	2010	8	1	2	0	—	2
Florida	2008	7	3	1	0	1	1
Florida	2009	3	1	2	0	0	0
Florida	2010	6	2	3	3	0	1
New Jersey	2008	3	0	1	1	—	0
New Jersey	2009	4	0	1	0	—	0
New Jersey	2010	6	0	0	0	—	0

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

Table A.11
Number of discharges with a hospital-acquired surgical site infection following certain orthopedic procedures, by primary payer, State, and year

State	Year	Medicare	Medicaid	Private insurance	Self-pay	No charge	Other
Arizona	2008	10	6	8	0	0	4
Arizona	2009	4	7	4	0	0	1
Arizona	2010	11	2	9	0	0	0
California	2008	70	24	37	3	—	36
California	2009	79	16	44	4	—	27
California	2010	48	21	36	1	—	16
Florida	2008	35	8	25	5	2	12
Florida	2009	43	6	20	0	0	9
Florida	2010	28	5	17	0	0	5
New Jersey	2008	6	1	14	3	0	2
New Jersey	2009	9	1	13	1	0	2
New Jersey	2010	9	0	14	2	0	2

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.

Table A.12
Number of discharges with a hospital-acquired surgical site infection following bariatric surgery, by primary payer, State, and year

State	Year	Medicare	Medicaid	Private insurance	Self-pay	No charge	Other
Arizona	2008	0	0	0	0	0	0
Arizona	2009	0	0	0	0	0	0
Arizona	2010	0	0	0	0	0	0
California	2008	0	0	0	0	0	0
California	2009	1	0	0	0	0	1
California	2010	0	0	0	0	0	0
Florida	2008	0	0	0	0	0	0
Florida	2009	0	0	0	0	0	0
Florida	2010	0	0	0	0	0	0
New Jersey	2008	0	0	0	0	0	0
New Jersey	2009	0	0	0	0	0	0
New Jersey	2010	0	0	0	0	0	0

SOURCE: RTI analysis of 2008–2010 Healthcare Cost and Utilization Project State inpatient databases.