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Patient-Centered Medical Homes and Hospital Value-Based Purchasing: Investigating Provider Responses to Incentives

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Patient-Centered Medical Homes and Hospital Value-Based Purchasing: Investigating Provider Responses to Incentives

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List of abbreviations

ACA – Affordable Care Act

ACNP – Acute care nurse practitioner

ACS – American Community Survey

AHA – American Hospital Association

AHRQ – Agency for Healthcare Research and Quality

BBA – Balanced Budget Act of 1997

BLS – Bureau of Labor Statistics

CMS – Center for Medicare and Medicaid Services

ED – Emergency department

EHR – Electronic health record

EMTALA – Emergency Medical Treatment and Active Labor Act of 1986

FPL – Federal poverty level

FTE – Full-time equivalent

FY – Fiscal year

FQHC – Federally-qualified health center

GED – General education development

GLM – Generalized linear model

HCRIS – Healthcare Cost Report Information System

HRSA – Health Resources and Services Administration

HVBP – Hospital value-based purchasing program

IPPS – Inpatient prospective payment system

LPN – Licensed practical nurse

MACRA – Medicare Access and CHIP Reauthorization Act of 2015

MDH – Medicare-dependent hospital

MEPS – Medical expenditure panel survey

MEPS-HC – Medical expenditure panel survey household component

MICE – Multiple imputations by chained equations

MOS – Medical organizational survey

NCQA – National Committee for Quality Assurance

NP – Nurse practitioner

PA – Physician assistant

PCMH – Patient-centered medical home

RN – Registered nurse

RRC – Rural referral center

SCH – Sole community hospital

USC – Usual source of care

VHI – Virginia Health Information

Abstract

Provider incentives are a commonly used policy tool to mold provider behaviors.[1] However, while we frequently measure the change in patient outcomes, failure to consistently produce changes in outcomes does not mean that providers are not changing their behavior. This paper focuses on two programs with null or inconsistent quality outcomes to try to identify why such inconsistency occurs. The two programs, both ratified in the Affordable Care Act, are 1) patient-centered medical homes (PCMHs), and 2) the Medicare Hospital Value-Based Purchasing (HVBP) program.

Chapter 1: Using data from the Medical Expenditure Panel survey (MEPS), I match provider characteristic surveys to member experience with care in order to evaluate characteristics key to patient-centered medical homes. I find that patient-perceived patient-centeredness of a practice is not related to the number of PCMH attributes a practice reports. However, some characteristics do play specific and significant roles in patient perception and outcomes. For instance, case management is not only associated with increased patient perception of after-hours access to care, but overall costs were reduced. Interestingly, having after hours clinic hours was more common with practices highly consistent with PCMH criteria, but these hours did not result in decreased emergency department use or cost of care.

Chapter 2: The second provider incentive studied is the Medicare Hospital Value-Based Purchasing Program (HVBP). This program assigns payment adjustments based on performance on a series of rotating quality metrics. To date, changes in patient outcomes cannot be attributed to the program; however, it should not be concluded that hospitals are not responding at all. I identify changes in staffing by provider type as an early indicator of hospital response to payment incentives. Data come from the Virginia Health Information (VHI) Hospital Cost Report, 2010-2017. Using a generalized linear model, I find that when receiving a penalty, hospitals reduce staffing among the most and least expensive personnel (physicians and nursing aides). Hospitals increase nursing and administrative staff following a bonus. These findings are consistent with hospitals responding to incentives both by aiming to improve efficient use of resources and maintain or improve quality of care.

Chapter 3: Finally, I assess potential unintended consequences of the HVBP program, specifically the provision of charity care. Using the VHI cost reports for year 2013 to 2017 with a regression discontinuity model, I find that hospitals receiving a bonus decrease their charity care among the lowest income patients (under 100% federal poverty level (FPL)). Hospitals receiving a penalty tend to reduce charity care among higher income patients (100%-200% FPL). These findings are consistent with two separate responses to the incentives. Hospitals receiving bonuses appear to be cream-skimming healthier, wealthier individuals while hospitals receiving penalties appear to be shifting the focus of their charity care to the most needy, likely in an effort to reduce cost of care levels overall while maintaining their community benefit programs, potentially as a result of goal gradient cognitive bias.

Introduction

Since the passage of the Affordable Care Act (ACA), an additional 20 million people have gained access to health insurance and more than 70% of people report having a usual source of care.[2,3] However, there is little evidence that the overall health of Americans has substantially changed.[4] In fact, recent reports indicate that the United States continues to rank last in overall performance, access, and health outcomes compared to 10 other industrialized countries.[5] Furthermore, while health expenditures slowed for a number of years following the ACA, when specific delivery system and payment reforms are evaluated, it is unclear which models are consistently cost savers and why.[6] Now, several years after many of the ACA delivery system and payment reforms were implemented, it is critical to take a deeper look at these models to identify both how providers have responded to incentives and how patients are experiencing their care.

This series of papers focus on two reforms: 1) patient-centered medical homes and 2) Medicare Hospital Value-Based Purchasing (HVBP) program. Both of these programs have provided inconsistent effects on patient outcomes at best. In the case of the HVBP program, many researchers argue that no improvements in care at all can be attributed to the payment incentive, though some disagree.[7] Yet, despite failure to produce consistent effects, policymakers are not discussing ending either incentive structure. Instead, continual modest adjustments are made to both programs in an effort to correct where the programs may be failing. However, with little research focused on *why* these programs produce inconsistent results and only on the results themselves, policymakers have little guidance on what adjustments to make. Therefore, it is incumbent on health policy, health economics, and health services researchers to investigate these policies more thoroughly in order to identify why these programs are failing to produce desired effects, and importantly, if the incentives are not producing the expected behavior, what behaviors are they producing? Answering these questions will enable policymakers to build on and improve current programs and identify possible unintended detrimental effects. This series aims to begin that investigation by identifying specific provider attributes associated with patient-centeredness, identifying how hospitals shift their workforce budgets in response to HVBP penalties, and measuring unintended consequences of the HVBP program in the form of charitable care provisions.

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ABSTRACT

Background: Patient-centered medical homes (PCMHs) have become increasingly more common throughout the country, however, evidence of their effects on both patient outcomes and expenditures is mixed. With numerous accrediting bodies and methods of meeting accreditation criteria, this study aims to identify specific PCMH attributes that are correlated with patient perception of patient-centeredness and influence emergency department use and expenditures.

Methods: Data come from the 2015 and 2016 MEPS Medical Organizational Survey (MOS), and Household Component (MEPS-HC). The MOS supplement was first conducted in 2015 (released in 2017), and is the first nationally representative survey to pair patient experiences with characteristics of their provider's practice. With two years of data, the final sample size was 12,127 paired surveys. Indices were created to identify practices with few, medium, and large numbers of PCMH criteria both from the provider and patient perspectives. Logit regressions were used to assess concordance between provider and patient perceptions and likelihood of an emergency department (ED) visit. Individual attributes were also tested. Log-transformed OLS was used to assess change in expenditures.

Results: Few practice attributes were associated with patient perceived patient-centeredness; however, practices that offered extended hours were more likely to hire nurse practitioners (NPs) or physician assistants (PAs) (0.27, $p < 0.01$). However, extended hours did not lead to reduced ED use or expenditures. Case management is associated with both increased perception of access to after-hours care (0.16, $p < 0.05$) and decreased overall cost (-0.01, $p < 0.05$).

Discussion: PCMH attributes do not result in patients perceiving their care to be patient-centered, nor does it result in fewer ED visits or lower expenditures. There are, however certain attributes that may be more important than others. Case management reduced expenditures and improved patient perceived access to care after hours. While high patient–centered practices and practices with NPs or PAs were much more likely to offer extended office hours, these hours had

no effect on ED use or expenditures. However, when taken together, measures of patient-perceived accessibility (including extended office hours) were associated with a lower likelihood of an ED visit and a 2 percentage point reduction in expenditures.

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INTRODUCTION

A patient-centered medical home (PCMH) is a delivery system model aimed at improving primary care continuity and cost efficiency. While there is no single definition, the concept of a PCMH was developed by several primary care professional societies and emphasized the importance of having an ongoing relationship with a "whole person" oriented provider, coordinated care across the continuum, enhanced access, and commitment to quality and safety.[8] The PCMH model was then implemented through a series of demonstration projects under the Affordable Care Act (ACA). Since enactment of the ACA, the PCMH model has grown, taking many forms, with a variety of certifying entities. Although no two entities have the exact same definition of a PCMH, the National Committee for Quality Assurance (NCQA) has established PCMH principles that have been widely adopted by various PCMH certifying entities and the PCMH demonstrations authorized by the ACA.[9,10] These principles include comprehensive and team-based care, care coordination, quality improvement, and patient-centered access.

When first implemented, the hope was that these medical homes would dramatically decrease costs by avoiding emergency department (ED) visits through appropriate use of preventive services, reduce duplicative services, and improve the patient experience of care.[9] Evaluations of these medical homes have found that in fact, many have succeeded in achieving these goals.[11,12] For instance, in Seattle, PCMHs were found to decrease ED use by 29% while reducing costs by $10.30 per patient per month.[11] However, numerous other studies have shown these medical homes to have little to no effect on costs, utilization or satisfaction.[13–15] With such mixed findings, policy makers are left with no clear direction to move in primary care.

One of the major limitations with evaluations of PCMHs is that while there are some general principles of a PCMH, little guidance has been provided on how these principles should be operationalized. This has led to extensive heterogeneity of practices, and likely contributes to the mixed findings from PCMH evaluations. Most studies evaluate certified PCMHs as a group, as if each medical home practice is the same;[11–14] however, certification requirements may be met in a variety of ways and even basic criteria are inconsistent across accrediting entities. Therefore, it is difficult to know what to extrapolate from these findings. Certified PCMH

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practices may look as similar to each other as they do to practices with no certification, but who choose to adopt some patient-centered characteristics.

There are a limited number of studies that focus on patient-centered attributes as opposed to certification. These studies allow the principles of patient-centered medical homes to be examined outside of the certification framework. From this type of analysis, it is clear that patients who report receiving care consistent with patient-centered principles of access, care coordination and continuity of care are more likely to report a positive experience, with the magnitude of the effects increasing as more patient-centered principles are met.[16,17] However, these studies are limited in that they rely solely on the perspective of the patient.[16,17] Without the ability to match the patient perspective to the practice, it is impossible to know what attributes are most closely related to the patient experience of patient-centered care. In fact, studies that focus on attributes of practices, as opposed to patient's perception, have shown opposite effects on quality – namely that practices more likely to adopt attributes consistent with PCMH principles also had higher rates of preventable readmissions.[18] Identifying the relationship between patient experience and specific practice attributes is key for policy makers and providers aiming to establish and implement PCMH principles that improve quality of care. Without this knowledge, there is little guidance on direct actions that may be taken to promote high quality primary care through patient-centered medical homes.

To date, there has been no nationally representative data source that enables researchers to link the patient experience of care to the practice in which they receive the majority of their care. However, a supplemental survey to the Medical Expenditure Panel Survey (MEPS) released in 2017 not only links patient experience to provider characteristics, but also includes patient healthcare utilization, insurance status, and healthcare spending. Using this unique data source, this study aims to compare the concordance between characteristics of a practice reported by the provider and their patients' experience with the services and to identify which perspective most influences ED utilization and expenditures.

CONCEPTUAL FRAMEWORK

Not all primary care is created equal. In an effort to identify key characteristics essential for providing high quality patient-centered care, the National Committee for Quality Assurance

(NCQA) established a model with six key principles for recognizing patient-centered primary care: 1) team-based care, 2) managing the patient population, 3) patient-centered access, 4) care management and support, 5) care coordination, and 6) quality improvement (see figure 1-1). These six patient-centered principles are not only the basis for PCMH recognition, but are echoed in other models for high-quality primary care, such as Bodenheimer et al.'s "10 Building Blocks of High-Performing Primary Care."[19] As the most widely cited PCMH recognition standards, the NCQA principles form the basis for identifying PCMH characteristics for this study.

Figure 1-1. NCQA principles of patient-centered medical homes
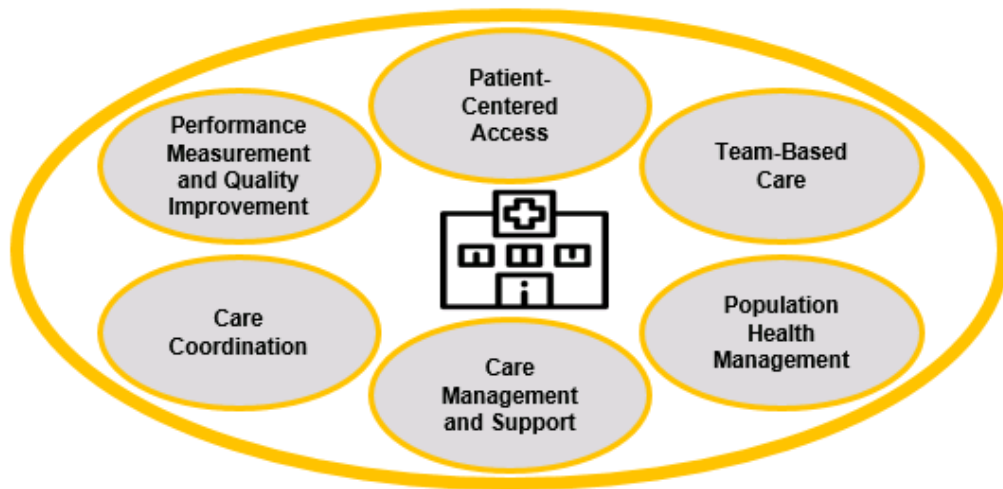
As PCMH principles are specifically intended to improve patient satisfaction, improve health outcomes, reduce ED use and reduce expenditures, I assume that practices exhibiting a higher number of attributes based on PCMH principles will be more likely to have patients that report experiencing patient-centered care and have better outcomes in the form of lower ED utilization and expenditures. Based on the NCQA principles, these outcomes are achieved through a combination of practice workforce, technology, policies and structures. For instance, the principle of team-based care requires that practices utilize the expertise of providers with a variety of backgrounds, such as physicians, nurse practitioners, specialists and primary care. Even the patient and patient's caregivers are included as part of the care team. Through the

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inclusion and coordination of each of these perspectives, the intent is to provide comprehensive, "whole person" care consistent with the patient's own goals.[20]

The care coordination principle is related to team-based care, but in addition to having a variety of perspectives, it aims to ensure that all care providers across the continuum are aligned in their understanding of the patient's needs and current treatments, and that the patient understands how to follow-through with each plan of care.[20] This may mean that each patient is assigned to a case manager that is, for instance, alerted when a patient is discharged from the hospital and can coordinate referrals as needed.

Aside from the various workforce roles and responsibilities, the NCQA principles heavily emphasize the role of electronic health records (EHRs). Not only may an EHR contribute to more effective care coordination by enabling sharing of information across and within practices, it may also assist in adherence to evidence-based guidelines (care management and support principle), population management and performance improvement. The principle of care management and support refers to the ability of the practice to provide evidence-based care for an individual patient. NCQA sees EHRs as critical to this principle by providing decision support and reminders for care standards. Population management is somewhat broader and refers to the practice's overall management of their patient population's level of adherence to various preventive care measures or other standard guidelines, such as flu shots, or percent of diabetics receiving A1C testing. The EHR is able to aid in identifying patients with outstanding labs or screening needs, permitting documentation, and preparing reports for providers on how well they meet guidelines throughout their practice (performance improvement principle).[20,21] Lastly, health information technology may improve accessibility of care by allowing for email or portal communication in addition to more traditional forms of communication, like telephones.[22]

PCMHs are intended to promote practice efficiency and increase satisfaction by optimizing primary care to be convenient for patients, meet clinical standards, and be aligned with patients' personal goals. This focus on patient needs and efficiency is then expected to reduce the need for non-emergent emergency department visits and prevent emergent visits through appropriate primary care. Furthermore, it is expected to reduce expenditures, both through this prevention of ED utilization, but also through overall improved health and efficient

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coordination of care. Several studies have shown that, in fact, practices recognized by NCQA as a PCMH have improved patient satisfaction, and reduced ED utilization and expenditures.[23–25]

The first step in identifying key PCMH attributes that may influence patient experience and outcomes is to compare practice reported attributes to the care patients perceive. For instance, while providers may report offering certain services, such as same day appointments, patients may still report having difficulty getting in to see their provider. This study aims to identify the extent to which patients and providers agree on which facilities are patient-centered. More specifically, the study aims to identify if there are certain practice attributes that stand out to patients in terms of changing how they view the patient-centeredness of their care. In addition to measuring agreement between patient and provider perspectives, this study aims to use the NCQA PCMH principles to identify which perspective (the patient's or the provider's) most influences health expenditures and ED utilization. This secondary analysis is critical to inform public policy that currently relies on PCMH certification as a way to reduce costs and improve health.[26]

Hypotheses

H1: The greater the number of PCMH attributes reported by providers about their practice, the more positively the patient will rate the patient-centeredness of their care.

H2: Overall patient care expenditures will decrease as *provider-reported* PCMH attribute index increases.

   H2a: Overall patient care expenditures will decrease as *patient-reported* PCMH attribute index increases.

H3: ED utilization will decrease as *provider-reported* PCMH attribute index increases.

   H3a: ED utilization will decrease as *patient-reported* PCMH attribute index increases.

METHODS

Data

Data come from the 2015 and 2016 MEPS Medical Organizational Survey (MOS), and Household Component (MEPS-HC). MEPS is supported by the Agency for Healthcare Research

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and Quality (AHRQ) and collects detailed information on patient characteristics, health care utilization, health expenditures and insurance status. The MOS supplement was first conducted in 2015 (released in 2017), and is the first nationally representative survey to pair patient experiences with characteristics of their provider's practice. The survey was designed to obtain more detailed information about practice characteristics specifically among providers who were identified by survey respondents as their usual source of care, or the provider that respondents go to most often when they have a health concern. These providers are identified by general survey respondents who must have visited the provider at least once during the survey year, and may not be an emergency department provider. Information such as payment structure, provider type, and services offered are collected and then matched with the referred patient. The data is structured at the patient-level, with an average of 1.7 patients per provider surveyed.[27]

In 2015, a total of 4,216 practices were surveyed corresponding to 7,161 individuals.[27] This sample size increased to 5,201 practices for 9,137 individuals in 2016, with a response rate of 76 percent for the MOS supplement.[28] The cumulative response rate for the full-year household component and the MOS was 36.7% in 2015 and 35.0% in 2016.[29,30] MEPS, like all federal household surveys, has experienced a decline in response rates in recent years, mostly due to declines in response rates to the National Health Interview Survey, which serves as a sampling frame for MEPS.[31] While this raises some concerns about nonresponse bias, reports to date on federal household survey response rates suggest that nonresponse bias is less associated with overall response rates than specific items. Survey weights are applied to adjust for differential nonresponse.[31]

Item non-response is assessed for patterns in missing data. It is found that when non-clinical, non-office manager personnel – such as a receptionist or clerk – responded to the MOS survey, that more items were missing. However, more than 92% of all surveys had fewer than 3 missing items. Surveys with 3 or more missing values (1,108 surveys) were considered too incomplete for analysis, and therefore excluded. Of the remaining sample of 15,190 paired surveys, 3,974 still had at least one key practice characteristic variable missing. Patterns in missingness were again assessed and were determined to be at random. In order to maximize the utility of the information provided in these near complete survey responses, 4 variables with the highest number of missing values were imputed. These variables included two practice survey

responses: 1) whether or not the practice used quality report cards to inform providers of their performance, and 2) whether or not the practice used an EHR system to remind providers of clinical guidelines. Two additional variables from the patient perspective were also imputed. These variables were related to respondents that responded that they "did not know" whether or not their usual source of care was easy to reach by phone after hours or if the office was open beyond regular business hours. As these are likely responses by patients that have not had to use these services, these responses provide valuable information that would be lost if excluded from the sample. In order to retain the greatest power and maximize the use of information, these 4 variables are imputed using multiple imputations by chained equations (MICE) including all covariates used in final models. This method generates predicted estimates for these variables through multiple regression analyses using the information about both the practice these respondents may use, as well as the patient's health status and other demographic information.[32,33] Sensitivity analyses are performed on the categorization of the patient perspective variables, further described in the *Sensitivity Analyses* section. In order to perform MICE methodology, remaining responses considered too incomplete to use in the predictive imputation model were excluded.[32] This resulted in a final sample size of 12,127 paired survey responses (see figure 1-2).

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Figure 1-2. Multiple imputation process and sample selection
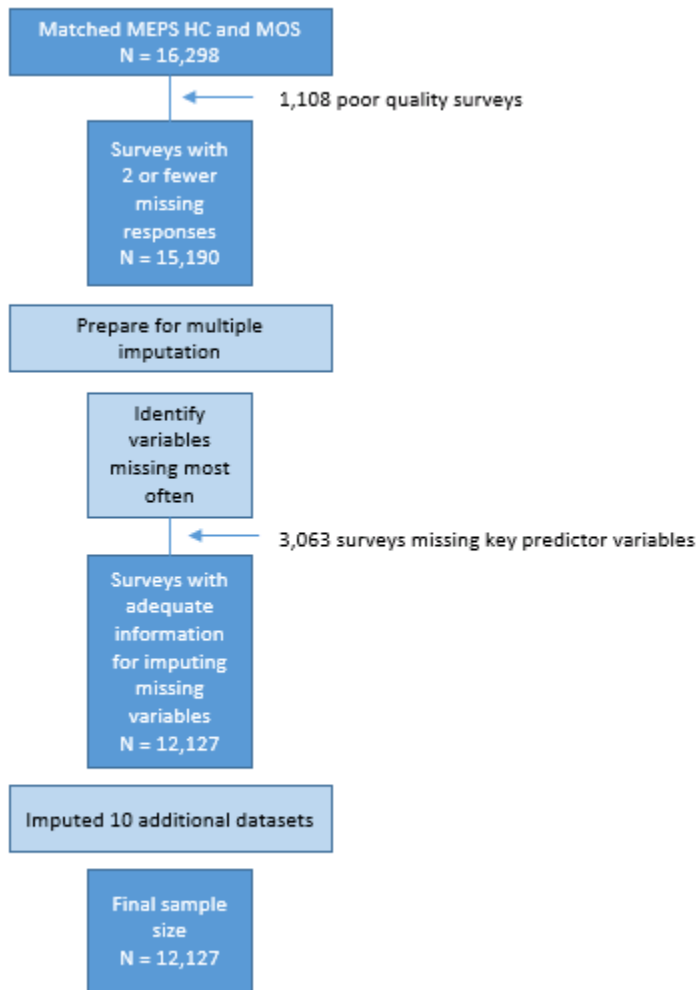
All estimates are weighted to be nationally representative at the person-level according to race/ethnicity, income, residential setting, and employment. Weights are adjusted based on respondents that declined to have their usual source of care contacted. Strata and primary sampling unit weights account for potential correlation between patients attending the same usual source of care provider. All reported standard errors reflect adjustments made to account for complex survey design as well as added variance due to multiple imputation methods in statistical analysis of data.

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Patient-Centered Care Measures

In order to identify patient-centered medical home characteristics, I reference both the NCQA PCMH recognition standards and a series of studies by Rittenhouse, Casalino and Shortell that develop a PCMH index using provider characteristics.[18,34] Although these studies used a different data source, much of the available information from respective surveys is similar. Relevant items from the MEPS MOS survey for a provider practice PCMH index include 10 elements: 1) presence of a primary care provider, 2) presence of a nurse practitioner or physician assistant, 3) multiple specialty practice, 4) presence of case manager, 5) follow-up with patients discharged from a hospital within 72 hours, 6) reserved time for same day appointments, 7) preventive care reminders, 8) use of EHRs to communicate with patients, 9) use of EHRs for decision support or population management support, and 10) provider report cards.

A provider practice is awarded 1 point for each of the patient-centered characteristics it exhibits. For instance, if the practice reports using email to communicate with patients, that practice is awarded 1 point. If it also permits same day appointments, it receives another point, and so forth. Once each practice is awarded a total score for each of the 10 patient-centered characteristic (maximum score of 10), the practices are divided into modified tertiles representing practices displaying high, medium, or low patient-centered attributes. In total, there were 2,991 low-patient centered practices who reported having 0-5 characteristics; 4,502 practices with 6-8 PCMH characteristics; and 4,634 practices with 9 or 10 PCMH characteristics.

In order to identify concordance between the provider attributes and patient-perceived patient-centeredness, NCQA PCMH standards were also applied to the person-level questionnaire for questions corresponding to perceptions of their usual source of care. Although patient survey questions were not identical to provider questions, similar principles were used to identify patient responses indicating patient-centered care. Patient-centered care items included 7 items: 1) ability to reach provider by phone, 2) ability to reach provider by phone after hours, 3) extended practice hours (open weekends and evenings), 4) inclusion of patient in treatment decisions, 5) provider explains treatment options clearly, and 6) provider asks about other care patient is receiving, and 7) shows respect for treatment decisions (full questions shown in appendix 1-1). While these questions clearly are aimed at addressing the patient-centeredness and patient-responsiveness of providers, they are not directly matched to the questions asked of

provider practices. Therefore, provider indices are matched against individual patient-level questions as opposed to a patient index.

For the patient survey, patients may provide one of 4 potential responses ranging from "never" to "always." For analysis purposes, all responses are categorized into binary variables, with "never" or "sometimes" grouped together, and then "often" and "always" grouped together. For outcome measures (ED use and expenditures), a point system, similar to that of the provider index is used to create a patient-centered index representing patients receiving low, medium, or highly patient-centered care. This index for the patient perspective is only used in the ED and expenditures models.

Expenditures and utilizations measures

In addition to measuring the congruence between the patient's experience of their care and the provider's attributes, health expenditures and utilization are included in analyses. Many prior analyses of certified medical homes have found no impact on overall expenditures and mixed effects on ED use.[12,13,15] Using PCMH attributes as opposed to certification may expand on these studies by identifying if attributes such as case management or use of electronic reminders of standards of care play a role in expenditures or ED use. Healthcare expenditures include spending from all payers (including out-of-pocket) and all settings. Expenditures is operationalized as a continuous variable. Since all selected participants must have seen their usual source of care at least once during the study period, nearly all participants have expenditures greater than zero. ED utilization is measured on a binary scale as having any visit or no visit during the 2015 and 2016 interview timeframes. A binary variable as opposed to a count variable is used to measure ED use, since ED visits are considered a rare event in this dataset.

Health status

Respondents in poor health are likely to utilize healthcare to a greater degree than respondents in good to excellent health. Therefore, health can be considered an indicator of exposure to the healthcare system. Although the data does not explicitly indicate number of visits with the usual source of care, models predicting utilization and expenditures should adjust for health status to account for potential variation in exposure. Health status is identified using

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the patient-level question on perceived health status. The variable is categorical ranging from poor health to excellent health.

Covariates

All models are adjusted for respondent demographics and insurance status. Demographic information includes gender, age, marital status, education (less than high school, high school or GED, some college, at least a bachelor's degree), race/ethnicity (White non-Hispanic, Black non-Hispanic, Asian non-Hispanic, Hispanic and other), and region of residence (Northeast, South, Midwest, and West). Income is measured as percent of the federal poverty level (FPL). Insurance status is based on full year coverage. A respondent is classified as uninsured if he or she was uninsured for the full survey period. For those with insurance for any duration, respondents were classified into Medicare, Medicaid, Private or other coverage based the coverage held for the longest time period. Respondents holding both Medicaid and Medicare coverage for equal time periods were categorized as Medicare, since income level is already accounted for through another covariate.

Statistical analysis

Multivariable logit regressions are used to examine overall concordance between provider-reported patient centeredness and patient-reported patient-centeredness of care. Marginal effects are estimated to asses percentage point change in likelihood of patient–reported patient-centered care. Estimates of marginal effects on multiple imputed data is consistent with Rubin's rule for post-analysis of imputed data.[35] Regressions use the provider index regressed onto individual patient perceptions of care. To identify which particular practice attributes may be driving the associations between the provider index and patient perceptions, a secondary analysis is conducted using individual practice characteristics in place of the overall index. Similar multivariable logit regressions are then modelled to estimate likelihood of having an ED visit. Data distribution and goodness of fit is checked with a Hosmer-Lemeshow test modified to account for survey weights and multiple imputation datasets. Expenditures are estimated using ordinary least squares. However, due to significant positive skewness of expenditure data, all expenditures are log-transformed to approximate a normal distribution. Since the sample is based only on respondents that saw a physician at least once during the survey period, only 14 respondents are identified as having no healthcare costs. Therefore, it is not necessary to address

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further distribution concerns regarding high proportion of the sample with zero costs, as is typical in healthcare expenditure analyses. Log transformation is sufficient to produce normally distributed expenditure estimates. To address concerns of log-transforming an estimate of $0, $1 is added to all healthcare expenditure estimates. Duan smearing factor is used to re-transform model estimates for meaningful interpretation.

Seven separate models are estimated to measure agreement between the provider perspective of patient-centeredness, representing the seven patient-level survey questions. All models use the same covariates and form. As an example, one logit model for extended office hours is shown, comparing patient-reported availability of extended hours to the provider reported patient-centered index:

$\text{Ln}[(\text{extended hours})/(1-(\text{extended hours}))]_{it} = \alpha + \beta_1(\text{provider patient-centeredness index})_{it} + \beta_2(\text{education})_{it} + \beta_3(\text{income})_{it} + \beta_4(\text{race/ethnicity})_{it} + \beta_5(\text{marital status})_{it} + \beta_6(\text{age})_{it} + B_7(\text{region})_{it} + \beta_8(\text{insurance type})_{it} + \beta_9(\text{general health status})_{it} + \beta_{10}(\text{practice type})_{it} + u_{it}$

For the two outcomes, ED use and expenditures, one model is estimated each. The outcome models include the provider index as used previously, as well as an index for patient-perceived patient-centeredness. Models for both outcomes are shown below:

$\text{Ln}[E(\text{ED use})/(1-E(\text{ED use}))]_{it} = \alpha + \beta_1(\text{provider index})_{it} + \beta_2(\text{patient index})_{it} + \beta_3(\text{education})_{it} + \beta_4(\text{income})_{it} + \beta_5(\text{race/ethnicity})_{it} + \beta_6(\text{marital status})_{it} + B_7(\text{age})_{it} + \beta_8(\text{region})_{it} + \beta_9(\text{insurance type})_{it} + \beta_{10}(\text{general health status})_{it} + \beta_{11}(\text{practice type})_{it} + u_{it}$

$\text{Ln}[E(\text{expenditures})]_{it} = \alpha + \beta_1(\text{provider index})_{it} + \beta_2(\text{patient index})_{it} + \beta_3(\text{education})_{it} + \beta_4(\text{income})_{it} + \beta_5(\text{race/ethnicity})_{it} + \beta_6(\text{marital status})_{it} + B_7(\text{age})_{it} + \beta_8(\text{region})_{it} + \beta_9(\text{insurance type})_{it} + \beta_{10}(\text{general health status})_{it} + \beta_{11}(\text{practice type})_{it} + u_{it}$

A secondary analysis is conducted using individual patient-centered attributes from the provider and patient perspective. This analysis aims to identify any specific attributes that may drive overall findings.

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Sensitivity analyses

Several sensitivity analyses were conducted to estimate the robustness of results. First, to address concerns of item non-response, multiple methods for addressing missing values were conducted. In addition to the main analysis, which imputes responses for 2 provider- and 2 patient-perspective variables, listwise deletion was conducted to drop all survey responses with missing values in any pertinent question. A third analysis re-categorizes patients who reported "I don't know" in response to survey questions asking about availability of providers after regular hours either in person or by phone. In this sensitivity analysis, these respondents were categorized as not having any difficulty reaching their providers after hours, since it assumed these respondents did not need to reach their providers during non-traditional office hours. Finally, models also compared ED use among respondents who knew about accessibility compared to those that did not know.

Sensitivity analyses regarding the definition of the PCMH attributes and categorization into low/medium/high patient-centered facilities were also conducted. A linear relationship using number of total attributes was conducted, along with a binary indicator for patient-centeredness based on facilities who report at least two-thirds of all PCMH attributes, as was described in the PCMH index used by Rittenhouse et al. [34] Furthermore, the MEPS questionnaire for provider practices asks practices whether or not they are a certified PCMH. This measure was used to compare findings based on PCMH practice attributes to certification. Findings using the certification as opposed to attributes were similar but weaker both in terms of magnitude of the estimate and statistical significance.

Due to similarity of concepts among questions asking patients about their experiences reaching a provider during regular or after hours, a separate sensitivity analysis was conducted using a composite patient-perceived access measure. This measure was defined as having easy access if the patient responded positively to either being able to reach their provider easily during regular office hours by phone, after hours by phone, or that the office offers extended office hours. While the composite measure masked differences in concordance between provider characteristics and patient perceptions, it was found to be significantly associated with both ED use and expenditures (details described in *Results* section below).

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RESULTS

While most certified PCMHs were considered high patient-centered facilities based on their reported attributes (58.2%), 18% of certified PCMHs reported having less than half of the patient-centered attributes, leaving them in the low-patient centered category.

More than one-third (35.5%) of all practices in the top tertile of patient-centered attributes report having all possible patient-centered attributes (Table 1-1). The other practices in the top tertile report having all but one attribute, with the most likely attribute to be missing being a multi-specialty practice with 60.5% of practices reporting positively to this question. However, this far outpaced the 9.0% of low patient-centered practices reporting to be part of a multi-specialty practice. While at least 88.0% of providers in all categories reported reserving time for same day appointments and having a primary care provider on staff, less than three-quarters of low patient-centered providers reported use of any other PCMH attribute. Patient characteristics, such as age, race/ethnicity, and insurance type were largely similar between all three groups, although Medicaid patients were slightly more likely to be in medium or high patient-centered practices. This may indicate a tendency for these patients to use federally-qualified health centers (FQHCs) as their usual source of care, as these providers were early adopters of PCMH principles.[36,37] I do not identify practice type by insurance status in this analysis; however, it is evident that low patient-centered facilities are disproportionately independent practices (37.1% vs 13.6% of high patient-centered), whereas, high patient-centered practices are disproportionately government or non-profit practices, such as an FQHC (20.2% vs 4.1% of low patient-centered) (see table 1-1.)

The mean age of patients ranged from 39.2 year in low patient-centered practices to 42.4 years in high patient-centered practices. Private insurance was the most commonly reported insurance for all groups. Finally, region varies somewhat among the three groups, with patients in the South more likely to receive care in facilities with a low number of patient-centered attributes (43.4%), whereas, patients in the West and Midwest regions were more likely to receive care in high patient-centered practices (25.3%% and 25.1%, respectively). This may indicate availability of patient-centered practices by region and prevalence of local PCMH health systems, such as Kaiser Permanente in the Western region that is known for its unique medical home structure.[38] Income level was largely consistent between groups, ranging from 409.2%

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FPL in the high patient-centered practice group to 403.5% FPL in the low patient-centered group. Low-income patients may be under-represented in this sample, as low-income patients are more likely to use the ED as a usual source of care, which is not included in the MEPS Medical Organization Survey.

Patient and provider perspective concordance

Index

Aside from extended office hours, little congruence is found between the patient and provider perspectives of patient-centeredness. In fact, as shown in table 1-2, if any other association is found, it is that patients in high patient-centered practices are less likely to be able to reach their provider by phone during regular hours, but slightly more likely to reach them after hours ($p<0.10$). This could be a reflection of how these facilities are structured. For instance, if high patient-centered facilities tend to rely heavily on electronic means of communication, they may be less likely to respond to phone calls unless immediate after hours response is required. Extended office hours, however, is the main area of concordance between perspectives, with each additional tertile of patient-centered attributes increasing the likelihood of offering extended hours (0.30, $p< 0.01$ for medium patient-centered; 0.47, $p< 0.01$ for high-patient-centered). Overall, the likelihood of patients reporting that their usual source of care offers extended office hours increased 47% for patients in high patient-centered practices ($p< 0.01$).

Attributes

To determine whether any single provider attribute was most strongly correlated with patient experiences, additional regression models that substituted the PCMH index with binary indicators for each of the attributes were estimated. Findings from these models suggest that the main practice attribute driving the association between practice and patient perceived patient-centeredness (especially in regards to offering extended hours) is whether or not the practice hires nurse practitioners (NPs) or physician assistants (PAs) (0.27, $p< 0.01$) (see table 1-3). However, NPs and PAs are also associated with a decrease in the likelihood that patients report the practice be easy to reach by phone after hours (-0.18, $p< 0.05$), while presence of case managers increased this likelihood (0.16, $p< 0.05$). Multi-specialty practices are less likely to be reachable during office hours (-0.24, $p< 0.05$), but more likely to ask patients about other care they may be receiving (0.19, $p< 0.05$). Finally, practices using quality report cards to evaluate

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provider performance was associated with a decreased likelihood of patients reporting being included in treatment decisions (-0.30, p< 0.05). This may be due to incentives to provide care that is measured on report cards rather than what may be in line with patient goals, as has been shown in prior studies on provider behavior following report card implementation.[39]

Emergency department use and expenditures

Indices

In terms of patient outcomes, the number of PCMH attributes a practice has is not found to be associated with a reduction to overall expenditures. There is also no association found between the patient's perspective of patient-centeredness and cost of care. Only weak associations were found between patient-centeredness of provider and emergency department use. In fact, compared to patients using low patient-centered practices, patients using medium patient-centeredness were found to have slightly higher ED use (0.15, p< 0.10). However, when looking from the patient perspective of care, both medium and high patient-centered usual sources of care were associated with fewer ED visits (-0.16, p< 0.10; -0.15, p< 0.10, respectively) (shown in table 1-4). A deeper analysis of the specific attributes that may be driving these findings suggests that only practices that offer same day appointment are strongly associated with ED use, and interestingly, I find that patients with providers who report offering same day appointments were associated with an increased risk of ED utilization. It is possible that this finding suggests a limitation with cross-sectional data and that patients who have required ED use in the past, may choose a usual source of care that offers same day appointments. Furthermore, only 4% of the usual sources of care surveys say they do not offer same day appointments, limiting the sample size of these providers. Therefore, with a limited sample size, conclusions should not be drawn from this finding.

Attributes

A number of characteristics, both provider-reported and patient-perceived, were associated with expenditures. In terms of reducing costs, providers reporting having a case manager and practices that patients were able to easily reach by phone both contributed to lower expenditures (-0.01, p< 0.05; -0.01, p< 0.05, respectively). However, using EHRs to assist in reminding providers of standards of care and asking patients about other treatment received both

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were associated with increased costs (0.01, p< 0.05; 0.03, p< 0.01, respectively) (as shown in table 1-5).

Composite

While individual attributes for patient perceived access were only weakly associated with outcomes, the composite measure for patient-perceived access was found to be strongly correlated with both the likelihood of having an ED visit and expenditures. Among patients who perceived their providers to be easy to reach after or during regular hours, the likelihood of an ED visit decreased (-0.32, p< 0.01) compared to those who perceived access to providers to be more difficult. Expenditures for these patients were 2% percentage points lower (p= 0.02) than their counterparts reporting poorer access to providers (see table 1-6).

Sensitivity analysis

Knowledge of availability of provider after regular hours could influence patient's decisions to go to an ED as opposed to contacting their usual source of care. Analyses looking at whether or not a patient knew whether or not a provider was easy to reach after hours indicated that patients who reported providers were difficult to reach after hours were the most likely to have an ED visit compared to those who reported easy access or that they did not know if they were accessible (easy to reach -0.19, p=0.03, unknown -0.24, p< 0.01). However, no difference in overall expenditures was identified (see appendix 1-4).

It may be expected that sicker patients have more exposure to providers or have different experiences with their usual source of care than people with fewer health problems. For this reason, models were stratified by self-reported health status. Findings for the healthier patients were consistent with estimates from the main analyses. Few associations were found between provider/respondent congruence or patient outcomes for respondents reporting fair or poor health. The exception to this is that patients in poorer health who reported being asked about other therapies they were receiving also had higher expenditures (0.10, p < 0.01 (see appendix 1-2 and 1-3)). This may indicate that providers appreciate the complexity of these patients, and how various treatments may interact with one another, potentially requiring expensive alternative treatments. However, the fact that healthier patients appear to be more consistent with findings from the main analysis suggest that this population is driving results. This may be simply due to the size of the healthy population, with 96% of the sample reported good or better health.

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DISCUSSION

PCMH criteria is selected with the intention of improving quality of care and reducing expenditures. However, I find that simply having PCMH practice attributes is not associated with patients perceiving their care to be patient-centered, nor it is associated with fewer ED visits or lower expenditures. There are, however certain attributes that may be more important than others, both in terms of the patient experience and in terms of outcomes. Of all the various measures of patient-centeredness, both in terms of specific provider characteristics and in terms of patient perceptions of care, the patient's overall perception of provider accessibility (estimated using a composite measure) seems to be most highly correlated with both a lower likelihood of an ED visit and lower expenditures. The perception of accessibility, rather than the provider reporting attributes such as using email to communicate with patients or offering same day appointments, is a key factor for how likely a patient is to use the ED or have other high cost care. It should be noted, that perception of accessibility was associated with a few provider-reported attributes that may be key areas of focus for future research. Notably, having a case manager was associated with patients perceiving their provider to be easy to reach after hours, and was itself directly associated with lower expenditures. Additionally, patients were more likely to believe their USC offered extended hours if the practice staffed nurse practitioners or physician assistants; however, patients also reported these facilities to be harder to reach by phone after hours.

Prior studies on PCMHs have found little effect of certification on expenditures. My findings on specific attributes suggest that this may be because while some PCMH attributes are associated with decreased costs, other are actually associated with increased expenditures. Specifically, having a case manager and being easy to reach by phone are associated with decreased total expenditures, while using electronic reminders for standards of care and discussing treatments received outside of the physician's care are associated with increased costs. With attributes both positively and negatively associated with costs, when looking only at total count of PCMH attributes, I found no change in expenditures. More nuanced findings were washed out. With variable PCMH definitions and simple attestation of adherence to criteria, it is important to not only assess whether or not the certification itself has an impact on patient

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outcomes, but which attributes drive these findings. Through further analysis into specific attributes, more tailored and evidence-based PCMH accreditation can be established.

Limitations

This analysis has several limitations. First, multiple imputation methods were used to impute missing values. While analyses were completed to asses for patterns in missingness, it is possible that values were not missing at random, which would introduce bias into imputed estimates. To address such concerns, sensitivity analyses were conducted around methods of dealing with missing values. In addition to imputations, general listwise deletion methods were used. A third analysis re-categorized patient-reported "I don't know" responses for ease of reaching a provider after hours and extended office hours to "not easy to reach" and "no extended hours" as opposed to imputed. Models also compared ED use among respondents who knew about accessibility compared to those that did not know. Findings were robust to various methods for addressing missing values.

Another limitation of this study is that causality cannot be attributed. It is possible that, for instance, patients with ED visits select into usual sources of care with certain attributes. Models estimating concordance between provider-reported attributes and patient perception are not impacted by potential endogeneity; however the models estimating the correlations with patient outcomes (ED use and expenditures) may be. To the extent that healthier patients select into high PCMH practices, estimates may be over-stated. However, other indications suggest that is it unlikely that healthier patients are selecting into these facilities. First, it should be noted that self-reported health status was similar among respondents at all practice categories. Second, medium and high PCMH-like practices had a disproportionate number of Medicaid beneficiaries, who tend to have more complex health needs than patients with other insurance types.[40] While endogeneity concerns are not eliminated in these models, based on these indications of health status, selection of healthier patients into high PCMH USCs is unlikely to be occurring. However, further analysis of this topic should include the use of longitudinal data to address these temporal constraints. Estimates on the concordance between patient and provider perceptions of patient-centered care do not suffer from the same limitations, as the questions of patients are specifically asked in regards to care received at their matched usual source of care.

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Finally, as present in all studies using survey data, reporting error may be present. For instance, while providers may report using email to communicate with patients, that does not mean this practice actually occurs. It may not occur simply because providers have the capability but choose not to use it, or it may have been reported in error. For this reason, I discuss "provider-reported" or "provider-perceived" attributes and patient perceptions. Perception, however, is the important component in this study. The mismatch between what providers believe they offer and what patients experience is the question of concordance.

Conclusion

Findings suggest that, in general, provider-reported PCMH attributes are not highly correlated with patients' perception of care. This lack of correlation is problematic, suggesting that while many providers may report use of various services, patients may not actually be experiencing these services as intended. Implementation of services may be inadequate or focused in ineffective areas. PCMH accrediting entities may benefit from considering implementation of criteria in addition to certifying practices have capability. Further analysis into why patients do not experience services providers report using should be conducted

While overall concordance between provider and patient perceptions of patient-centeredness may be weak, there are some key areas where associations are found, specifically in the area of perceived accessibility. This areas is critical in that patient perception of accessibility was also strongly correlated with both reduced likelihood of an ED visit and a 2 percentage point reduction in expenditures. Therefore, the concordance between patient and provider perspectives in terms of accessibility should be noted. The attributes with some concordance in terms of accessibility include practices that report having a case manager and practices reporting staffing a nurse practitioner or a physician assistant. These additional personnel may play a key role in patients' belief that they are able to easily access a provider, and should be further researched in order to provide recommendations on their use. Accrediting entities may choose to emphasize criteria focuses on accessibility, including the use of case managers in future iterations of PCMH criteria.

Table 1-1. Characteristics of practices and patients by patient-centered index

	Low Patient-Centered N = 2,991		Medium Patient-centered N = 4,502		High Patient-centered N = 4,634	
	%	SE	%	SE	%	SE
Certified PCMH	18.02%	(0.014)	37.38%	(0.020)	58.17%	(0.022)
Practice Attributes						
Same day appointments	89.00%	(0.009)	97.30%	(0.004)	99.60%	(0.002)
Uses email for communication	30.40%	(0.015)	79.80%	(0.011)	96.60%	(0.004)
Multi-specialty practice	9.00%	(0.008)	21.90%	(0.013)	60.50%	(0.018)
Has NPs or PAs	43.80%	(0.017)	70.30%	(0.015)	95.50%	(0.006)
Has a PCP	88.90%	(0.010)	96.50%	(0.005)	99.40%	(0.002)
Has a Case Manager	13.20%	(0.010)	41.10%	(0.017)	90.90%	(0.009)
Sends preventive care reminders	71.40%	(0.013)	95.00%	(0.007)	99.50%	(0.001)
Follow-up within 48 hours of hospital discharge	41.60%	(0.017)	74.50%	(0.016)	95.00%	(0.008)
EHR send guideline reminders to provider	38.90%	(0.017)	86.20%	(0.010)	98.20%	(0.004)
Provider receive quality of care report cards	66.60%	(0.014)	94.70%	(0.006)	99.60%	(0.002)
Type of usual source of care practice						
Independent	37.10%	(0.013)	24.20%	(0.012)	13.60%	(0.010)
Hospital or academic medical center	10.60%	(0.012)	23.50%	(0.017)	27.20%	(0.019)
Government or non-profit	4.10%	(0.006)	9.60%	(0.008)	20.20%	(0.011)
Other or unknown	48.20%	(0.015)	42.70%	(0.015)	39.00%	(0.018)
Patient Attributes						
Age (mean)	39.244	(0.874)	40.01	(0.797)	42.384	(0.760)
Male	46.10%	(0.012)	44.50%	(0.009)	43.30%	(0.009)
Race/Ethnicity						
Non-Hispanic White	62.60%	(0.019)	64.20%	(0.017)	65.70%	(0.016)
Non-Hispanic Black	11.20%	(0.011)	11.50%	(0.009)	10.00%	(0.009)
Hispanic	16.70%	(0.013)	16.20%	(0.013)	15.60%	(0.014)
Non-Hispanic Asian	5.40%	(0.008)	4.50%	(0.006)	4.10%	(0.005)
Other	4.10%	(0.006)	3.50%	(0.005)	4.70%	(0.006)
Marital status						
Married	36.30%	(0.014)	39.10%	(0.014)	43.60%	(0.012)
Separated/Widowed/Divorced	17.70%	(0.011)	16.90%	(0.008)	17.60%	(0.008)
Never married	17.60%	(0.010)	15.70%	(0.008)	17.30%	(0.008)
Not applicable (under 16)	28.40%	(0.016)	28.30%	(0.014)	21.50%	(0.011)
Education						
Less than high school	28.00%	(0.012)	27.50%	(0.011)	24.30%	(0.009)
High school	19.50%	(0.011)	20.50%	(0.010)	22.20%	(0.010)
Some college	17.30%	(0.012)	16.50%	(0.008)	18.60%	(0.008)
Bachelor degree or more	21.70%	(0.013)	22.40%	(0.012)	25.00%	(0.012)
Not applicable (under 5)	13.40%	(0.010)	13.10%	(0.009)	9.90%	(0.008)
Region of residence						

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Northeast	18.40%	(0.018)	20.40%	(0.025)	19.60%	(0.017)
Midwest	17.80%	(0.018)	18.20%	(0.015)	25.10%	(0.026)
South	43.40%	(0.024)	40.60%	(0.023)	30.00%	(0.018)
West	20.40%	(0.014)	20.80%	(0.017)	25.30%	(0.017)
Income as percent of federal poverty level (mean)	403.488	(12.753)	407.393	(12.145)	409.195	(12.206)
Self-reported health						
Poor	2.90%	(0.004)	3.80%	(0.005)	3.10%	(0.004)
Fair	9.40%	(0.007)	10.60%	(0.007)	11.20%	(0.006)
Good	25.40%	(0.011)	24.90%	(0.010)	29.10%	(0.011)
Very good	31.50%	(0.013)	30.70%	(0.012)	32.60%	(0.011)
Excellent	30.80%	(0.014)	30.00%	(0.012)	24.00%	(0.010)
Insurance type						
Uninsured	3.50%	(0.005)	2.80%	(0.004)	3.30%	(0.004)
Medicaid	16.90%	(0.011)	18.80%	(0.012)	18.60%	(0.012)
Medicare	13.00%	(0.010)	13.40%	(0.008)	13.80%	(0.009)
Private	65.80%	(0.015)	63.90%	(0.014)	62.80%	(0.016)
Other	0.80%	(0.002)	1.20%	(0.003)	1.50%	(0.003)

Note: SE= standard errors

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Table 1-2. Concordance between provider practice index and patient perceived patient-centered care

	Easy to reach by phone during regular hours		Extended office hours		Easy to reach by phone after hours		Provider shows respect for treatment decisions		Provider includes patient in decision-making		Provider explains treatment options		Provider asks about other treatments received	
	Coef	SE	Coef	SE	Coef	SE	Coef	SE	Coef	SE	Coef	SE	Coef	SE
Patient-centered practice (ref = low)														
Medium	-0.20*	(0.11)	0.30***	(0.09)	0.11	(0.08)	-0.08	(0.16)	-0.04	(0.11)	-0.26	(0.18)	0.08	(0.10)
High	-0.22*	(0.12)	0.47***	(0.10)	0.15*	(0.09)	0.06	(0.16)	0.17	(0.10)	-0.19	(0.20)	0.09	(0.11)
Age	-0.01	(0.00)	-0.02***	(0.00)	0.00	(0.00)	0.00	(0.00)	-0.01*	(0.00)	0.00	(0.00)	-0.01**	(0.00)
Income as percent of federal poverty level (mean)	-0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	-0.00	(0.00)	0.00	(0.00)	0.00***	(0.00)	0.00	(0.00)
Male	-0.03	(0.06)	0.05	(0.05)	-0.08	(0.06)	-0.06	(0.09)	0.00	(0.06)	0.10	(0.10)	0.04	(0.06)
Race/Ethnicity (ref = Non-Hispanic white)														
Non-Hispanic black	0.22*	(0.12)	0.32***	(0.10)	0.29***	(0.09)	0.53***	(0.14)	0.60***	(0.12)	0.38**	(0.17)	0.11	(0.09)
Hispanic	0.22*	(0.12)	0.29**	(0.12)	0.39***	(0.11)	0.01	(0.17)	-0.06	(0.13)	0.55***	(0.20)	0.04	(0.10)
Asian	0.31	(0.22)	0.38*	(0.20)	0.35*	(0.18)	-0.01	(0.28)	-0.14	(0.19)	0.01	(0.28)	-0.23	(0.17)
Other	0.49**	(0.24)	0.16	(0.20)	0.13	(0.18)	0.55*	(0.31)	0.40	(0.26)	0.65**	(0.28)	0.06	(0.23)
Region of residence (ref = Northeast)														
Midwest	0.21	(0.15)	-0.44***	(0.14)	-0.45***	(0.13)	-0.24	(0.19)	0.26	(0.16)	0.02	(0.24)	-0.26**	(0.12)
South	0.18	(0.14)	-0.83***	(0.13)	-0.60***	(0.12)	-0.10	(0.18)	0.05	(0.16)	-0.23	(0.22)	0.05	(0.13)
West	-0.21	(0.13)	-0.70***	(0.13)	-0.78***	(0.14)	-0.79***	(0.16)	0.21	(0.15)	-0.48**	(0.20)	-0.28**	(0.13)
Marital status (ref = Married)														
Separated/Widowed/Divorced	0.13	(0.10)	0.01	(0.09)	-0.03	(0.10)	-0.11	(0.12)	-0.02	(0.11)	-0.53***	(0.19)	-0.41***	(0.11)
Never married	-0.00	(0.11)	-0.07	(0.10)	0.01	(0.11)	0.07	(0.16)	-0.12	(0.11)	0.03	(0.19)	-0.46***	(0.12)
Not applicable (under 16)	-0.02	(0.19)	-0.11	(0.16)	0.59***	(0.14)	0.06	(0.28)	0.11	(0.20)	-0.09	(0.27)	-0.45***	(0.16)
Education (ref = less than HS)														
High school	0.07	(0.12)	-0.03	(0.10)	0.03	(0.11)	-0.14	(0.16)	0.02	(0.10)	-0.22	(0.17)	0.00	(0.10)

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Some college	-0.14	(0.13)	-0.04	(0.12)	-0.11	(0.12)	-0.22	(0.16)	0.22*	(0.12)	0.02	(0.19)	0.28**	(0.11)
Bachelor degree or more	-0.16	(0.16)	-0.19*	(0.11)	0.03	(0.12)	-0.04	(0.19)	0.21*	(0.12)	-0.32*	(0.19)	0.53***	(0.12)
Not applicable (under 5)	0.16	(0.17)	-0.29***	(0.11)	0.12	(0.12)	-0.05	(0.22)	-0.05	(0.17)	-0.11	(0.32)	-0.13	(0.14)
Insurance type (ref = uninsured)														
Medicaid	0.09	(0.26)	-0.11	(0.16)	-0.31	(0.20)	-0.09	(0.24)	-0.41**	(0.19)	-0.13	(0.28)	0.05	(0.15)
Medicare	0.37	(0.25)	0.13	(0.18)	0.29	(0.19)	-0.00	(0.26)	-0.14	(0.21)	-0.24	(0.29)	-0.10	(0.18)
Private	0.40	(0.26)	0.21	(0.14)	0.35**	(0.16)	0.20	(0.23)	-0.12	(0.19)	0.04	(0.28)	0.10	(0.14)
Other	1.15**	(0.46)	-0.01	(0.37)	0.34	(0.32)	-0.68	(0.43)	-0.11	(0.32)	1.28*	(0.77)	0.73**	(0.30)
Self-reported health (ref = poor)														
Fair	0.30**	(0.14)	0.06	(0.17)	-0.03	(0.16)	0.39*	(0.21)	0.13	(0.18)	0.27	(0.25)	-0.09	(0.17)
Good	0.61***	(0.16)	0.30*	(0.16)	0.09	(0.15)	0.65***	(0.21)	0.30*	(0.18)	0.40*	(0.24)	-0.05	(0.16)
Very good	0.81***	(0.16)	0.29*	(0.17)	0.19	(0.15)	0.56**	(0.22)	0.44**	(0.19)	0.41	(0.26)	-0.22	(0.16)
Excellent	0.95***	(0.17)	0.38**	(0.18)	0.36**	(0.16)	0.84***	(0.25)	0.64***	(0.19)	0.48*	(0.29)	-0.19	(0.17)
Type of usual source of care practice (ref = independent)														
Hospital or academic medical center	-0.18	(0.15)	-0.36***	(0.12)	-0.19*	(0.11)	-0.32*	(0.18)	-0.06	(0.14)	-0.07	(0.27)	0.18	(0.12)
Government or non-profit	-0.34**	(0.16)	-0.18	(0.12)	-0.46***	(0.11)	-0.06	(0.19)	0.02	(0.13)	-0.00	(0.24)	-0.10	(0.12)
Other or unknown	-0.09	(0.12)	0.08	(0.08)	0.11	(0.08)	-0.02	(0.14)	0.04	(0.10)	-0.02	(0.18)	0.01	(0.10)

Note: SE= standard error, *** p<0.01, ** p<0.05, * p<0.1

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Table 1-3. Concordance between practice attributes and patient perspective of patient-centeredness

	Easy to reach by phone during regular hours		Extended office hours		Easy to reach by phone after hours		Provider shows respect for treatment decisions		Provider includes patient in decision-making		Provider explains treatment options		Provider asks about other treatments received	
	Coef	SE	Coef	SE	Coef	SE	Coef	SE	Coef	SE	Coef	SE	Coef	SE
Offers same day appointments	0.14	(0.23)	0.27	(0.17)	0.20	(0.18)	0.33	(0.28)	0.09	(0.18)	0.53	(0.36)	-0.18	(0.21)
Uses email or electronic means of communication with patients	-0.15	(0.13)	0.06	(0.08)	0.04	(0.09)	-0.21	(0.15)	0.01	(0.11)	-0.16	(0.16)	0.01	(0.11)
Multi-specialty practice	-0.24**	(0.10)	0.10	(0.08)	-0.10	(0.08)	0.14	(0.12)	0.04	(0.10)	-0.13	(0.16)	0.19**	(0.08)
Has nurse practitioners or physician assistants	-0.19	(0.12)	0.27***	(0.09)	-0.18**	(0.08)	0.15	(0.16)	0.06	(0.10)	-0.07	(0.18)	0.00	(0.08)
Has a primary care provider	-0.25	(0.23)	0.09	(0.18)	-0.00	(0.15)	-0.09	(0.24)	0.04	(0.24)	-0.26	(0.29)	-0.37*	(0.20)
Has a case manager	0.10	(0.12)	0.12	(0.08)	0.16**	(0.08)	0.11	(0.14)	0.05	(0.09)	-0.00	(0.15)	0.05	(0.08)
Sends preventive care reminders	0.17	(0.13)	-0.21	(0.14)	0.21*	(0.12)	-0.01	(0.18)	0.17	(0.15)	0.03	(0.22)	-0.05	(0.16)
Follows up with patients within 72 hours of hospital discharge	0.06	(0.10)	0.12	(0.08)	0.03	(0.08)	-0.08	(0.12)	0.13	(0.09)	-0.20	(0.14)	0.09	(0.09)
Uses electronic reminders of guidelines and standards of care	-0.03	(0.13)	0.12	(0.10)	0.07	(0.11)	0.10	(0.16)	-0.07	(0.11)	0.01	(0.22)	-0.09	(0.11)
Uses quality report cards for providers	-0.20	(0.16)	0.15	(0.10)	-0.01	(0.12)	-0.34	(0.23)	-0.30**	(0.14)	0.09	(0.26)	-0.00	(0.14)

Note: All models are adjusted for age, gender, race/ethnicity, income level, marital status, education, region of residence, health status, type of health insurance and type of practice. SE = Standard errors. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

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Table 1-4. Patient outcomes by provider and patient-level patient centeredness

	ED use		Total expenditures	
	Coef	SE	Coef	SE
Patient-centered practice (ref = low)				
Medium	0.15*	(0.09)	0.00	(0.01)
High	0.04	(0.08)	0.00	(0.01)
Patient-centered from patient perspective (ref = low)				
Medium	-0.16*	(0.09)	0.00	(0.01)
High	-0.15*	(0.09)	0.00	(0.01)
Age	0.01	(0.00)	0.00***	0.00
Income as percent of federal poverty level (mean)	-0.00***	(0.00)	0.00***	0.00
Male	-0.17***	(0.06)	-0.02***	0.00
Race/Ethnicity (ref = Non-Hispanic, white)				
Non-Hispanic black	0.12	(0.09)	0.06***	(0.01)
Hispanic	0.12	(0.08)	0.01	(0.01)
Asian	-0.41**	(0.18)	-0.02**	(0.01)
Other	0.51**	(0.25)	0.07***	(0.01)
Region of residence (ref = Northeast)				
Midwest	-0.01	(0.12)	0.00	(0.01)
South	-0.23**	(0.10)	-0.02***	(0.01)
West	-0.26**	(0.11)	0.00	(0.01)
Marital status (ref = Married)				
Separated/Widowed/Divorced	0.30***	(0.09)	0.01*	(0.01)
Never married	0.09	(0.12)	0.02***	(0.01)
Not applicable (under 16)	-0.07	(0.23)	0.03***	(0.01)
Education (ref = less than HS)				
High school	0.13	(0.11)	0.01	(0.01)
Some college	0.06	(0.12)	0.02**	(0.01)
Bachelor's degree or more	0.12	(0.11)	0.03***	(0.01)
Not applicable (under 5)	0.79***	(0.15)	-0.01	(0.01)
Insurance type (ref = uninsured)				
Medicaid	0.23	(0.19)	0.07***	(0.01)
Medicare	-0.06	(0.21)	0.12***	(0.01)
Private	-0.28	(0.18)	0.10***	(0.01)
Other	-0.20	(0.37)	0.07***	(0.03)
Self-reported health (ref = poor)				
Fair	-0.60***	(0.14)	-0.08***	(0.01)
Good	-1.06***	(0.14)	-0.15***	(0.01)
Very good	-1.44***	(0.14)	-0.20***	(0.01)
Excellent	-1.60***	(0.14)	-0.24***	(0.01)
Type of usual source of care practice (ref = independent)				
Hospital or academic medical center	0.03	(0.10)	0.01	-0.01
Government or non-profit	-0.07	(0.11)	-0.02**	-0.01
Other or unknown	-0.04	(0.08)	0	-0.01

Note: SE = Standard errors. *** p<0.01, ** p<0.05, * p<0.1

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Table 1-5. Patient outcomes by provider attributes and patient perceived characteristics

	ED Use		Total expenditures	
	Coef	SE	Coef	SE
Provider attributes				
Offers same day appointments	0.43***	(0.17)	0.01	(0.01)
Uses email or electronic means of communication with patients	-0.09	(0.09)	0.00	(0.01)
Multi-specialty practice	-0.02	(0.07)	0.00	(0.00)
Has nurse practitioners or physician assistants	0.10	(0.08)	-0.00	(0.01)
Has a primary care provider	-0.04	(0.16)	0.00	(0.01)
Has a case manager	-0.08	(0.06)	-0.01**	(0.00)
Sends preventive care reminders	0.06	(0.15)	-0.00	(0.01)
Follows up with patients within 72 hours of hospital discharge	-0.11	(0.07)	-0.00	(0.01)
Uses electronic reminders of guidelines and standards of care	0.11	(0.10)	0.01**	(0.01)
Uses quality report cards for providers	0.12	(0.11)	-0.00	(0.01)
Patient perception				
Easy to reach by phone during regular hours	-0.14	(0.10)	-0.01**	(0.01)
Extended office hours	0.05	(0.08)	-0.01	(0.01)
Easy to reach by phone after hours	-0.12	(0.09)	-0.00	(0.01)
Provider shows respect for treatment decisions	-0.17	(0.12)	-0.00	(0.01)
Provider includes patient in decision-making	-0.06	(0.10)	-0.00	(0.01)
Provider explains treatment options	0.18	(0.15)	0.00	(0.01)
Provider asks about other treatments received	0.15*	(0.08)	0.03***	(0.01)

Note: All models are adjusted for age, gender, race/ethnicity, income level, marital status, education, region of residence, health status, type of health insurance and type of practice. SE = standard errors. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 1-6 Patient outcomes with composite for patient-perceived accessibility

	ED Use		Total expenditures	
	Coef	SE	Coef	SE
Provider attributes				
Offers same day appointments	0.44***	(0.17)	0.01	(0.01)
Uses email or electronic means of communication with patients	-0.09	(0.09)	0.00	(0.01)
Multi-specialty practice	-0.01	(0.07)	0.00	(0.00)
Has nurse practitioners or physician assistants	0.11	(0.08)	-0.00	(0.01)
Has a primary care provider	-0.04	(0.16)	0.00	(0.01)
Has a case manager	-0.07	(0.06)	-0.01**	(0.00)
Sends preventive care reminders	0.06	(0.15)	-0.00	(0.01)
Follows up with patients within 72 hours of hospital discharge	-0.11	(0.07)	-0.00	(0.01)
Uses electronic reminders of guidelines and standards of care	0.11	(0.10)	0.01**	(0.01)
Uses quality report cards for providers	0.11	(0.11)	-0.00	(0.01)
Patient perception				
Composite accessibility measure	-0.32***	(0.11)	-0.02**	(0.01)
Provider shows respect for treatment decisions	-0.16	(0.11)	-0.00	(0.01)
Provider includes patient in decision-making	-0.08	(0.10)	-0.00	(0.01)
Provider explains treatment options	0.18	(0.15)	0.00	(0.01)
Provider asks about other treatments received	0.15*	(0.08)	0.03***	(0.01)
Covariates				
Age	0.01*	(0.00)	0.00***	(0.00)
Income as percent of federal poverty level (mean)	-0.00***	(0.00)	0.00***	(0.00)
Male	-0.17***	(0.06)	-0.02***	(0.00)
Race/Ethnicity (ref = Non-Hispanic, white)				
Non-Hispanic black	-0.00	(0.08)	-0.05***	(0.01)
Hispanic	-0.12	(0.09)	-0.06***	(0.01)
Asian	-0.52***	(0.17)	-0.09***	(0.01)
Other	0.39	(0.24)	0.01	(0.01)
Region of residence (ref = Northeast)				
Midwest	-0.02	(0.12)	-0.00	(0.01)
South	-0.24**	(0.11)	-0.02***	(0.01)
West	-0.28**	(0.11)	-0.00	(0.01)
Marital status (ref = Married)				
Separated/Widowed/Divorced	0.32***	(0.09)	0.01**	(0.01)
Never married	0.11	(0.12)	0.03***	(0.01)
Not applicable (under 16)	-0.03	(0.23)	0.04***	(0.01)
Education (ref = less than HS)				
High school	0.14	(0.11)	0.00	(0.01)
Some college	0.06	(0.12)	0.02**	(0.01)
Bachelor's degree or more	0.10	(0.11)	0.02***	(0.01)
Not applicable (under 5)	0.80***	(0.15)	-0.01	(0.01)
Insurance type (ref = uninsured)				
Medicaid	0.23	(0.19)	0.07***	(0.01)
Medicare	-0.05	(0.20)	0.12***	(0.01)
Private	-0.28	(0.18)	0.10***	(0.01)
Other	-0.22	(0.37)	0.07**	(0.03)
Self-reported health (ref = poor)				
Fair	-0.59***	(0.14)	-0.08***	(0.01)

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Good	-1.04***	(0.14)	-0.15***	(0.01)
Very good	-1.42***	(0.14)	-0.19***	(0.01)
Excellent	-1.58***	(0.15)	-0.23***	(0.01)
Type of usual source of care practice (ref = independent)				
Hospital or academic medical center	0.02	(0.10)	0.00	(0.01)
Government or non-profit	-0.09	(0.12)	-0.02**	(0.01)
Other or unknown	-0.04	(0.08)	0.00	(0.01)

Note: SE = Standard errors. *** p<0.01, ** p<0.05, * p<0.1

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Chapter 2 Hospital Value-Based Purchasing and Staff Budgeting Decisions

ABSTRACT

Background: Medicare Hospitals Value-Based Purchasing (HVBP) aims to improve patient outcomes and increase efficiency in use of resources. However, numerous studies to date have failed to demonstrate meaningful changes in patient outcomes following implementation. While many have taken this to mean that hospitals are not responding to incentives, whether because the financial incentive is too small or because the performance metrics are numerous and varied, few studies have looked at hospital responses as opposed to patient outcomes. This study uses staffing changes as an early indicator of shifting financial priorities to assess internal hospital responses to incentives.

Methods: Data come from the Virginia Health Information Hospital Detail Reports 2010-2017 and Center for Medicare and Medicaid Services (CMS) Impact files for hospital-specific HVBP adjustments. Generalized linear models were used to identify associations between HVBP penalties or bonuses with number of provider-specific full-time equivalents (FTEs). Measures were direct patient care and administrative hours, in addition to clinician types such as physicians, nurse practitioners, registered nurses and nursing aides. Reliance on Medicare funding as a measure of proportion of patient revenue tied to Medicare was also estimated as a potential moderating factor.

Results: Hospitals receiving penalties responded by reducing the numbering of physician FTEs (-0.35, p< 0.01) and nursing aide FTEs (-0.29, p< 0.01) in the following year. In hospitals receiving bonuses, staff were added. In particular, administrative staff (0.30, p< 0.01), registered nurses (0.22, p=0.03), and other staff (0.19, p< 0.01) all had increased FTEs in the year following the bonus.

Discussion: Findings are consistent with expected behaviors if hospitals are responding to incentives by aiming to both improve quality and reduce costs. For instance, hospitals aiming to improve quality may add registered nurses, a provider type with staffing ratios tied to numerous quality metrics, and may hire additional administrative staff to assist with quality improvement initiatives. However, reductions in physicians and nursing aides are likely results of efforts to

reduce expenses. Hospitals may choose to reduce physician FTEs, since they are the most costly providers. Nursing aides, while not costly, are not necessary for hospitals to function; therefore, they may be seen as a luxury. Overall, findings are consistent with hypotheses that hospitals are responding internally to incentives, even if changes do not results in changes in patients outcomes.

INTRODUCTION

Historically, provider payment in the United States healthcare system has largely been fee-for-service based or volume driven.[41] This method, however, has led to unnecessary services that often result in little benefit, even potentially harming patients.[42] The fee-for-service model has also contributed to exceptionally high health expenditures not seen in health systems that use other payment models.[5] Efforts to curb excessive health spending in primary and specialty outpatient care have resulted in models such as managed care in the 1990's, medical homes (as described in chapter 1), accountable care organizations, and a multitude of additional alternative payment models established through the Medicare Access and CHIP Reauthorization Act (MACRA) of 2015.[9,43–46] Each model has a distinct set of measures, structures, and aims.

While efforts to reform payment models in the outpatient setting have been numerous and varied, efforts on the inpatient side have been somewhat more uniform. Although hospitals and states have had some flexibility in establishing unique models, by far the largest payment reform programs were initiated by Medicare and are mandatory for nearly all acute care hospitals. In an effort to incentivize healthcare providers to deliver higher quality and cost-efficient care, the Centers for Medicare and Medicaid Services (CMS) implemented the Hospital Value-Based Purchasing (HVBP) program in 2012 as an initiative of the ACA. Medicare hospital costs were specifically targeted in part due to their size and expense, since hospital costs contribute to nearly one-third of all healthcare expenditures, despite only about 7% of the population having an inpatient stay.[47,48]

While the initiative itself is uniform across hospitals nationally, the individual measures vary greatly. Initially, HVBP quality measures were focused on care processes. To some extent, the focus on these measures is evident in recent comparative reports that show that while the United States ranks at the bottom of overall healthcare system performance, we perform best on care processes, with a ranking of 5th out of 11 industrialized countries.[5] Since 2012, the VBP program has expanded to incorporate numerous additional quality measures, ranging from patient satisfaction with care to patient safety indicators. Most recently, in fiscal year (FY) 2018, hospitals were ranked on their performance in 4 domains: patient experience and care coordination, safety, clinical care and cost efficiency.[49] However, the weight of these domains for payment purposes varies by year, as do the specific measures.

Now, more than five years into the HVBP program, several evaluations have been published indicating minimal effect on health outcomes.[50,51] Although hospital acquired conditions have declined by more than 17 percent since initiation of the program,[52] studies comparing VBP hospitals to control hospitals suggest that improvements in healthcare are demonstrative of overall trends as opposed to specific payment system reforms.[50,51,53] This conclusion is consistent with findings from the prior Premier Hospital Quality Incentive Demonstration (Premier HQID), an early value-based purchasing pilot for a limited number of medical conditions, that was found to have little effect on mortality or costs.[53,54]

Despite academic literature that suggests the current inpatient HVBP program is largely ineffective,[7] value-based purchasing programs more broadly have and are likely continue to expand both in the hospital and outpatient settings.[44,55] Therefore, in order for health policy research to be an effective tool in shaping public policy, researchers must begin to study not just whether or not VBP impacts outcomes, but focus on why the programs are or are not working, so that improvements to the program can be made. To date, the cause of the failure of HVBP to show results is still speculative. Many researchers blame the insufficient size of the incentive, believing that without adequate consequences, hospitals are unlikely to make any systematic changes.[7,56] In fact, the percent of a hospital's overall payment at-risk based on HVBP performance is small, beginning with 1% of base Medicare MS-DRG payments in FY 2013 and capping out at 2% in FY 2017.[57] Other explanations have focused on the numerous quality measures that may lead to confusion among clinicians and administrative burden.[1,7,56,58] Although little research has investigated "quality improvement overload" as a driver of ineffective improvement strategies, it has quickly become a popular explanation for disjointed, poorly executed quality improvement initiatives.[7,59] This study aims to begin the investigatory process into the evidence behind these two explanations by identifying changes in internal budgeting decisions among hospitals in which the incentive is a considerable component of overall revenue compared to those in which it is a not. By studying an internal response as opposed to an outcome, I can conclude whether or not incentives are too small to cause a response, or if the response is simply not resulting in improved patient outcomes. Additionally, this study measures administrative FTEs separately from other FTEs to see if hospitals are responding to an increase in administrative burden.

Paper 2 of 3: Hospital Value-Based Purchasing and Staff Budgeting Decisions

When CMS modified inpatient payments in the past with the Balanced Budget Act (BBA) of 1997, evidence suggested that hospitals responded with changes in nurse staffing ratios proportional to the size of their payment cut.[60] Later, as margins again increased and evidence grew regarding the association between staffing ratios and quality of care, hospitals again began increasing their staffing levels.[61] With nearly 60 percent of a hospital's budget dedicated to staff expenses, responses to changes in reimbursement are often first evident among staffing changes.[60,62] Therefore, in order to investigate whether HVBP incentives are large enough to invoke hospital system-level changes, staffing decisions are an early indicator. Using hospital cost reports combined with individual HVBP adjustments, this study examines how hospital staffing decisions change in response to HVBP incentives.

CONCEPTUAL FRAMEWORK

With a growing number of VBP programs implemented in various settings, Damberg et al. at RAND Corporation developed a framework for evaluating these programs.[63] The framework is adapted for this study, and aims to identify not only the theoretical basis in which incentives may affect behavior of providers and healthcare entities, but also identify potential confounding factors. The original RAND VBP model (figure 2-1) illustrates how the VBP approach, with specific design features, may result in specific responses, which ultimately may lead to both intermediate effects and long-term outcomes. Additionally, this framework addresses how external factors such as competing polices, fiscal environment, and organizational culture may influence how entities respond to incentives.

Figure 2-1. RAND Value-Based Purchasing Conceptual Framework
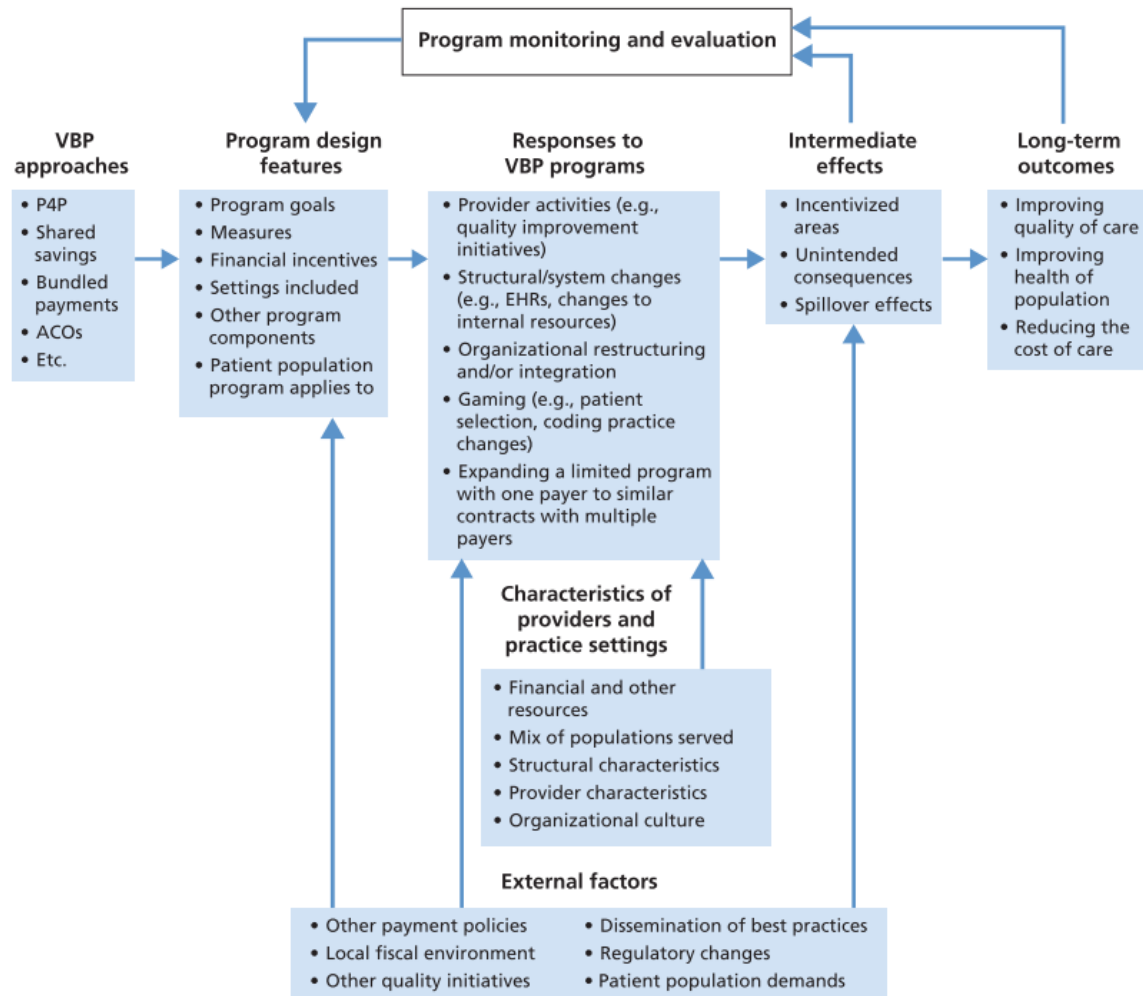
Current literature on the HVBP program has largely been focused at the end of the potential pathway, finding few changes in long-term outcomes. However, it should not be assumed that simply because effects of the HVBP program are not seen at the end of the pathway that no there is no response to incentives. In order to improve our understanding of why incentives have not resulted in changes in outcomes, this study shifts the focus from long-term outcomes to the earliest stages of entity response, or responses to VBP programs. As such, the model is adapted to include the outcomes evaluated in this study – changes in staffing full-time equivalents (FTEs) – in the "responses to VBP programs," while both intermediate and long-term outcomes are not evaluated in this study (see figure 2-2).

Figure 2-2. Medicare Hospital Value-Based Purchasing Program Conceptual Framework (modified from RAND VBP framework)
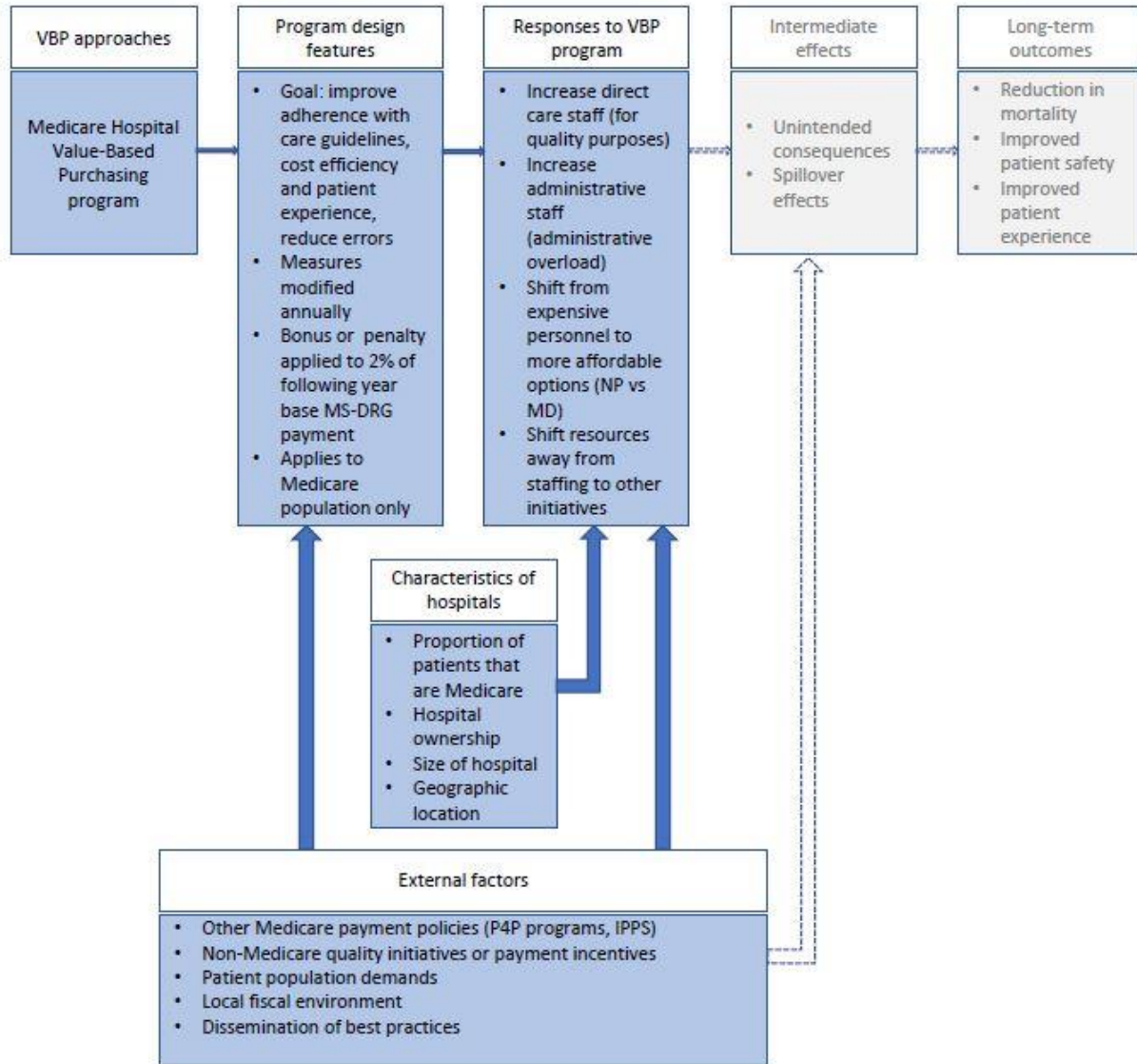
Note: Concepts in grey are not included in study

Using an approach adapted from the RAND VBP model, the "design features" of the Medicare HVBP program include the goals of the HVBP program, which is to improve adherence to care standards, patient safety, patient experience and efficient use of resources. The definitions of each of these goals fluctuates by year as domains and measures change, another pertinent feature of the program. The "response" of interest in this study is staffing changes,

which may be expected to vary in a number of ways described in more detail below (see *Hypotheses* section).

As indicated in the model, the response to the HVBP incentive is influenced by other "external factors" and "hospital characteristics." External factors, as described by Damberg et al., include contextual factors that may influence how an entity responds to the incentive. For instance, other conflicting or complimentary payment policies for Medicare or other payers. One example of a complimentary payment policy is the Medicare hospital readmissions reduction program (HRRP), which was implemented in a similar timeframe but unlike HVBP, evidence suggests that changes in patient outcomes may be attributable to payment policy.[64] Since this study aims to investigate why patient outcomes are not responsive to HVBP policy, it is critical to account for policies such as HRRP to avoid inaccurate interpretation due to confounding factors.

Characteristics that Damberg et al. refer to as "characteristics of providers and practice settings" are specific to the entity being incentivized, in this case, hospitals (therefore, these are referred to as "hospital characteristics" in the model above). Of key importance for this study is the proportion of the hospital's revenue that is based on Medicare dollars. Hospitals with relatively larger Medicare populations will receive a proportionally larger financial incentive to perform well on HVBP performance measures. With many researchers hypothesizing that the limited size of the incentive is the reason that few changes in patient outcomes are seen, it is important to distinguish between hospitals with relatively larger incentives compared with smaller incentives to identify variation in responsiveness to HVBP policy.[7]

Hypotheses

Financial and performance incentives are not new to hospitals.[65] Over the last two decades, various payment reforms have required hospitals to respond to changing financial and political environments, with each policy incentivizing slightly different behavior.[65,66] For instance, the BBA, which resulted in significant budget cuts, led hospitals to reduce costs largely by reducing their workforce.[60] On the other hand, hospitals responded to quality report cards by investing in additional resources necessary to improve outcomes.[67] The HVBP program has both a financial and quality component. The program is intended to incentivize hospitals to improve

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which may be expected to vary in a number of ways described in more detail below (see *Hypotheses* section).

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their quality and efficiency of resource use by assigning penalties or bonuses based on hospital performance on quality metrics, one of which specifically includes efficiency of resources.

With both financial- and quality-based incentives, hospitals may respond to HVBP incentives through four different mechanisms. First, hospitals could respond purely to the financial incentives. If this is the case, one would expect hospitals to respond in a manner similar to that of the BBA response – hospitals will cut FTEs if they receive a penalty.[60] Second, hospitals could aim to improve quality of care. Like investments made to improve CABG outcomes following Medicare's public release of report cards, hospitals could choose to invest in FTEs that are associated with improved outcomes for various HVBP metrics.[67] The third mechanism through which hospitals could respond to HVBP incentives would be to aim to address both efficiency of resources and quality of care. An example of this would be to substitute costly FTEs with lower cost FTEs seen as providing similar quality of care. Finally, hospitals could not respond to HVBP incentives at all, at least as seen through workforce modifications. This study aims to evaluate these competing hypotheses to determine which of the four mechanism is supported by hospital behavior.

Mechanism 1: Hospitals respond to financial pressure only

H1: Hospitals receiving HVBP penalties will decrease their FTEs.

H2: Hospitals with a high proportion of Medicare patients will be more likely to adjust their staffing FTEs in response to HVBP than hospitals with a small proportion of their budget tied to Medicare payments.

Similar to responses seen in prior Medicare payment cuts, such as the BBA, hospitals may indiscriminately reduce FTEs, especially those staffed at high numbers, such as registered nurses.[60,68] Hospitals have been found to reduce FTEs as an early response to changes in financial pressure associated with Medicare policy, with hospitals with greater reliance on Medicare responding more aggressively to incentives.[60,69,70] These reductions in FTEs have occurred despite associated reductions in quality as a result of increased workloads.[71,72]

Mechanism 2: Hospitals respond to HVBP incentives by improving quality

H3: Hospitals receiving penalties will increase the number of direct care FTEs, especially those FTEs correlated with improved patient outcomes, such as registered nurse (RN) FTEs.

In the HVBP context, as opposed to the BBA, payment penalties are directly tied to quality outcomes. In order to avoid or reduce such penalties, quality of care may be improved in a number of ways through workforce modifications. For instance, there is a large body of evidence demonstrating that quality of care is directly related to nurse staffing levels. Higher nurse staffing ratios are associated with lower mortality rates for a variety of conditions, increased patient experience scores on HCAHPS surveys, fewer hospital-acquired infections, fewer patient falls, higher compliance to standards of care, and a variety of other patient outcome measures.[61,72–83] Aside from nurses, other direct patient care staff FTEs have also been found to be associated with outcomes, which hospitals may use to avoid HVBP penalties.[84,85]

Mechanism 3: Hospitals respond to HVBP incentives by addressing both resource efficiency and quality of care

H4: Hospitals will increase the number of administrative FTEs following VBP implementation.

This mechanism through which hospitals may respond to HVBP incentives – by containing costs and maintaining or improving quality – is the overall goal of the HVBP program. However, how this is effectuated may take varying forms, and the combination of multiple hypotheses may be required to suggest mechanism 3 is utilized. For instance, one possible way a hospital may respond to pressure to improve quality of care efficiently is through designating project management personnel.[59] As opposed to incresaing direct care FTEs as one might expect if the hospital responded by improving quality alone, hospitals may instead increase their administrative staff, as reported by hospital associations.[86] In an environment with rotating quality metrics and changing benchmarks, such as that in HVBP, hospitals must efficiently target quality improvement strategies and align metrics and resources. Unlike other payment reforms, the HVBP program has the added complexity of numerous, potentially burdensome quality monitoring and reporting requirements. Therefore, hospitals may require additional administrative personnel to assist the hospital in meeting program requirements efficiently and effectively.[58,63,87] This response has become increasingly cited in popular, anecdotal literature, though has not been evaluated to date.[86]

H5: Hospitals receiving HVBP penalties will substitute low-cost FTEs for high-cost FTEs that provide similar functions with similar quality.

Finally, hospitals aiming to address resource efficiency while maintaining quality of care could choose to shift costs from more expensive personnel to less expensive personnel seen as equivalent in quality and skill. For instance, hospitals may shift FTEs away from physicians and increase FTEs among nurse practitioners (NPs) or physician assistants (PAs), provider types demonstrated to be cost-effective replacements for physicians in many settings, including acute care hospitals.[88–90] As discussed in the Harvard Review, a recent survey by the Medical Group Management Association found that hospitals with higher ratios of non-physician providers, such as NPs and PAs had higher profitability than hospitals with lower ratios.[91] Over the last few decades, NPs have increasingly been used to substitute for junior physicians, and even senior physicians, in acute inpatient settings.[92] Nearly 10% of all NPs are now certified to practice in an inpatient setting, with more than 90% reporting current employment.[93] NPs and PAs may function in similar roles as physicians in a variety of capacities, both administratively and clinically in inpatient settings. A recent survey of certified acute care nurse practitioners (ACNPs) indicated that critical care was the most common specialty among those currently employed in an inpatient setting.[93] In fact, the Health Resources and Services Administration (HRSA) reports that there are nearly as many critical care nurse practitioners as critical care physicians, with a 73% expected growth rate in the field.[94] Nurse anesthetists, frequently used as the sole anesthesia provider in rural areas, now outnumber anesthesiologist.[95,96] In addition to ACNPs and PA substituting for physicians, other clinicians may have substitutes. For instance, registered nurses (RNs) and licensed practical nurses (LPNs) generally fulfill similar roles in hospitals. Nurse aides, while unable to fulfil all duties of nurses may act as a partial substitute by reducing the staffing levels required to maintain quality of care through reductions in nursing workload.[60,76,97]

Mechanism 4: No response
H6: There are no changes in FTEs for any provider type following an HVBP penalty or bonus.

It is feasible that hospitals do not respond specifically to HVBP incentives. In fact, many researchers finding no change in patient outcomes assume this is the case.[7] Indeed, hospitals report not knowing how to respond due to the shifting nature of the measures and relatively small

financial incentive attached to performance.[1] This study is structured to eliminate this hypothesis if one of the competing hypotheses described above is supported. However, failure to eliminate this hypothesis should not be interpreted as supporting it, since finding no changes in FTEs following HVBP bonuses or incentives does not mean that hospitals did not respond in other ways. Supporting one of the other mechanisms of response does eliminate the hypothesis of no response.

METHODS

Data

Data come from 2010-2017 Virginia Health Information (VHI) Hospital Detail Reports and CMS Impact Files. VHI collects financial records and produces cost reports for all hospitals in Virginia. Records include information on hospital expenditures and revenues, including labor expenses by clinician type and administrative and direct patient care full-time equivalents (FTEs). While national datasets, such as the American Hospital Association (AHA) annual survey have estimates of nursing ratios, VHI is more suitable to address the research questions in this study because it offers more granular information on types of roles and hours as well as information on employees beyond nursing, such as physicians and even non-clinical personnel. Furthermore, in AHA data, full-time equivalent employment (FTEEs) are very roughly estimated and do not distinguish the number of hours worked within full-time and part-time staff, so that a nurse working 8 hours per week is counted the same as a nurse working 30 hours per week, as both are seen as part-time.[81] In addition to these more precise estimates of FTEs, VHI also distinguishes between administrative hours and direct patient care hours for all clinician types. This precision is important when studying the impact of HVBP, as the types of hours may shift between types of clinicians and between direct patient care and administrative hours depending on the focus of the hospital or response to either administrative overload, an effort to improve quality of care, attempts to decrease costs, or all of the above.[1,60,98]

All 75 acute adult general hospitals in Virginia eligible to receive HVBP payments are included in the sample, for a total of 501 observations. While the time span includes 2010 to 2017, the sample is constructed as a cross-section of seven 2-year panels in which the HVBP adjustment in year 1 is regressed onto the number of FTEs in year 2. HVBP-exempt hospitals excluded from the sample include children's hospitals, PPS-exempt cancer hospitals, critical

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access hospitals, long term care facilities, rehabilitation hospitals, and inpatient psychiatric facilities. Hospitals cited for deficiencies posing immediate danger to patients during their baseline performance period, hospitals not participating in the Hospital Inpatient Quality Reporting program, and hospitals with too few patients in specific quality measurement categories are not eligible for HVBP payments. In Virginia, 5 adult acute hospitals (for a total of 8 observations) did not participate in the HVBP program in at least 1 year for reasons unspecified. HVBP adjustments for each hospital are publicly available through CMS archives. Adjustments were first announced in 2012, with the first year of bonus payments and penalties taking effect in 2013.

FTEs

FTEs are categorized by clinician type: 1) physician, 2) NP or PA, 3) RN, 4) LPN, 5) nurse aide, 6) other staff. Both contract and direct employee hours are included. Hours are divided between direct patient care and administrative responsibilities. FTEs cannot be parsed out by hours spent on specific activities. Therefore, clinicians whose positions include both administrative and direct care roles are categorized by where the staff member spends the majority of his or her hours. For instance, while a nurse quality improvement coordinator would be considered administrative, a bedside nurse who serves part-time on a quality improvement committee is categorized as direct patient care in terms of FTEs. Future FTEs are also likely dependent on past FTEs. For this reason, all models include a control variable to adjust for the prior year's number of FTEs for any given provider-type.

HVBP adjustment

HVBP adjustment is reported by CMS as a percent adjustment to the hospital's Medicare MS-DRG inpatient payments. CMS presents the adjustments as 1.0 if no adjustment is made, meaning the hospital receives 100% of their MS-DRG payments. If the adjustment is greater than 1.0, then the hospital receives a bonus. If the adjustment is less than 1.0, than the hospital receives a penalty. For this study, a hospital is categorized as receiving a null adjustment if the adjustment is between 0.999 and 1.001. All other adjustments are categorized as either negative or positive. Since hospitals may be more inclined to protect against losses than to aim for bonus payments, a binary indicator for having received a payment cut versus no payment cut is created as well.[1] Similarly, a dummy is created to identify those hospitals receiving a bonus vs no

change or a penalty. Finally, hospitals may not react to one or two years of penalties or bonus payments, but may instead respond to an accumulation of penalties. For sensitivity analyses, two variables were created to address potential effects seen as a result of accumulation of penalties. The first variable is linear and includes the number of years the hospitals has received a penalty. The second variable flags hospitals that have received a penalty at least 3 times.

Medicare Reliance

HVBP incentive payments are likely to have varying effects on hospitals according to the fiscal pressure they represent.[60] Hospitals whose margins are more dependent on Medicare dollars are more likely to respond to changes in Medicare payment incentive structures. Hospitals that care for few Medicare patients, are less likely to respond to minimal changes in single insurance policies. Therefore, to identify the extent to which a hospital relies on Medicare for funding, I calculate net Medicare revenue and divide this by net patient service revenue. This provides me with the proportion of net revenue attributable to Medicare payments. A binary indicator for hospitals in the top tertile for dependence on Medicare dollars is used in the analyses, as these are considered the hospitals most likely to experience treatment effects.

Covariates

All models are adjusted for additional variables that may impact hospital staffing for reasons other than the HVBP program. Hospital volume is accounted for by including total number of inpatient days per year. The resources of the hospital location are adjusted for using both the rurality of the area as well as the general region of the state based on the five health planning regions, as defined by the Virginia Department of Health. Hospital ownership is also included in all models and defined as either non-profit or proprietary. Virginia has two state hospitals that do not report cost information to VHI and are excluded from analyses. Affiliation with a large health system, defined as having at least 3 hospitals in Virginia or Virginia Commonwealth University and University of Virginia System hospitals, are also identified since hospitals in a large system may have additional global resources that could influence how payment changes effect individual hospitals within the system. CMS provider type is also included to distinguish between hospitals that CMS views as potentially vulnerable or unique compared to typical inpatient prospective payment (IPPS) hospitals. These provider types include IPPS hospitals, sole community hospitals, Medicare dependent hospitals, and rural

referral centers. The CMS definition of Medicare-dependent hospital is based on hospital rurality and size of facility and is not based on reliance on Medicare financing as interpreted through cost reports. For this reason, provider type could not be used as the moderating variable for analyses purposes, but is included as a covariate. Other covariates include the CMS case mix index from the CMS Impact Files for each hospital to account for patient severity, prior year operating margins to address financial health and capacity to respond to financial incentives, and adjustments to Medicare payments due to the Hospital Readmission Reduction Program.

Statistical Analyses

Seven two-year panels were constructed, in which the HVBP adjustment from year 1 was matched to the number of FTEs for a given provider-type in year 2. By creating a cross section of 2-year panels, endogeneity associated with the staffing decisions is reduced. While the dataset consists of 2-years per panel, the hospital has 3 years to makes staffing decisions. HVBP adjustments are announced the year prior to implementation, implementation then occurs over the following year, and finally, FTEs are measured on year 3. This ensures adequate time for hospitals to respond to budgetary modifications if desired.

Generalized linear models are used to estimate the number of FTEs for each provider type (administrative, direct patient care, MD, PA/NP, RN, LPN, nurse aide, other staff). Due to significant skewness of FTE distribution, all models were log-transformed. High reliance on Medicare financing was included as a moderating variable and interacted with an indicator for hospitals who received a VBP penalty or bonus. Panel fixed effects were included to address potential variation in staffing decisions overtime not explained by other covariates. Errors were clustered by facility to account for inter-relatedness of staffing decisions within any given hospital.

Eight individual models were estimated, one for each type of provider. All models measure the extent to which penalties assessed in year one lead to changes in staffing decisions in year two. The moderating variable of Medicare reliance is included based on the assumption that hospitals with heavy reliance on Medicare funding may be more likely to change staffing as a result of their proportionately larger incentive. Using direct patient care FTEs as an example, the generalized linear model is presented below:

$$\text{Ln[direct patient care FTEs]}_{it} = \alpha + \beta_1(\text{HVBP penalty})_{it-1} + \beta_2(\text{Medicare reliance})_{it-1} +$$
$$\beta_3(\text{HVBP penalty} * \text{Medicare reliance})_{it-1} + \beta_4(\text{direct care FTEs})_{it-1} + \beta_5(\text{rurality})_{it} +$$
$$\beta_6(\text{region})_{it} + \beta_7(\text{non-profit})_{it} + B_8(\text{system})_{it} + \beta_9(\text{patient days})_{it} + \beta_{10}(\text{operating}$$
$$\text{margin})_{it-1} + \beta_{11}(\text{case mix index})_{it} + \beta_{12}(\text{HRRP adjustment})_{it-1} + \eta(\text{panel}) + u_{it}$$

A secondary analysis was performed to assess the effect of bonus payments on FTEs as opposed to penalties. Eight individual models were similarly estimated replacing penalty with bonus payment.

Sensitivity analyses

Several sensitivity analyses were performed to ensure robustness of results. In addition to analyzing the data as cross-sections of 2-year panels, a full panel dataset was constructed using 75 individual hospitals over 7 years. A panel fixed effects model was estimated for each FTE type. Findings were generally similar in direction to the main model; however, statistical significance was greatly reduced.

A second set of sensitivity analyses tested the hypothesis that effects of penalties or bonuses are cumulative as opposed to annual. For this sensitivity analysis, two separate methods were used. First, a linear variable accounting for the number of penalties accumulated was created and replaced the binary indicator. The second method used a cutoff of 3 penalties or bonuses over time. Three penalties or bonuses was selected since nearly all hospitals experiencing at least 1 penalty or bonus also received a second. However, the number dramatically declined to 10% of the total sample when three penalties were assessed.

Additional sensitivity analyses included grouping all nurses who share similar responsibilities together (RNs and LPNs) and nurses with nursing aides. These provider types, while differing in expense, share similar roles. As nursing care makes up the largest proportion of FTEs, varying definitions of these categories were estimated to ensure that all practical groupings were assessed.

Sensitivity analyses were also performed around the use of individual covariates. Specifically, while prior year's operating margins were included in the main model, since this is the margin associated with patient care activities, sensitivity analyses were conducted using total margins instead. Hospitals' overall financial stability is the result of both revenue and expenses

related to patient care, but also the revenue and expenses outside of patient care. As opposed to operating margins, total margins may account for other revenue sources outside of patient care activities that could supplement the financial stability of the institution. Sensitivity analyses using total margins resulted in similar findings as the main model (see appendix 2-28 and 2-29). Full results of all sensitivity analyses are shown in appendices 2-4 through 2-29.

RESULTS

Of the 501 observations, 93 received penalties while 110 received bonuses, 298 hospitals received no adjustment (83 in years following implementation). In nearly all categories of provider-types, mean FTEs were higher among hospitals receiving penalties than in those that received either no adjustment or received a bonus. This is especially true for FTEs devoted to direct patient care activities (1,052.8 vs 888.5 or 706.4), physicians (56.9 vs 28.3 or 11.5), physician assistants/nurse practitioners (21.3 vs 12.1 or 5.7) and staff in the "other" category (865.0 vs 782.9 or 615.2) (see table 2-1). Staff in the "other" category may include FTEs for positions such as nutrition, social work, behavioral health clinicians, and janitorial staff. Nursing aides are the only staff type who are fairly equally represented in hospitals receiving penalties as they are in hospitals receiving bonuses (85.4 vs 89.8). The higher number of unadjusted FTEs among providers receiving penalties may be due to the fact that larger hospitals were more represented in the penalty category than the bonus category, although hospitals receiving no adjustment were similar in size to those receiving a penalty. The average number of patient days among hospitals receiving a penalty was 51,394 compared to 51,115 in the null category and 43,828 in the bonus category. In addition to size, ownership of hospitals is also associated with HVBP adjustment. While 80.7% of hospitals receiving penalties are not-for-profit, only 65.5% of hospitals receiving bonuses are not-for-profit, suggesting that for-profit hospitals are more successful at securing bonuses. Table 2-1 provides hospitals characteristics among each HVBP adjustment category.

The base analytic models (see tables 2-2 and 2-3) assess the relationship between either an HVBP penalty or a bonus and FTEs in the following year, controlling for the effect of Medicare reliance. These models do not allow for any moderating relationship between Medicare reliance and HVBP payment incentive. Based on these models, hospitals receiving penalties are associated with a reduction in physician FTEs (-0.35, $p < 0.01$) and nurse aide FTEs

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(-0.29, p< 0.01). Interestingly, these reductions are among some of the most and least costly FTEs (see table 2-2). In hospitals receiving bonuses, staff are added. In particular, administrative staff (0.30, p< 0.01), registered nurses (0.22, p=0.03), and other staff (0.19, p< 0.01) all have increased FTEs (see table 2-3). Shifting the comparator to hospitals receiving no adjustment results in similar estimates, hospitals receiving penalties continue to have fewer physician and nursing aide FTEs, while hospitals receiving bonuses have increased administrative, nursing, and other FTEs in the following year (see appendix 2-1).

Hypothesis 2 suggests that hospitals with a heavy reliance on Medicare funding may be more prone to respond to HVBP incentives due to the relative size of the incentive. However, the moderating variable was not statistically significant in any model, suggesting that responses seen to HVBP incentives are not based on the size of the incentive (see appendix 2-2 and appendix 2-3). The moderated models instead show similar results to the non-moderated models for hospitals less reliant on Medicare. In the moderated models, hospitals receiving penalties (less reliant on Medicare) continue to have fewer physician and nurse aide FTEs following a penalty, and continue to increase FTEs for administrative staff, registered nurses and other staff. Licensed practical nursing FTEs also had increased FTEs following receipt of a bonus payment. Since reliance on Medicare was not found to be a contributing factor to hospitals' response to HVBP incentives either through statistical significant in the model or through a post-test F-test, the non-moderated models are considered to be the main analytic models for this analysis. Results from moderated models may be found in the appendices (appendices 2-2 through 2-3) along with results from other sensitivity analyses.

Sensitivity analyses were conducted using panel data, as well as measuring penalties and bonuses as either a threshold effect (at least 3 penalties or bonuses) or an accumulation effect. Results of the sensitivity analyses largely mirrored those of the main analyses, showing declines in physician FTEs following a penalty and increases in nursing and administrative staff FTEs following bonuses. Full results from these sensitivity analyses may be found in appendices 2-4 through 2-23. Further sensitivity analyses for hypothesis 4 and 5, investigating whether hospitals' responses are demonstrative of aiming to both improve resource efficiency and address quality concerns, were conducted using both a pre/post analysis of the HVBP implementation period and a ratio of high-cost providers to low cost providers. For the latter, a ratio of

physicians to NP/PAs was created as well as a ratio of RNs to LPNs and RNs to nursing aides. Supporting findings from main analyses, the ratio of physicians to NP/PAs declined following HVBP implementation period. Furthermore, the ratio of nurses to nursing aides increased following a bonus, while the number of LPNs to registered nurses (a less costly substitute) increased following a penalty (see appendices 2-24 to 2-27).

DISCUSSION

Findings indicate that receiving an HVBP penalty is associated with a decrease of one-third of a physician FTE (about 14 hours) and about one-quarter of a nurse aide FTE (about 11 hours). These reductions are similar in magnitude to reductions seen in nursing staff following implementation of BBA.[60] While the payment cute was more significant following the BBA, hospital responses seem to be of similar magnitude. The difference in the reductions following the two policies seem to be the types of FTEs reduced. Whereas the BBA cut payments in general, the HVBP program also incentivizes quality of care. This may be why hospitals appear to be strategically reducing certain staff and not others. For instance, while the BBA mainly cut RN and LPN FTEs, since they are by far the largest proportion of hospital staff, reductions following HVBP penalties are focused in physician and nurse aide FTEs, while RN and LPN FTEs remain unchanged.[60]

Based on the findings from this study, hospitals appear to behave in a way most consistent with entities aiming to both improve efficiency and maintain quality at the same time. If hospitals responded incentives solely through reducing expenses, then FTEs should have decreased overall following penalties and hospitals with larger financial incentives would have cut FTEs at a greater rate. My findings are not consistent with this hypothesis. Only physician and nurse aide FTEs were cut, the most and least expensive, and hospitals with heavy reliance on Medicare funding were no more or less likely to respond to incentives than other hospitals. However, the reductions in physician and nurse aide personnel do suggest some sensitivity to financial penalties. Potential explanations for the reductions among these two roles specifically may be due to the high cost in the case of the physician, and the non-essential, luxury good nature of the nurse aide. Nurse aides are generally used to augment the role of the RN or LPN by assisting in basic care, such as transporting patients, and assisting in activities of daily living, like baths and brushing patient's teeth.[99] These activities, if not otherwise completed by a nurse

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aide, would be added to the workload of the patient's nurse. However, nurse aides cannot give medications to patients, so cannot act as a full substitute for LPNs or RNs. Therefore, with a more limited scope of practice, unlike a RN or LPN, nurse aides are not a required part of patient care, but instead may promote high quality care and job satisfaction by decreasing burdens on the nurse's time and enabling faster attention to patient needs. When hospital budgets are reduced, these staff are among the first to experience decreases in FTEs. This suggests the HVBP program may result in the unintended consequence of increasing nurse workload, and potentially decreasing the quality of her work.

Reductions in FTEs were not the only response identified among hospitals following HVBP implementation. Hospitals also responded to incentives by shifting FTEs following receipt of a bonus. In these instances, hospitals increased several types of FTEs, including registered nurses, administrative staff, and other personnel not otherwise specified. The addition of this type of staff is most consistent with responses related to mechanism 2: responding to HVBP incentives by improving quality (or the quality component of mechanism 3). Hospitals have frequently reported that VBP programs require the hiring of additional administrative personnel to establish, monitor, and report on quality improvement initiatives.[59,86] Additionally, RN FTEs are likely one of the most cost-efficient FTEs directly associated with quality of care.[74,76] These positions take a significant investment, but are high priorities for hospital management. The roles that experience increases in FTEs are roles that may support hospital-specific initiatives, including quality improvement initiatives. Such programs may not be necessary for daily activities, but may be high priority investments for hospitals when additional funding, such as those achieved through HVBP, are available.

The hypothesis that hospitals do not respond to HVBP incentives at all is not supported by my findings. While the HVBP program may not have resulted in significant changes to patient outcomes, that is not equivalent to hospitals not responding to incentives at all. However, the hypothesis that HVBP has not resulted in significant changes in patient outcomes because the incentive is too small requires further investigation. Findings suggest that the hospitals likely to experience significant risk due to the proportion of revenue attributable to Medicare do not respond to incentives more than hospitals with low reliance. In fact, hospitals with little dependence on Medicare funding seem to be the drivers of overall response seen among

hospitals. This may be because hospitals highly dependent on Medicare funding respond more strongly to other larger Medicare payment incentives such as general fee-for-service, DRG payments, or other quality initiatives such as HRRP. Hospitals with less reliance on Medicare may be more receptive to HVBP programming because they may be preparing for similar VBP initiatives with other payers.

Limitations

The main limitation of this study is its limited generalizability. This study is conducted on hospitals in the state of Virginia and may not be generalizable outside of the state. Hospitals within the state may have similar practice patterns and management styles as other nearby hospitals. Staffing availability may also be similar for hospitals practicing within the state and facilities may compete for labor. While the effects of the ebb and flow of staff availability is minimized through the panel fixed effects and regional and rurality controls, hospital management styles and staff availability may reduce generalizability. Furthermore, the limited sample size may have resulted in inadequate power to identify moderating effects of Medicare reliance.

Another limitation is the potential endogeneity of staffing and performance on HVBP metrics. Nursing staffing ratios are a well-documented contributor to quality metric performance.[78] To minimize this risk, HVBP adjustment was regressed on to the following year FTEs. Additionally, prior year FTEs were controlled for, as future FTEs are likely dependent on past year FTEs. While this does not eliminate the risk of endogeneity, it reduces it.

Lastly, while this study aims to identify the type of response hospitals have to HVBP incentives, this study cannot ascribe reasons behind actions. Additional qualitative analyses may assist is attributing the "why" behind hospital behaviors. For instance, while hospitals clearly increase their administrative and other staff FTEs, possible explanations for this behavior are based on known practices consistent with the response, but actual reasons may vary by hospital.

Conclusion

While prior literature has not found meaningful changes in patient outcomes, hospitals are responding to HVBP payment incentives, regardless of the size of the incentive in proportion to their overall revenue. Hospitals respond to HVBP penalties in a similar fashion as previous

payment cuts, by reducing staff.[60] In fact, the magnitude of reductions are similar to those seen following the BBA.[60] Most notably, the first staff to see reductions are expensive physicians and relatively inexpensive nursing aides, whose role reduces work burden on nurses, but cannot replace the function of other personnel, in essence, making them additional expenses to nursing FTEs. However, the hospital response to HVBP incentives is more complex than simply reducing staff, as might be expected based on the additional complexity of the program itself. Hospitals receiving payment bumps from the HVBP program seem to respond to the program not just by reducing costs, but seem to aim to reduce costs while maintaining or improving quality of care. This is demonstrated by the increase their FTEs for nursing, administrative and other staff following a bonus. These may be positions that aid the hospital in achieving the quality metrics necessary to avoid future penalties and achieve additional bonuses. These additions may occur when bonuses are achieved because while hospitals may have wanted to hire or increase these FTEs, they likely had competing priorities that were reduced when additional funding was realized. While hospital responses to HVBP adjustments may not result in desired clinical outcomes, that does not mean that hospitals are not responding. Contrary to this assumption, hospitals appear to respond to incentives in a manner consistent with staff changes that would both reduce costs and maintain or improve quality. Future studies should investigate the pathway between identified internal responses to HVBP adjustments and clinical outcomes.

Table 2-1 Hospital characteristics by VBP adjustment category

	Penalty N= 93 %	Null N=298 %	Bonus N= 110 %
Total FTEs (mean)			
Patient care	1,052.8	888.5	706.4
Administration	307.8	228.9	228.2
Physician	56.9	28.3	11.5
Physician assistant/nurse practitioner	21.3	12.1	5.7
Registered nurse	475.8	415.7	334.1
Licensed practical nurse	29.4	27.4	22.2
Nursing aide	85.4	89.1	89.8
Other	865.0	782.9	615.2
Medicare reliance	39.8	27.9	42.7
Rural	29.0	37.9	30.0
Region			
Central	18.3	19.1	15.5
Eastern	14.0	23.2	33.6
Northern	12.9	13.4	10.9
Northwest	25.8	12.4	11.8
Southwest	29.0	31.9	28.2
Provider type			
IPPS	68.8	71.1	68.2
Rural referral center (RRC)	7.5	3.7	0.9
Medicare dependent hospital	3.2	9.7	3.6
Sole community hospital (SCH)	10.8	12.4	22.7
SCH/RRC	9.7	3.0	4.6
Not-for-profit	80.7	78.2	65.5
Health system	74.2	75.8	82.7
Total patient days	51,394.2	51,115.4	43,828.3
Prior year total margins	5.2	4.6	6.6
Prior year operating margins	4.1	3.9	5.9
HRRP adjustment (mean)	0.993	0.998	0.994
Case mix index (mean)	1.5	1.4	1.5

Table 2-2 Adjusted regressions for HVBP penalties on FTEs (not moderated)

	Direct patient care	Administration	Physicians	Physician assistants/ Nurse practitioners	Registered nurses	Licensed practical nurses	Nursing Aides	Other
	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)
Penalty	-0.054	-0.050	-0.348***	-0.169	-0.017	-0.048	-0.268***	-0.026
	(0.043)	(0.225)	(0.116)	(0.133)	(0.042)	(0.066)	(0.097)	(0.041)
High Medicare reliance	0.021	0.010	0.618**	0.212***	-0.002	-0.011	0.132	-0.049
	(0.053)	(0.080)	(0.263)	(0.078)	(0.044)	(0.063)	(0.091)	(0.049)
Rural	-0.366**	-0.525***	-1.951	-0.680**	-0.486***	-0.153	-0.757***	-0.389***
	(0.156)	(0.164)	(1.904)	(0.316)	(0.151)	(0.155)	(0.224)	(0.132)
Region (ref= Central)								
Eastern	-0.017	0.187	-1.688**	-1.171**	-0.179	0.072	0.091	0.158*
	(0.082)	(0.154)	(0.744)	(0.456)	(0.174)	(0.110)	(0.173)	(0.087)
Northern	-0.263**	-0.006	-1.472***	-0.800***	-0.215***	-1.094***	-0.001	-0.083
	(0.116)	(0.206)	(0.221)	(0.219)	(0.061)	(0.340)	(0.140)	(0.150)
Northwest	0.200***	0.201	-0.787	0.164	0.163**	-0.046	0.079	0.308***
	(0.070)	(0.406)	(0.765)	(0.305)	(0.066)	(0.084)	(0.166)	(0.067)
Southwest	0.121*	0.087	-1.046***	-0.080	0.011	0.082	-0.043	0.319***
	(0.063)	(0.196)	(0.371)	(0.332)	(0.063)	(0.107)	(0.246)	(0.079)
CMS provider type (ref=IPPS)								
Rural referral center (RRC)	0.238	0.427	0.947	1.003***	0.249	0.206	0.451	0.332**
	(0.160)	(0.436)	(2.430)	(0.385)	(0.160)	(0.179)	(0.419)	(0.134)
Medicare-dependent hospital (MDH)	-0.470	0.266	-6.862***	-3.753**	-0.219	-0.395	-0.026	-0.158
	(0.336)	(0.268)	(2.656)	(1.545)	(0.329)	(0.265)	(0.319)	(0.284)
Sole community hospital (SCH)	-0.027	0.364	-0.480	-0.390**	0.015	-0.091	0.200	0.161
	(0.142)	(0.295)	(0.435)	(0.171)	(0.131)	(0.246)	(0.175)	(0.125)
SCH and RRC	0.166	0.534***	0.573	0.216	0.122	0.335**	0.286***	0.355***
	(0.125)	(0.176)	(0.457)	(0.321)	(0.103)	(0.135)	(0.108)	(0.106)

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Not-for-profit	0.270***	0.340	2.941***	2.001***	0.108	0.131	-0.024	0.354***
	(0.086)	(0.208)	(0.811)	(0.439)	(0.105)	(0.118)	(0.121)	(0.103)
Health system affiliation	-0.031	0.043	2.956***	0.549***	0.024	-0.057	0.061	-0.016
	(0.055)	(0.228)	(0.981)	(0.101)	(0.069)	(0.056)	(0.091)	(0.069)
Total number of patient days	0.000***	0.000**	0.000***	0.000***	0.000***	-0.000	0.000	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Prior year operating margin	0.408	1.758***	-13.379***	-8.109***	0.778*	-0.517	0.087	1.059***
	(0.384)	(0.678)	(3.758)	(1.868)	(0.460)	(0.441)	(0.545)	(0.376)
Case mix index	0.735***	0.333	0.737	1.218**	0.627***	0.697**	0.448**	0.638***
	(0.172)	(0.369)	(1.298)	(0.615)	(0.231)	(0.277)	(0.191)	(0.180)
Readmission penalty	0.022	-0.137	1.344*	0.324	-0.045	0.095	0.222***	-0.055
	(0.062)	(0.101)	(0.710)	(0.382)	(0.072)	(0.077)	(0.069)	(0.047)
Prior year FTE	0.000***	0.001**	0.002**	0.001	0.000	0.015***	0.004***	0.000***
	(0.000)	(0.000)	(0.001)	(0.002)	(0.000)	(0.002)	(0.001)	(0.000)

Note: All models include panel fixed effects (not shown). See appendix for full results. *p< 0.1, **p<0.05, ***p<0.01.

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Table 2-3 Adjusted regressions for HVBP bonuses on FTEs (not moderated)

	Direct patient care	Administration	Physicians	Physician assistants/ Nurse practitioners	Registered nurses	Licensed practical nurses	Nursing Aides	Other
	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)
Bonus	0.121	0.302***	0.026	0.089	0.090**	0.102	0.026	0.192***
	(0.076)	(0.078)	(0.429)	(0.274)	(0.042)	(0.062)	(0.062)	(0.054)
High Medicare reliance	0.009	-0.021	0.594*	0.218**	-0.012	-0.020	0.141	-0.065
	(0.055)	(0.078)	(0.329)	(0.107)	(0.044)	(0.061)	(0.097)	(0.045)
Rural	-0.351**	-0.469***	-1.552	-0.646*	-0.471***	-0.139	-0.811***	-0.359***
	(0.155)	(0.137)	(2.960)	(0.357)	(0.146)	(0.148)	(0.266)	(0.117)
Region (ref= Central)								
Eastern	-0.014	0.145	-1.579**	-1.157**	-0.187	0.061	0.134	0.141*
	(0.078)	(0.137)	(0.803)	(0.467)	(0.169)	(0.104)	(0.171)	(0.082)
Northern	-0.275**	-0.048	-1.823***	-0.882***	-0.227***	-1.101***	-0.011	-0.099
	(0.112)	(0.189)	(0.324)	(0.214)	(0.063)	(0.330)	(0.161)	(0.139)
Northwest	0.191***	0.191	-0.545	0.169	0.163**	-0.055	0.041	0.307***
	(0.064)	(0.356)	(0.976)	(0.337)	(0.065)	(0.078)	(0.200)	(0.066)
Southwest	0.123*	0.073	-1.198**	-0.061	0.010	0.076	-0.029	0.313***
	(0.064)	(0.189)	(0.500)	(0.352)	(0.063)	(0.103)	(0.261)	(0.077)
CMS provider type (ref=IPPS)								
Rural referral center (RRC)	0.229	0.403	1.496	0.992**	0.241	0.199	0.365	0.323**
	(0.162)	(0.410)	(3.845)	(0.417)	(0.159)	(0.182)	(0.476)	(0.133)
Medicare-dependent hospital (MDH)	-0.481	0.266	-6.829*	-3.907**	-0.221	-0.398	0.010	-0.159
	(0.344)	(0.247)	(3.873)	(1.687)	(0.331)	(0.263)	(0.316)	(0.289)
Sole community hospital (SCH)	-0.056	0.256	-0.606	-0.429**	-0.012	-0.112	0.269	0.090
	(0.145)	(0.233)	(0.660)	(0.212)	(0.125)	(0.233)	(0.198)	(0.113)
SCH and RRC	0.161	0.517***	0.603	0.166	0.123	0.317**	0.247*	0.347***
	(0.116)	(0.125)	(0.430)	(0.319)	(0.094)	(0.132)	(0.132)	(0.084)

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Not-for-profit	0.287***	0.406**	3.337***	2.034***	0.131	0.149	-0.072	0.395***
	(0.085)	(0.188)	(1.119)	(0.428)	(0.103)	(0.117)	(0.135)	(0.100)
Health system affiliation	-0.036	0.039	3.002*	0.560***	0.027	-0.056	0.006	-0.012
	(0.051)	(0.177)	(1.725)	(0.107)	(0.065)	(0.052)	(0.081)	(0.060)
Total number of patient days	0.000***	0.000***	0.000***	0.000***	0.000***	-0.000	0.000	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Prior year operating margin	0.323	1.616***	-12.548***	-8.358***	0.749	-0.542	0.320	0.967**
	(0.390)	(0.619)	(4.329)	(2.151)	(0.470)	(0.441)	(0.535)	(0.387)
Case mix index	0.707***	0.331	-0.341	1.126*	0.627***	0.682***	0.457**	0.639***
	(0.166)	(0.358)	(1.367)	(0.654)	(0.220)	(0.259)	(0.191)	(0.178)
Readmission penalty	0.025	-0.136	1.183	0.343	-0.032	0.087	0.193***	-0.038
	(0.055)	(0.084)	(0.763)	(0.400)	(0.065)	(0.079)	(0.071)	(0.035)
Prior year FTE	0.000***	0.001***	0.002*	0.000	0.000	0.015***	0.004***	0.000***
	(0.000)	(0.000)	(0.001)	(0.002)	(0.000)	(0.002)	(0.001)	(0.000)

Note: All models include panel fixed effects (not shown). See appendix for full results. *p< 0.1, **p<0.05, ***p<0.01.

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Chapter 3 Unintended Consequences of Hospital Value-Based Purchasing: Charity Care

ABSTRACT

Background: The Medicare Hospital Value-Based Purchasing program was implemented in 2013 and provides hospitals with bonuses or penalties based on hospital performance on quality metrics compared to national benchmarks. Such payment incentives could lead to unintended consequences such as reductions in charity care as hospitals aim to minimize losses. These reductions could come in two forms 1) reductions among higher income patients, if hospitals protect against losses while maintaining community benefits; or 2) reduction among lower income patients, if hospitals select healthier, less resource-intensive patients. This study aims to evaluate charity care provision following HVBP to identify unintended consequences for low income patients.

Methods: Data come from the Virginia Health Information Hospital Cost reports for 2013 to 2017 linked to CMS Impact Files for hospital-specific HVBP adjustments. Charity care is measured as net charity care costs (in 2017 dollars), cost of charity care provided to patients under 100% FPL, cost of charity care provided to patients between 100-200% FPL and total uncompensated care costs. Using a regression discontinuity model, I estimate the effect of HVBP incentives on hospitals just above and just below the HVBP bonus threshold. A secondary analysis is conducted using a generalized linear model to identify any moderating effect of local uninsured rates.

Results: Hospitals receiving a bonus provided $16 million less in charity care on average (p< 0.01). The largest proportion of the reduction was among patients with incomes below 100% FPL ($12 million, p= 0.04). Charity care among those in the higher income bracket was somewhat more stable. Hospitals receiving penalties tended to reduce their charity care among the higher income bracket first, unless the hospital was in an area with high uninsured rates, in which case all levels of charity care were decreased.

Discussion: Findings suggest that hospitals successful in the HVBP program are learning to cream-skim healthier, wealthier patients in order to achieve bonus payments. However, hospitals performing poorly in the HVBP program are also reducing charity care, but among less needy

individuals first. This discrepancy may be a result of variance in hospital missions, especially in terms of tax status, as for-profit hospitals are more likely to receive a bonus than not-for-profit hospitals. It may also be a result goal gradient cognitive bias that suggests hospitals starting from a lower baseline performance may not believe they can achieve a bonus, even though cream skimming, so instead may respond to incentives simply by avoiding additional costs.

INTRODUCTION

As described in chapter 2, evaluating the Medicare Hospital Value-Based Purchasing Program (HVBP) requires a broader focus than patient clinical outcomes alone. While literature to date has largely concluded that HVBP has little effect on patient outcomes, that does not mean that the program has no effect overall.[7,50,51,53] Chapter 2 shifted the focus of analysis from patient outcomes to internal hospital responses. This chapter broadens that lens to include unintended consequences of the HVBP program, specifically changes in charity care provision.

The HVBP program was not established in a vacuum, but instead was one part of the larger Affordable Care Act (ACA) health reform initiative. As originally written, the ACA required states to increase Medicaid eligibility to 138% of the federal poverty level (FPL).[100] This provision, though seemingly unrelated to HVBP, provided hospitals with budgetary stability by decreasing their uncompensated care costs associated with the uninsured. When paired with Medicaid expansion, the uncertainty inherent in a pay-for-performance program such as HVBP is minimized by ensuring a new funding source through Medicaid. However, in 2012, before states were set to expand, the Supreme Court ruled that the Medicaid expansion be voluntary, allowing states to locally decide the eligibility of their Medicaid programs.[101]

As a result of the Supreme Court ruling, many states chose to forego Medicaid expansion. As of January 2019, 33 states and the District of Columbia had chosen to expand, while 17 states had not.[102] Hospitals in states that did not expand lacked the financial stability associated with increased Medicaid revenue and instead mainly experienced the ACA policies that resulted in greater financial uncertainty, such as HVBP. Indeed, as might be expected, Medicaid expansion has led to lower uncompensated care costs for hospitals, with estimates ranging from -21% to -41% in expansion states.[103,104] However, for hospitals in states like Virginia that did not expand Medicaid until 2019, uncompensated care needs remained high in the years following HVBP implementation and for a broader range of income levels.[103] The continued need for charity care in non-expansion states contributes to the additional financial burden experienced by these hospitals, as demonstrated by the higher levels of hospital closures and lower revenues in non-expansion states, especially in rural areas and areas with high rates of uninsured.[105,106] By uncoupling the revenue support of Medicaid expansion from the uncertainty of the HVBP

program, states that have not expanded Medicaid can more precisely measure the effect of the HVBP program on uncompensated care.

Hospitals could respond to HVBP incentives in one of three ways: 1) hospitals under financial pressure could reduce their provision of charity care, starting with the least needy to minimize losses while protecting the most vulnerable members of the community; 2) hospitals could aim to achieve bonuses and avoid reductions by cherry-picking healthier patients; and 3) hospitals could make no changes to their provision of charity care.

It may be expected that hospitals under financial pressure or in times of uncertainty would reduce their provision of charity care. Charity care is the provision of care for which hospitals expect no reimbursement, so a struggling hospital may very well forego such community services and instead focus on profitable services. In fact, this response has been seen following previous payment reductions or in areas with high financial pressure.[107–109] However, hospitals are unlikely to eliminate this type of care entirely. Hospital are required to stabilize patients regardless of ability to pay as part of the Emergency Medical Treatment and Labor Act (EMTALA) of 1986. Furthermore, non-profit hospitals have community benefit standards they are required to meet. Therefore, since hospitals cannot eliminate these expenses, they may choose to reduce them strategically. A hospital wanting to reduce their financial vulnerability while continuing to serve their community may, for instance, choose to reduce their charity care for patients in higher income brackets while focusing their community service contributions on the most needy.[110] This would be an efficient use of their charity care resources in terms of serving the community need while minimizing their losses.

Hospitals could also respond to HVBP incentives by aiming to achieve bonuses and reduce risk of penalties through selecting healthier, less resource intensive patients. This practice, referred to as cream-skimming or cherry-picking, is a well-documented phenomenon in which hospitals reduce admittance of more complex patients to artificially elevate performance on quality metrics, such as those in the HVBP program.[67,111,112] Like the first potential response, this practice would also result in reduction in charity care. However, it would most likely result in greater reduction in care among the poorest community members rather than those in higher income brackets.[113] Uninsured, very low income patients tend to have more complex medical and social needs, and are therefore, more resource intensive, requiring additional resources for

these needs to avoid poor outcomes.[105,113,114] Therefore, it can be expected that if hospitals respond to incentives through cream-skimming, it will result in greater reductions in care among the lowest income individuals, and may occur in hospitals even if they are not experiencing as high financial stressors.

Lastly, it is feasible that hospitals will not change their charity care provision as a result of HVBP. In fact, the response may differ by region as a result of need. One study found that in in areas where the market had high demand for charity care, hospitals continued to provide these services at high rates, regardless of financial pressure.[115]

The Commonwealth of Virginia is uniquely situated to examine the question of the effect of HVBP on uncompensated care for a variety of reasons. Not only did it not expand Medicaid until 2019, which reduces noise in analyses of HBVP payment incentives, but it also has a mandatory reporting system in which all hospitals in the state must provide annual cost reports that detail charity care expenses at a variety of income levels.[116] This allows differentiation between hospitals that are reducing all charity care, and strategic decisions by hospitals to reduce charity care among those with higher or lower income. While findings may be focused on Virginia hospitals, performance on HVBP measures has been roughly average in Virginia hospitals compared to nationwide performance, and uninsured rates are similar to those in other states.[117,118] Therefore, while findings will be specific to Virginia, conclusions may be informative when considering other non-expansion states.

CONCEPTUAL FRAMEWORK

Following the conceptual framework model referenced in chapter 2, this study uses a modified version of the Damberg et al. RAND Corporation framework for evaluating VBP programs. The RAND framework addresses the various pathways in which a VBP program may produce internal provider responses, intermediate responses such as unintended consequences, and long-term outcomes, which tend to be the focus of other literature on HVBP. The original RAND framework is shown in Figure 1.

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Figure 3-1. RAND Value-Based Purchasing Conceptual Framework
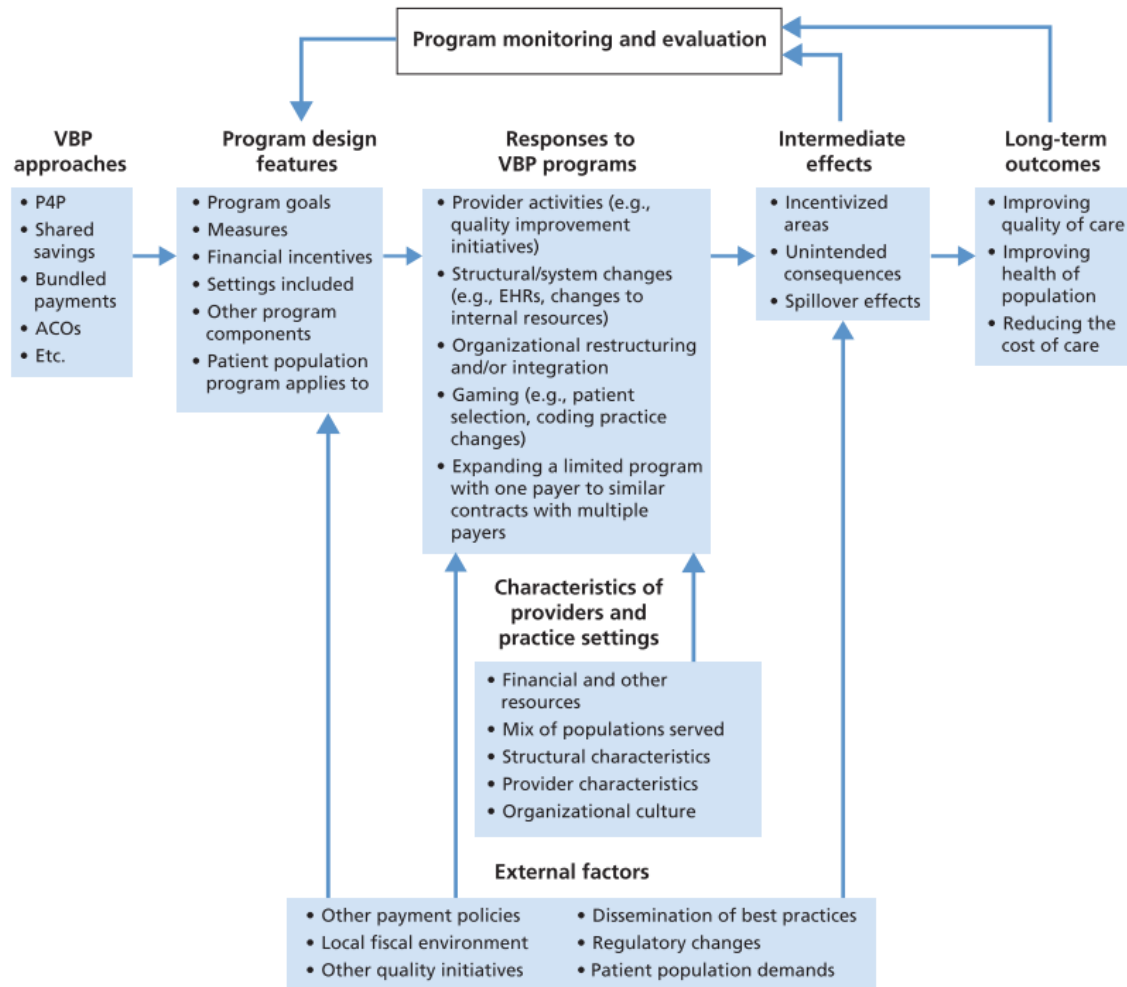
Chapter 2 aims to evaluate the HVBP program by identifying internal responses to the HVBP incentives, specifically changes in staffing. This chapter shifts the focus from responses to the program to the intermediate effects portion of the framework to identify possible unintended consequences of the HVBP program. The modified framework (shown in Figure 2), describes how the program design, HVBP responses and external factors may lead to unintended consequences. In this case, changes in charity care, while an inadvertent effect of the program, may occur as a result of the payment system.

Figure 3-2. Medicare Hospital Value-Based Purchasing Program Conceptual Framework (modified from RAND VBP framework)
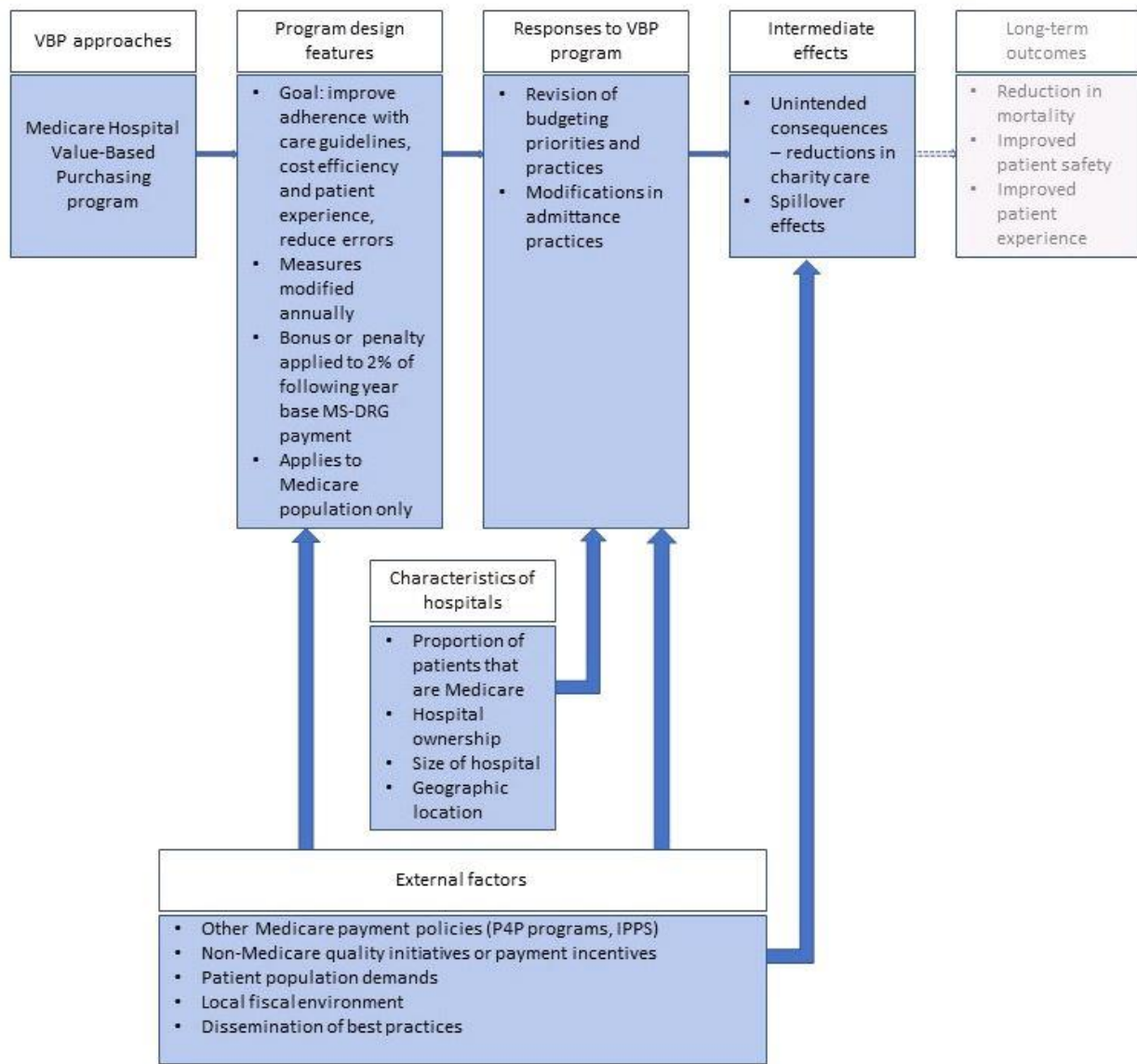
Note: Concepts in grey not included in study

Using an approach adapted from RAND, the unintended consequence of changes in charity care are influenced by internal hospital responses, such as changes in admitting practices, more stringent requirements for patients to qualify for charity care, or being more aggressive in collecting bad debt.[111,115] Evidence from numerous other payment system policies, such as the initiation of the inpatient prospective payment system, have found that hospitals frequently reduce charity care when under financial pressure, or will cherry pick healthier patients when

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resource efficiency or performance on quality measures will lead to higher profit margins.[111,112,119] Unintended consequences, such as reductions in charity care, are also influenced by hospital characteristics and external factors, such as other programs that may provide financial stability or increase uncertainty and uninsured rates in the local hospital area.

Hypotheses

As described above, in terms of charity care provisions, hospitals may respond to HVBP incentives by either reducing their charity care or by not responding at all. Hospitals reducing their charity care may do so for different reason, with somewhat different results. First, hospitals could reduce their charity care out of financial necessity (such as due to receipt of penalties), but aim to minimize harm to their community through strategically eliminating or reducing charity care to the least needy individuals in their community – those with the highest income. Hospitals could also respond to incentives through cream-skimming, or selecting healthier, less resource intensive patients for admissions. While this response would also result in reductions to charity care, it would take a slightly different turn. As opposed to being inextricably linked to financial instability, like reductions based on the first option would be, cream-skimming may occur even among hospitals receiving bonuses (or under less financial pressure), and reductions in charity care would be targeted at lower income individuals likely to be the most complex. However, it is also feasible that hospitals do not reduce their charity care at all. As prior studies have found, local uninsured rate may be a key factor in whether or not hospitals reduce their charity care, since hospitals with high uninsured rates have been found to maintain levels of charity care despite poor financial well-being.[110,120] This study aims to identify hospital response by evaluating these competing hypotheses.

H1: Hospitals will respond to HVBP incentives by reducing charity care provision.

  H1a: Hospitals will minimize harm to community members by selectively reducing charity care among patients with highest income levels.

  H1b: Hospitals will cream-skim to achieve higher bonus payments, reducing charity care among the patients with the lowest income levels.

H2: Hospitals will not change their provision of charity care.

H2a: Local uninsured rates will moderate the effect of HVBP penalties on charity care provision.

METHODS

Data

Data come from the Virginia Health Information (VHI) Hospital Detail Reports, years 2013-2017. HVBP incentives were first implemented in 2013. Virginia mandates that cost reports be submitted annually by all private hospitals in the state. This data is then validated with intermittent auditing. The VHI Hospital Detail Reports are especially unique data in that hospitals distinguish between charity care provided to patients below 100% FPL, between 100% and 200% FPL and above 200% FPL. This level of precision is not available through national databases including the Hospital Cost Report Information System (HCRIS). VHI data is linked to CMS Impact Files for archived hospital-specific HVBP adjustments. Uninsurance rates are estimated using 5-year averages as provided by the American Community Survey. Total sample size is 354 observations of 74 unique hospitals. All HVBP-eligible hospitals are included.

Charity care

Charity care is defined as care provided for which no payment is expected or received. Hospitals report the amount of charity care provided based on the patient's gross household income as a percentage of the federal poverty level (FPL). Charity care provided to patients under 100% FPL is estimated separately, as is charity care for patients with incomes between 100% and 200% FPL. Net charity care is also estimated as the sum of all charity care provided to patients of all income levels. Finally, since hospitals may include charity care as bad debt, or care provided for which payment was expected but not received, a fourth variable is constructed to include all uncompensated care, defined as net charity care plus bad debt. VHI reports charity care reductions as charges, which are converted to expenses using the American Hospital Association method for calculating cost-to-charge ratios.[121] All expenses are adjusted to 2017 dollars using the Consumer Price Index (CPI) medical component.[122]

Uninsurance rate

County-level American Community Survey (ACS) 5-year estimates for years 2012-2017 are linked to the VHI data for the same years. In Virginia, cities have their own FIPS codes, and

are considered adjacent to, but distinct from the counties within which they reside. As opposed to including FIPS or county codes, VHI data indicates hospital location by the city or township listed on the hospital address. While many larger cities are included in ACS as counties, some smaller townships in the VHI data are not included in ACS data. Where there are discrepancies or a town or city is not present in ACS, the United States Census Bureau QuickFacts Database is used to determine the surrounding county of the hospital's township. The uninsured rate for civilian non-institutionalized residents of all ages and incomes is included in the sample. While children's hospitals are excluded from HVBP eligibility, Virginia only has 2 pediatric-specific hospitals. Therefore, in the majority of the state, children frequent general acute hospitals and would contribute to uncompensated care if uninsured or underinsured. Tertiles were calculated to determine "high" levels of uninsurance in a local area. Areas with an uninsured rate of at least 14.4% were in the top third of the Commonwealth, and therefore considered areas of high uninsurance.

HVBP adjustment

The HVBP program is budget neutral, meaning that for some hospitals to receive bonuses, others must receive penalties. The Center for Medicare & Medicaid Services (CMS) reports annual HVBP adjustments as a percentage change to the hospital's annual inpatient MS-DRG market basket update. A hospital receiving no change to their update based on performance would receive an adjustment of 1.000, or 100% of normal payment. Hospital earning a bonus receive an adjustment greater than 1.000, whereas a hospital receiving a cut would see an adjustment less than 1.000. For the regression discontinuity model, this adjustment is re-centered around zero as a null adjustment. Binary indicators for having received a penalty or otherwise and a bonus or otherwise are also created. It should be noted that hospitals received notice of their HVBP adjust in the year prior to implementation. In other words, in 2012, hospitals were alerted of their adjustment that would be implemented in 2013. Therefore, hospitals have time to react to notices of upcoming adjustments.

Covariates

Models estimating the moderating effect of high uninsured rates on charity care are adjusted for a number of hospital characteristics that may influence a hospital's response to HVBP incentives. For instance, financial stability as measured by the prior year's total margin is

included as well as the proportion of revenue attributable to Medicare. Hospital volume is measured through the number of inpatient days per year. While individual hospital size may contribute to quantity of resources, system affiliation, even for smaller hospitals may provide financial stability and reduce negative effects of HVBP on charity care. For this reason, system affiliation is included as a control variable. Finally, hospital ownership may have a significant impact on charity care. Not-for-profit hospitals may be motivated by different incentives than for-profit hospitals. For instance, not-for-profit hospitals have charity care requirements to maintain their tax-exempt status and meet certificate of public need criteria if wanting to expand services.[123,124] Charity care may also be a part of their organization's mission. For-profit hospitals may not inherently value charity care the same way as not-for-profit hospitals, and therefore, could be more inclined to reduce it in times of financial instability, to avoid penalties, or to achieve bonuses.

Regional variation is another key factor that may influence hospital resources and culture. Virginia is a large state geographically, with mountains, ports, urban areas and rural areas. Five major regions as defined by the Virginia Department of Health are included to account for geographic variation in setting. To further adjust for the barriers associated with rural settings, rurality, as defined by CMS for IPPS payment purposes is also included.

Statistical analysis

The Medicare Hospital Value-Based Purchasing program exogenously assesses adjustments based on hospital performance compared to national benchmarks, with a sharp cutoff between hospitals who receive a penalty compared to those receiving a bonus. This design feature enables use of the regression discontinuity (RD) model. Because the HVBP program is budget-neutral, hospitals behaving in the exact same way and achieving exact same scores on performance measures over several years may be assigned differing adjustments based on the performance of other hospitals any given year. While hospitals have some influence on generally where they fall on their performance measures, they cannot determine their precise assignment around a null adjustment. RD models reduce endogeneity associated with unobserved factors by narrowly focusing on the difference between hospitals on either side of the threshold, which are assumed to differ only by their arbitrary threshold (appendix 3-1 provides hospital characteristics within the bandwidth surrounding the cutoff).

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Using a the Lee and Lemieux (2010)[125] and the Jacob et al (2012)[126] approaches to RD model specification, my model is specified as follows:

$$\Upsilon_i = \alpha + \beta_1(\chi_i - x_0) + \beta_2(\phi_i) + \beta_3(\chi_i - x_0){*}\phi_i + u_i$$

Where Υ_i is the amount of charity care provided in 2017 dollars, χ_i is the VBP score received by the hospital as demonstrated by the percent adjustment, and x_0 is the threshold at which the adjustment changes from a penalty to a bonus (1.0). "Treatment" defined has having received a bonus, is indicated by ϕ_i. The error term is represented by u_i.

RD models estimate the local average treatment effect (LATE), comparing hospitals just above to just below the cutoff. If there is a discontinuous effect, meaning that hospitals just above the null threshold behave differently than hospitals just below the threshold, then it can be concluded that the HVBP adjustment is influencing the behavior of otherwise similar hospitals in terms of charity care provision. RD models may be sensitive to functional form, appearing to have discontinuous jumps when in fact the function is mis-specified. To address these concerns, polynomials up through the 4th order were tested to ensure appropriate form. Fourth order was selected as the best fit model. Bandwidth for the model is selected using mean squared error (MSE)-optimal choice using the CCT method.[127] Models are estimated using a local linear regression approach with rectangular kernel weights. Sensitivity analyses around the bandwidth were conducted as were analyses using 2-year cross-sections to ensure appropriate temporal assumptions. In this analysis, VBP adjustment in year 1 was measured against its effect on charity care in year 2, to ensure hospitals had adequate time to make decisions. All sensitivity analyses are described in the *Sensitivity Analyses* section. Finally, in addition to net charity care, models were estimated to identify the effect of HVBP on charity care for patients under 100% FPL, between 100-200% FPL and all uncompensated care, which includes bad debt.

A second model is estimated to identify the extent to which hospital charity care differs by local uninsured rate. In order to include the moderating factor, a generalized linear model (GLM) is estimated, using log-transformed charity care expenses to account for skewed costs. Six observations associated with 4 distinct hospitals were excluded due to negative charity care expenses. High uninsured rate is interacted with a dummy indicating a hospital having received an HVBP bonus. Four models are estimated to measure the effect on charity care below 100% FPL, between 100-200% FPL, net charity care, and uncompensated care costs. All models

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include year fixed effects with standard errors clustered by facility to ensure errors are corrected for collinearity of multiple observations of the same hospitals. Models are adjusted for region, rurality, prior year total margin, system affiliation, total number of patient days, ownership, CMS provider type, and Medicare Hospital Readmissions and Reduction Program (HRRP) payment adjustment. The secondary model specification is as follows:

$$\text{Ln[net charity care]}_i = \alpha + \beta_1(\text{VBP penalty})_i + \beta_2(\text{uninsured rate})_i + \beta_3(\text{VBP penalty} * \text{uninsured rate})_{it-1} + \beta_4(\text{rurality})_{it} + \beta_5(\text{region})_i + \beta_6(\text{non-profit})_i + \beta_7(\text{system})_i + \beta_8(\text{patient days})_i + \beta_9(\text{prior year total margin})_i + \beta_{10}(\text{case mix index})_i + \beta_{11}(\text{HRRP adjustment})_i + \beta_{12}(\text{high Medicare reliance})_i + \beta_{13}(\text{CMS provider type})_i + \eta(\text{year}) + u_{it}$$

Similar to the primary model, a sensitivity model using a cross-section of 2-year panels was estimated. This was again intended to ensure adequate time for hospitals to make policy decisions. Additional sensitivity analyses included exclusion of safety net facilities. Sensitivity analyses are described below in the *Sensitivity Analyses* section

Sensitivity Analyses

A variety of analyses were conducted to ensure the RD model was appropriately applied. One way to check appropriate application of the RD model is to vary the bandwidth measured to identify discontinuity. The main bandwidth of 0.001 was selected using the CCT method for MSE-optimal choice. Cross-validation was also used to determine best bandwidth for the discontinuity measurement. In addition to bandwidth, the assumption of the sharp threshold should be assessed. The main model estimates a sharp RD, meaning that the threshold of a null adjustment is absolute, and all hospitals above the threshold receive a bonus and all hospitals below the threshold receive a penalty. While this is factual, the size of the penalty or bonus immediately surrounding the threshold may be very slight and differ based on the proportion of the hospital's pay attributable to Medicare. A fuzzy RD model allows for a less precise cutoff. Therefore, with potentially slight "treatment effects, a fuzzy RD model was estimated as an additional sensitivity analysis. With a fuzzy RD, the estimates from the sharp RD model, the expected charity care, is used as an instrument. Lastly, as described above, while the primary model uses cross-sectional data, an additional analysis was conducted using a cross-section of 2-year panels. This was to ensure that hospitals had time to make decisions on admitting patients

requiring charity care. Because estimates were similar in both models, the simpler model, the cross-sectional model, was selected as the main model.

Unlike RD models which compare hospitals within bandwidths to each other, GLM models or OLS models are potentially more sensitive to outliers within the dataset. Therefore, in order to test the robustness of results for the secondary model, hospitals with unique charity care expectations are excluded. In Virginia, two hospital systems – the University of Virginia (UVA) and Virginia Commonwealth University (VCU) – provide roughly 20% of all uncompensated care in the state. These hospitals are the main safety net providers and receive disproportionate share hospital (DSH) payments to compensate them for the high volume of charity care they provide. Despite desire to reduce charity care, these hospitals may be constrained in their ability to responds to incentives. In order to ensure that UVA and VCU are not the only drivers of findings, these two hospitals are excluded in a sensitivity analysis.

For all models, charity care and uncompensated care expenses were estimated both as costs and as percentages of total operating expenses. This analysis is intended to ensure size of hospital and therefore costs is not driving findings.

As described for the main model, a cross-section of 2-year panels was used to estimate effects of HVBP incentives in an additional sensitivity analysis. This was to ensure that hospitals had adequate time to respond to impending incentives.

RESULTS

In total, HVBP eligible hospitals provided $3.84 billion in charity care during the study period, just over half of which ($1.97 billion) was provided to community members with incomes under 100% FPL. When including bad debt to account for all uncompensated care costs, hospitals provided more than $20 billion in care over the study period. On average, this accounted for 6.3% of operating expenses.

All hospitals in Virginia provide at least some level of charity care every year, ranging from $111,990 in a rural, for-profit, sole community hospital (2017) to $110 million at the state's largest safety net hospital (2014). Over the study period, more than half of all charity care was provided to patients under 100% FPL (51.3%). On average, the uninsured rate was similar in areas surrounding hospitals receiving a penalty (12.7%) and areas surrounding hospitals

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receiving bonuses (12.4%). Hospitals receiving penalties (or below the HVBP null threshold) have significantly greater charity care expenses compared to hospitals receiving the bonus incentive (see table 1). However, while charity care expenses for patients with incomes under 100% FPL is dramatically lower among hospitals receiving a bonus than a penalty ($1.6 million vs $11.4 million), charity care for patients with a somewhat higher income level was roughly similar between hospitals receiving bonuses and penalties. In other words, hospitals receiving a bonus provide less charity care for very low income patients compared to other hospitals, but similar levels of charity care for patients of somewhat higher income levels.

Findings from the regression discontinuity model suggest that hospitals receiving bonuses reduce their charity care, especially among the very poor (less than 100% FPL). Figure 1 illustrates the discontinuous nature in which hospitals provide charity care. The x-axis shows the HVBP adjustment, with the bonus or penalty applied at the 0% null adjustment threshold. The y-axis is the amount of charity care provided. As demonstrated in Figure 1, hospitals above the cutoff (or receiving a bonus) are much more aggregated or similar in their response to one another. Hospitals to the left of the cutoff (those receiving penalties) are much less homogenous in their response to HVBP incentives. There is a considerable discontinuous jump in charity care when crossing the 0% threshold, as seen in Figure 1 panels A and B, and D, representing total charity care, charity care for patients with incomes under 100% FPL, and total uncompensated care. In other words, hospitals reduce their charity care, especially their charity care among the very poor. However, charity care for people of higher incomes (panel C) is largely consistent regardless of relation to the threshold. A small discontinuous decline may be present, but the majority of the overall decrease is among the charity care for the neediest individuals. In addition, it is evident that hospitals receiving penalties respond in much less uniform fashion than those receiving bonuses.
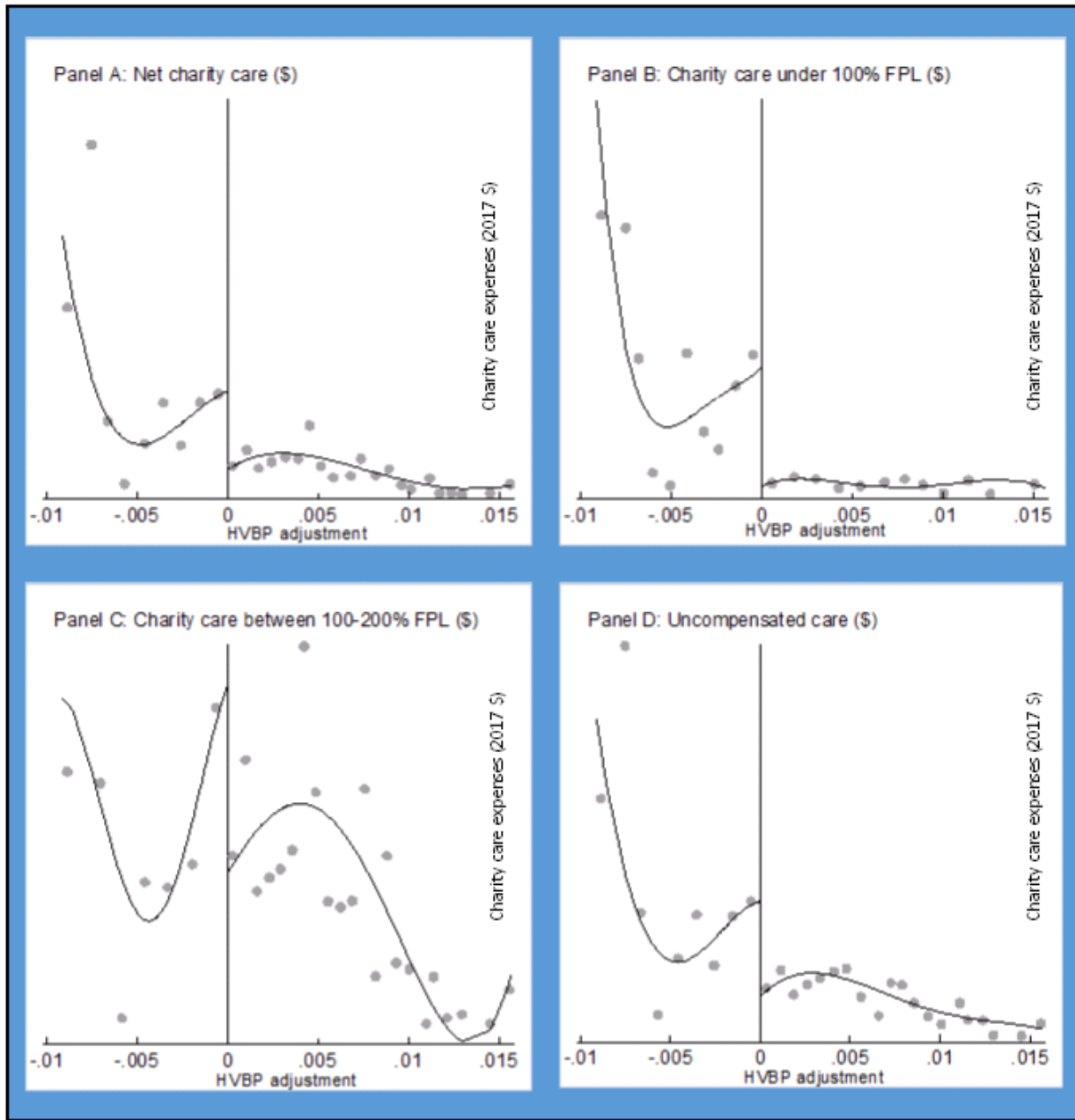
Hospitals receiving bonuses provided on average $16 million less in net charity care compared to hospitals just below the HVBP adjustment threshold (p< 0.01). The majority of this decline was among charity care provided to patients with incomes below 100% FPL ($12 million, p=0.04). An additional $5.7 million in reductions to charity care were for patients between 100%-200% FPL (p=0.03) (see table 3-2). Findings were robust to changes in bandwidth and exclusion of the 2 safety net hospitals. The only exception to this is the model

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estimating the provision of charity care for patients under 100% FPL. In this model, excluding the two main safety providers resulted in a change of significance from a p-value of 0.04 in the main model to 0.06 in the sensitivity analysis, although directionality remained constant (see appendix 3-2). It is probable that effects remain, however, removing the 2 hospitals (a total of 10 observations) may have reduced power of the analysis to underestimate actual effects. Results, however, were not all robust to a change in measurement unit. When assessing charity care expenses as a percent of percentage of total operating expenses, significant findings for two types of charity care remain. Overall charity care is reduced by about 1% with borderline statistical significance (p=0.07). Additionally, the only evident discontinuous jump that remains graphically is the provision of charity care among patients with incomes under 100% FPL. In this model, I find that hospitals just above the threshold decrease charity care for these patients, but as hospitals receive larger and larger bonuses, they tend to increase their charity care again to levels equivalent to those below the threshold (see appendix 3-3).

The secondary analysis incorporates the effect of local uninsured rate into the analysis. As opposed to the RD model that compares hospitals just above the cutoff to those just below the cutoff capitalizing on exogenous assignment, the GLM regression controls for specific defined characteristics, including local uninsured rate. With this analysis, consistent with findings from the RD analysis, the direction (although not statistically significant) of the relationship between bonuses and charity care is negative in all cases except charity care for patients with higher incomes (100%-200% FPL) (see table 3-3). Hospitals receiving penalties, however, are associated with reductions in charity care exactly among this population, the higher income bracket (-0.37, $p < 0.01$) along with total uncompensated care (-0.06, p=0.05) (see table 3-4). When accounting for any moderating effect of local uninsured rate, hospitals receiving bonuses have little response (see table 3-5). However, hospitals in areas with high uninsured rates have significantly lower charity care provision and uncompensated care in all categories when receiving a penalty (see table 3-6). Results are robust to use of panel data, however, statistical significance decreases as may be expected due to reductions in power in panel analyses when compared to cross-sectional analyses. Models excluding the two major safety net providers in the state continue to demonstrate that hospitals located in areas with high uninsurance rates reduce net charity care when a bonus is received

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DISCUSSION

I find evidence that hospitals both respond to HVBP incentives in a manner consistent with cream-skimming behaviors and with behaviors aimed at minimizing financial pressure while maintaining community benefits. While these behaviors may seem at odds with one another, hospitals in different financial positions may make different budgetary decisions. Both hypotheses are supported.

Hospitals receiving bonuses tend to demonstrate a learned behavior of cream-skimming, as evident by their greater reductions in charity care targeted at patients most likely to have the highest complexity levels: the lowest income patients. Charity care among the less complex patients, those with higher income, stays relatively stable regardless of the HVBP incentive received. This finding is consistent with hospitals learning to perfect cream-skimming behaviors in order to achieve HVBP bonuses in future years. At the same time, there was some evidence, although not causal evidence, that hospitals receiving penalties in areas with high uninsured rates are seen to have reductions in charity care among members with the highest incomes first. These hospitals, by definition under financial pressure due to receipt of penalties and local uninsured rates, may be responding in a manner consistent with responsibility to maintain community benefit. One possible explanation for the differences between these behaviors may be related to the ownership of the hospitals that tend to receive penalties compared to those that receive bonuses.

Both in prior literature, and in the study sample, for-profit hospitals have been found to be more likely to receive bonuses for HVBP than not-for profit hospitals. The inherent differences between these two types of institutions may explain why both hypotheses, cream-skimming and community responsibility, may both occur at the same time.[110] HVBP incentives may exaggerate the pre-disposition of hospitals to behave in one manner or another. For profit hospitals tend to be more prone to cream-skimming behaviors, while not-for profits, and especially safety net hospitals may continue to provide charity care at the expense of potentially continuing to perform poorly on HVBP measures.[110,120] In Virginia, not-for-profit hospitals have a base requirement for charity care provision in order to comply with certificate of public need regulations.[123,124] For-profit hospitals do not have those constraints.[123] However, even in those cases, hospitals could choose to reduce in the higher income brackets first.

Cream-skimming is a well-documented phenomenon in which hospitals may attempt to avoid admitting potentially costly patients in systems in which payment is not directly tied to cost of care.[111,112,128] This enables hospitals to maximize profit by reducing risk and costs. Under the HVBP program, the potential cost of the low-income patient is two-fold. First, there are guaranteed costs associated with providing charity care, care for which, by definition, hospitals do not expect to recoup costs. Second, low-income patients tend to have more complex health needs, which may prove detrimental for hospital HVBP scores.[129] In the HVBP program, hospitals receive scores for patient outcomes, which may be harder to achieve if patients are on the more complex side of the risk-adjusted strata. Additionally, in recent years, hospitals receive scores for efficient use of resources. If a hospital's patient load tends to be more complex, it likely will take additional resources to achieve similar patient outcomes. For these reasons, more complex patients pose a significant threat to hospital financial well-being under the HBVP program. Patients in the lowest income brackets are therefore likely to be riskiest.[111] At the same time, many hospitals, especially not-for-profit hospitals may see charity care as a central part of their mission.[110] For these hospitals, we see charity care reduced during times of financial pressure, with reductions targeted at the least needy in the community. It should be noted, however, that the evidence supporting findings of cream-skimming are more suggestive of a causal relationship due to the RD model, meaning that evidence is stronger that hospitals receiving bonuses engage in cream-skimming activities. Evidence that hospitals receiving penalties aim to maintain community benefits is suggestive of correlation and causal inferences should not be made.

I also find evidence through the RD models that hospitals respond in a less consistent manner when receiving a penalty rather than a bonus. This may be an indication that the cognitive bias of goal gradient is present. Research on provider incentives suggests that providers who are further from a target quality threshold may not believe that they can achieve a desired effects, and so are less likely to respond to incentives than providers beginning from higher performance scores.[1] Therefore, hospitals receiving bonuses may be more likely to respond directly to incentives, since they believe they can achieve them, while hospitals receiving penalties may not have confidence that changing behavior will result in avoiding a penalty or achieving a bonus. This is consistent with the finding that these hospitals respond instead to community responsibility rather than the HVBP incentive directly.

Evidence supports the hypotheses that the HVBP policy has resulted in the unintended consequence of reduction in charity care. Policy-makers aiming to implement similar programs or adjust the current HVBP program may consider incorporating social determinants of health into risk-adjustment policies. While the national debate about how to execute such a risk-adjustment has been ongoing, findings such as those in this study support the need find a viable method of doing so. By including social determinants of health into a risk-adjustment formula, hospitals providing care to low-income, resource intensive patients will not be penalized twice for their care (once through financial losses in the form of charity care, and a second through penalties associated with HVBP payment adjustments). Inclusion of these factor would decrease the incentives for hospitals to avoid caring for the neediest in the community, and promote the intended goals of programs such as HVBP: to improve the quality and efficiency of care for the population.

Limitations

Data in this study are limited to 2017 and earlier. With the expansion of Medicaid in Virginia, it may be expected that hospitals will modify their assessment of which patients pose the greatest risk to their financial well-being. Patients under 100% FPL will largely be eligible for Medicaid beginning in 2019. Therefore, these patients, while previously costly and medically complex, may become less costly and less complex with new health coverage for paying inpatient bills, but also covering outpatient services to improve management of chronic conditions. Therefore, in future years, hospitals may find that the 100%-200% FPL income bracket becomes higher risk than the very low-income, as more of these patients may remain uninsured or less able to access health resources. Future research should assess the extent to which hospitals shift their patient-mix in terms of charity care.

Another limitation of the study is potential complications with temporality. Hospitals receive notice of their HVBP adjustment amount the year prior to implementation. The Virginia Hospitals and Healthcare Association has reported (internally) that hospitals were well prepared and fully informed of their HVBP adjustment amount well-before implementation and with sufficient time for hospitals to make budgetary and internal policy adjustments. However, to the extent to which hospitals delayed response to payment incentives, additional years of implementation may be necessary to identify full causal effect. Sensitivity analyses using panel

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data to follow hospitals over the study period helps ensure robustness of results to issues of temporality. These findings suggest that cross-sectional data is likely sufficient for study purposes.

Finally, sample size is limited due to the focus on Virginia hospitals and five year time period, potentially reducing power necessary to fully capture present effects. The limited power may explain why some robustness checks showed mixed results. Specifically, when measuring charity care as a percent of total operating costs, much of the statistical significance disappeared, although directionality remained the same. Percentages inherently reduce variation compared to costs. This loss of variation in a limited sample size may lead to underestimation of effect. Future studies should aim to include additional non-expansion states if similarly detailed charity care information is available.

Conclusion

Findings from this study are consistent with prior literature that demonstrate that hospitals respond to quality or efficiency-based payment incentives through selecting healthier, wealthier patients, also known as cream-skimming or cherry picking.[111,112,128] However, these is also some evidence that hospitals under financial pressure may minimize financial losses through reducing charity care, but do so in a manner consistent with community benefit goals.[130] Through both potential responses, evidence from this study support the hypotheses that HVBP has resulted in an unintended consequence of reductions in their charity care. For some, the findings suggest that hospitals respond to the bonus by learning to cherry-pick healthier, wealthier patients while still maintaining charity care obligations through servicing patients in higher income brackets. For other hospitals, findings demonstrate the behavior of reducing charity care to the least needy when finances become limited due to penalties. Even hospitals in areas with high uninsured rates respond to the financial pressure associated with penalties, in fact they respond more consistently than hospitals in areas of low uninsured rates. Hospital mission may play a role in the manner in which a hospital responds to HVBP incentives, especially in relation to the mission of for-profit compared to not-for-profit and safety net hospitals. Findings may not be generalizable, however, to places that have expanded Medicaid, since the calculus of the risk-score of certain populations likely shifts with expansion of Medicaid eligibility. Further analysis should be conducted to identify other potential unintended consequences of the HVBP

initiative and the effect on low-income patients specifically. Policy makers aiming to decrease these unintended consequences should consider including social determinants of health in risk-adjustment methodologies.

Table 3-1 Hospital characteristics by relation to HVBP threshold

	Hospitals below adjustment threshold (penalty)	Hospitals above adjustment threshold (bonus)
	N = 145	N = 194
	%	%
Uninsured rate (mean)	12.7	12.5
Rural	31.1	28.9
Region		
Central	20.0	17.0
Eastern	17.2	30.9
Northern	12.4	12.9
Northwest	22.8	11.3
Southwest	27.6	27.8
Not-for-profit	80.7	68.0
Health system	78.6	83.0
Provider type		
IPPS	74.5	71.1
Rural referral center (RRC)	5.5	1.0
Medicare dependent hospital	4.1	5.2
Sole community hospital (SCH)	9.7	18.6
SCH/RRC	6.2	4.1
High Medicare reliance	31.7	34.0
Total patient days (mean)	62,039	43,840
Prior year operating margins	5.5	6.2
HRRP penalty	86.9	89.7
Case mix index (mean)	1.5	1.5
Net charity care	$16,500,000	$7,365,372
Charity care for patients under 100% FPL	$11,400,000	$1,626,110
Charity care for patients 100% - 200% FPL	$5,777,191	$5,248,589
All uncompensated care	$23,600,000	$11,900,000
Uncompensated care as percent of total operating expenses	6.8	5.9
Charity care for patients under 100% FPL as percent of total operating expenses	2.3	1.0

Table 3-2 Regression discontinuity estimates

	Coef ($)	SE	P
Net charity care	-16,000,000	5,400,000	< 0.01
Charity care for patients < 100% FPL	-12,000,000	6,000,000	0.04
Charity care for patients between 100% - 200% FPL	-5,700,000	2,600,000	0.03
Uncompensated care	-21,000,000	6,600,000	< 0.01

	Net Charity Care (SE)	Charity Care, under 100% FPL (SE)	Charity Care, 100%-200% FPL (SE)	Uncompensated Care (SE)
Bonus	-0.010	-0.100	0.216	-0.012
	(0.096)	(0.226)	(0.196)	(0.057)
High uninsured rate	0.057	0.067	-0.046	0.063
	(0.098)	(0.092)	(0.094)	(0.077)
High Medicare reliance	-0.146*	-0.227***	-0.110	-0.103
	(0.081)	(0.082)	(0.175)	(0.082)
Rural	-0.389***	-0.707	-0.570	-0.408***
	(0.122)	(0.448)	(0.472)	(0.091)
Region (ref= Central)				
Eastern	-0.043	-3.863***	0.672***	0.118
	(0.149)	(1.224)	(0.216)	(0.117)
Northern	-0.293*	-0.650*	-0.248	-0.248*
	(0.154)	(0.332)	(0.220)	(0.128)
Northwest	0.368***	1.074***	-0.057	0.349***
	(0.112)	(0.306)	(0.196)	(0.090)
Southwest	-0.074	0.453***	-3.968***	0.095
	(0.102)	(0.097)	(1.131)	(0.071)
CMS provider type (ref=IPPS)				
Rural referral center	0.117	1.485*	-1.798	0.037
	(0.122)	(0.778)	(1.747)	(0.123)
Medicare-dependent hospital	-0.970***	0.280	-4.335***	-0.880***
	(0.258)	(0.477)	(1.305)	(0.083)
Sole community hospital	0.071	0.905***	-0.694	-0.024
	(0.161)	(0.250)	(0.588)	(0.112)
Sole community hospital and rural referral center	0.301*	0.559	0.736	0.269**
	(0.165)	(0.603)	(0.517)	(0.115)
Not-for-profit	1.227***	1.254***	1.204***	0.982***
	(0.140)	(0.260)	(0.290)	(0.132)
Health system affiliation	-0.001	-0.427***	0.641**	-0.051
	(0.103)	(0.070)	(0.266)	(0.073)
Total number of patient days	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Prior year total margin	1.036*	5.062***	-0.598	0.925**
	(0.611)	(1.501)	(0.872)	(0.456)
Case mix index	1.554***	1.855***	0.945*	0.985***
	(0.372)	(0.590)	(0.521)	(0.269)
Readmission penalty	0.210*	0.352	0.058	0.225***

		(0.116)	(0.602)	(0.086)	(0.067)
Year (ref = 2013)					
	2014	-0.057	-0.334***	0.112**	-0.039
		(0.052)	(0.077)	(0.056)	(0.026)
	2015	-0.167**	-0.493***	0.033	-0.138***
		(0.069)	(0.088)	(0.078)	(0.039)
	2016	-0.267***	-0.297***	-0.402*	-0.206***
		(0.080)	(0.094)	(0.234)	(0.060)
	2017	-0.485***	-0.477***	-0.670**	-0.343***
		(0.109)	(0.165)	(0.283)	(0.076)

Note: SE = standard errors, *p<0.01, **p<0.05, ***p>0.01

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	Net Charity Care (SE)	Charity Care, under 100% FPL (SE)	Charity Care, 100%-200% FPL (SE)	Uncompensated Care (SE)
Penalty	-0.052	-0.066	-0.367***	-0.064**
	(0.048)	(0.086)	(0.097)	(0.033)
High uninsured rate	0.065	0.067	-0.078	0.073
	(0.094)	(0.087)	(0.093)	(0.076)
High Medicare reliance	-0.122	-0.182**	-0.027	-0.078
	(0.078)	(0.079)	(0.132)	(0.080)
Rural	-0.363***	-0.533	-0.517	-0.380***
	(0.121)	(0.458)	(0.385)	(0.090)
Region (ref= Central)				
Eastern	-0.061	-4.023***	0.669***	0.097
	(0.149)	(1.247)	(0.180)	(0.114)
Northern	-0.275*	-0.694**	-0.096	-0.228*
	(0.149)	(0.326)	(0.182)	(0.124)
Northwest	0.383***	1.166***	0.080	0.369***
	(0.113)	(0.339)	(0.209)	(0.094)
Southwest	-0.079	0.471***	-3.909***	0.091
	(0.099)	(0.096)	(1.098)	(0.069)
CMS provider type (ref=IPPS)				
Rural referral center	0.163	1.732*	-1.746	0.087
	(0.125)	(0.975)	(1.724)	(0.125)
Medicare-dependent hospital	-0.937***	0.527	-4.152***	-0.880***
	(0.240)	(0.627)	(1.555)	(0.092)
Sole community hospital	0.040	0.852***	-0.692	-0.061
	(0.154)	(0.287)	(0.471)	(0.105)
Sole community hospital and rural referral center	0.296*	0.460	0.754*	0.264**
	(0.160)	(0.579)	(0.416)	(0.109)
Not-for-profit	1.236***	1.267***	1.148***	0.993***
	(0.115)	(0.229)	(0.234)	(0.122)
Health system affiliation	0.003	-0.450***	0.572**	-0.043
	(0.100)	(0.075)	(0.227)	(0.073)
Total number of patient days	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Prior year total margin	0.880	4.659***	-0.613	0.773*
	(0.618)	(1.803)	(0.749)	(0.427)
Case mix index	1.573***	1.791***	1.075**	1.007***
	(0.360)	(0.566)	(0.447)	(0.258)
Readmission penalty	0.218**	0.243	0.116	0.234***

	(0.110)	(0.617)	(0.091)	(0.062)
Year (Ref = 2013)				
2014	-0.045	-0.323***	0.189*	-0.025
	(0.057)	(0.082)	(0.109)	(0.029)
2015	-0.135*	-0.441***	0.134	-0.105***
	(0.074)	(0.108)	(0.124)	(0.037)
2016	-0.255***	-0.279***	-0.252*	-0.191***
	(0.072)	(0.089)	(0.144)	(0.050)
2017	-0.459***	-0.435***	-0.475***	-0.314***
	(0.104)	(0.146)	(0.163)	(0.070)

Note: SE = standard errors, *p<0.01, **p<0.05, ***p>0.01

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Table 3-5 GLM regression estimates, effect of bonuses on charity care provision - moderated by local uninsured rate

	(1)	(2)	(3)	(4)
	Net Charity Care (SE)	Charity Care, under 100% FPL (SE)	Charity Care, 100%-200% FPL (SE)	Uncompensated Care (SE)
Bonus	-0.056	-0.050	0.193	-0.049
	(0.126)	(0.222)	(0.195)	(0.078)
High uninsured rate	0.034	0.072	-0.066	0.043
	(0.101)	(0.093)	(0.133)	(0.079)
Bonus*High uninsured	0.101	-0.336	0.046	0.086
	(0.103)	(0.290)	(0.155)	(0.088)
High Medicare reliance	-0.145*	-0.224***	-0.113	-0.103
	(0.079)	(0.083)	(0.176)	(0.079)
Rural	-0.413***	-0.685	-0.583	-0.428***
	(0.119)	(0.447)	(0.472)	(0.090)
Region (ref= Central)				
Eastern	-0.040	-3.788***	0.672***	0.119
	(0.145)	(1.187)	(0.218)	(0.114)
Northern	-0.307**	-0.629*	-0.263	-0.259**
	(0.155)	(0.328)	(0.231)	(0.130)
Northwest	0.353***	1.059***	-0.073	0.337***
	(0.114)	(0.296)	(0.219)	(0.092)
Southwest	-0.074	0.456***	-3.977***	0.098
	(0.102)	(0.100)	(1.131)	(0.071)
CMS provider type (ref=IPPS)				
Rural referral center	0.113	1.435*	-1.804	0.033
	(0.124)	(0.755)	(1.743)	(0.125)
Medicare-dependent hospital	-0.972***	0.273	-4.330***	-0.877***
	(0.262)	(0.459)	(1.298)	(0.082)
Sole community hospital	0.085	0.863***	-0.682	-0.012
	(0.159)	(0.258)	(0.592)	(0.109)
Sole community hospital and rural referral center	0.328*	0.569	0.758	0.291**
	(0.170)	(0.578)	(0.525)	(0.116)
Not-for-profit	1.245***	1.145***	1.208***	0.993***
	(0.136)	(0.266)	(0.291)	(0.133)
Health system affiliation	-0.008	-0.425***	0.637**	-0.059
	(0.101)	(0.071)	(0.273)	(0.070)
Total number of patient days	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Prior year total margin	1.060*	5.071***	-0.622	0.932**

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	(0.624)	(1.494)	(0.895)	(0.464)
Case mix index	1.549***	1.900***	0.956*	0.987***
	(0.368)	(0.590)	(0.546)	(0.269)
Readmission penalty	0.224**	0.398	0.063	0.234***
	(0.112)	(0.609)	(0.093)	(0.064)
Year (Ref = 2013)				
2014	-0.058	-0.333***	0.114**	-0.040
	(0.053)	(0.076)	(0.057)	(0.027)
2015	-0.165**	-0.490***	0.033	-0.137***
	(0.070)	(0.087)	(0.077)	(0.040)
2016	-0.267***	-0.297***	-0.406*	-0.206***
	(0.079)	(0.093)	(0.241)	(0.059)
2017	-0.478***	-0.478***	-0.667**	-0.337***
	(0.109)	(0.166)	(0.280)	(0.076)

Note: SE = standard errors, *p<0.01, **p<0.05, ***p>0.01

	Net Charity Care (SE)	Charity Care, under 100% FPL (SE)	Charity Care, 100%-200% FPL (SE)	Uncompensated Care (SE)
Penalty	0.120*	0.203*	-0.188	0.063
	(0.062)	(0.121)	(0.129)	(0.043)
High uninsured rate	0.173*	0.145**	-0.001	0.150**
	(0.093)	(0.070)	(0.086)	(0.070)
Penalty*High uninsured	-0.293***	-0.362***	-0.455**	-0.218***
	(0.070)	(0.134)	(0.231)	(0.052)
High Medicare reliance	-0.106	-0.121	-0.052	-0.079
	(0.070)	(0.099)	(0.125)	(0.074)
Rural	-0.421***	-0.560	-0.585*	-0.431***
	(0.120)	(0.456)	(0.345)	(0.090)
Region (ref= Central)				
Eastern	-0.074	-3.639***	0.628***	0.092
	(0.147)	(1.239)	(0.170)	(0.111)
Northern	-0.338**	-0.998***	-0.135	-0.270**
	(0.155)	(0.362)	(0.177)	(0.132)
Northwest	0.296***	0.966***	-0.037	0.315***
	(0.110)	(0.306)	(0.206)	(0.089)
Southwest	-0.075	0.372***	-3.848***	0.103
	(0.087)	(0.104)	(1.076)	(0.064)
CMS provider type (ref=IPPS)				
Rural referral center	0.088	1.664*	-2.158	0.028
	(0.127)	(0.890)	(1.618)	(0.127)
Medicare-dependent hospital	-1.007***	0.426	-4.317***	-0.924***
	(0.248)	(0.583)	(1.553)	(0.088)
Sole community hospital	0.046	0.750***	-0.655	-0.048
	(0.144)	(0.275)	(0.451)	(0.099)
Sole community hospital and rural referral center	0.384**	0.606	0.917**	0.335***
	(0.156)	(0.646)	(0.378)	(0.109)
Not-for-profit	1.264***	1.454***	1.172***	1.004***
	(0.111)	(0.255)	(0.222)	(0.122)
Health system affiliation	-0.024	-0.451***	0.536**	-0.070
	(0.089)	(0.065)	(0.213)	(0.064)
Total number of patient days	0.000***	0.000***	0.000**	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Prior year total margin	0.764	4.110***	-0.546	0.688
	(0.630)	(1.491)	(0.749)	(0.420)
Case mix index	1.456***	1.269**	1.121**	0.940***

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	(0.314)	(0.609)	(0.467)	(0.236)
Readmission penalty	0.222**	0.381	0.113	0.238***
	(0.108)	(0.583)	(0.094)	(0.059)
Year (Ref = 2013)				
2014	-0.069*	-0.316***	0.163*	-0.039*
	(0.041)	(0.080)	(0.088)	(0.022)
2015	-0.123	-0.383***	0.113	-0.100**
	(0.076)	(0.116)	(0.105)	(0.041)
2016	-0.255***	-0.259***	-0.296*	-0.185***
	(0.075)	(0.091)	(0.174)	(0.056)
2017	-0.397***	-0.340**	-0.457***	-0.273***
	(0.085)	(0.151)	(0.170)	(0.055)

Note: SE = standard errors, *p<0.01, **p<0.05, ***p>0.01

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References

Appendices

APPENDIX 1-1

Survey Questions	Modifications
Provider Practice	
Of the physicians working at the practice, how many are primary care physicians.	Categorized as binary for any or none.
Approximately how many nurse practitioners and physician assistants work at the practice.	Categorized as binary for any or none.
Is this a multi-specialty group practice.	N/A
If the practice uses an electronic records system, does it routinely provide reminders for either guideline-based interventions or screening tests.	If practice did not use an EHR, then practice categorized as "no."
If the practice uses an electronic records system, is it routinely used for exchanging secure messages with patients.	If practice did not use an EHR, then practice categorized as "no."
Does the practice regularly give reports to physicians on the clinical quality of care they individually provide.	N/A
Does the practice routinely set time aside for same-day appointments.	N/A
Does the practice routinely send patients reminders for preventative care or follow-up care.	N/A
Does the practice use case managers whose primary job is to coordinate patient care.	N/A
When patients are discharged from the hospital, does someone from the practice usually contact the patient within 48 hours.	N/A
Is the medical practice owned by physicians in the practice or another physician group. Type of practice.	In two separate questions for 2016, combined to permit for consistency in options across years.
Patient Usual Source of Care	
How difficult is it to contact {a medical person at} {PROVIDER} during regular business hours over the telephone about a health problem?	Categorized as binary for very difficult and somewhat difficult vs not too difficult and never difficult.
Does {PROVIDER} have office hours at night or on weekends?	N/A
How difficult is it to contact {a medical person at} {PROVIDER} after their regular hours in case of urgent medical needs?	Categorized as binary for very difficult and somewhat difficult vs not too difficult and never difficult.
Does {someone at} {PROVIDER} usually ask about prescription medications and treatments other doctors may give them?	Categorized as binary for never and sometimes vs usually and always

Thinking about the types of medical, traditional and alternative treatments that (READ NAME(S) BELOW) (is/are) happy with, how often does {a medical person at} {PROVIDER} show respect for these treatments?	Categorized as binary for never and sometimes vs usually and always
If there were a choice between treatments, how often would {a medical person at} {PROVIDER} ask (READ NAME(S) BELOW) to help make the decision?	Categorized as binary for never and sometimes vs usually and always
Does {a medical person at} {PROVIDER} present and explain all options to (READ NAME(S) BELOW)?	Categorized as binary for never and sometimes vs usually and always

APPENDIX 1-2

Concordance between patient and provider perspectives among respondents in fair to poor health

	Easy to reach by phone during regular hours	Extended office hours	Easy to reach by phone after hours	Provider shows respect for treatment decisions	Provider includes patient in decision-making	Provider explains treatment options	Provider asks about other treatments received
	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)
Patient-centered practice (ref = low)							
Medium	-0.17	-0.26	0.11	0.87	-0.03	0.43	0.33
	(0.44)	(0.45)	(0.34)	(0.54)	(0.39)	(0.58)	(0.46)
High	0.21	-0.30	0.56	0.38	0.27	0.79	-0.04
	(0.54)	(0.51)	(0.41)	(0.60)	(0.44)	(0.69)	(0.41)
Age	-0.00	0.00	0.00	0.02	0.00	0.00	0.01
	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
Income as percent of federal poverty level	0.00	0.00	0.00	-0.00	-0.00***	0.00**	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Male	0.06	-0.38	-0.13	0.39	0.62	-0.31	0.06
	(0.27)	(0.29)	(0.29)	(0.39)	(0.40)	(0.47)	(0.42)
Race/Ethnicity							
Black non-Hispanic	0.48	0.37	0.27	-0.73	-0.87**	-0.17	-0.50
	(0.41)	(0.95)	(0.34)	(0.50)	(0.43)	(0.65)	(0.50)
Hispanic	-0.02	0.13	-0.43	-0.32	-0.72*	-0.59	0.25
	(0.34)	0.42	(0.36)	(0.49)	(0.41)	(0.50)	(0.37)
Asian	-0.22	0.07	-0.58	-1.54*	-2.11***	-2.08**	-1.38
	(0.86)	(0.74)	(0.91)	(0.84)	(0.76)	(0.84)	(0.84)
Other	0.52	0.43	-0.07	0.27			-0.16
	(0.84)	(0.35)	(0.58)	(1.18)			(1.01)
Region of residence (ref = Northeast)							
Midwest	0.83	0.64	0.03	-0.58	0.08	1.26	0.45
	(0.51)	(0.55)	(0.40)	(0.72)	(0.58)	(0.86)	(0.55)

South	0.03	-0.87*	0.12	0.01	-0.32	1.09*	0.32
	(0.44)	(0.45)	(0.33)	(0.63)	(0.42)	(0.59)	(0.52)
West	-0.59	-1.26**	-0.42	-0.59	0.35	0.28	0.08
	(0.47)	(0.52)	(0.41)	(0.71)	(0.52)	(0.60)	(0.56)
Marital status (ref = Married)							
Separated/Widowed/Divorced	0.31	-0.46	-0.10	0.16	-0.63	-0.25	-0.10
	(0.35)	(0.32)	(0.31)	(0.38)	(0.43)	(0.47)	(0.35)
Never married	0.36	0.13	-0.01	0.69	-0.55	-0.04	-0.24
	(0.45)	(0.49)	(0.41)	(0.53)	(0.53)	(0.57)	(0.50)
Education (ref = less than HS)							
High school	-0.37	0.68*	-0.30	0.52	-0.36	-0.67	0.41
	(0.39)	(0.40)	(0.35)	(0.55)	(0.36)	(0.54)	(0.41)
Some college	0.55	0.80*	-0.37	0.30	-0.12	-0.79	0.33
	(0.48)	(0.05)	(0.41)	(0.62)	(0.43)	(0.60)	(0.54)
Bachelor degree or more	-0.08	0.70	0.44	-0.54	0.41	-0.57	0.28
	(0.55)	(0.53)	(0.60)	(0.57)	(0.51)	(0.71)	(0.59)
Insurance type (ref = uninsured)							
Medicaid	0.62	-0.20	0.28	-1.44	0.02	0.03	-0.27
	(0.71)	(0.59)	(0.61)	(0.88)	(0.87)	(0.83)	(0.68)
Medicare	-0.05	0.13	0.37	-1.97**	-0.66	-0.07	-0.36
	(0.69)	(0.56)	(0.62)	(0.85)	(0.80)	(0.83)	(0.63)
Private	-0.07	-0.62	0.26	-0.86	-0.10	-0.45	-0.36
	(0.73)	(0.61)	(0.60)	(0.87)	(0.81)	(0.80)	(0.63)
Other	-0.63		0.49	-0.36			
	(0.51)		(1.42)	(0.59)			
Type of usual source of care practice (ref = independent)							
Hospital or academic medical center	-0.86	-0.54	-0.03	0.01	-0.33	0.14	-0.30
	(0.55)	0.49	(0.41)	(0.61)	(0.55)	(0.88)	(0.48)
Government or non-profit	-0.50	-0.52	-1.45	-0.04	-1.12**	-0.13	-0.26
	(0.39)	(0.55)	(0.58)	(0.48)	(0.51)	(0.63)	(0.51)

*** p<0.01, ** p<0.05, * p<0.1

APPENDIX 1-3

Patient and provider perspectives and patient outcomes among respondents with fair to poor health

	ED use (SE)	Total expenditures (SE)
Patient-centered practice (ref = low)	0.56*	0.04
Medium	(0.32)	(0.03)
	0.08	0.11
High	(0.35)	(0.03)
	0.45	0.43
Patient-centered from patient perspective (ref = low)	-0.34	0.05**
Medium	(0.35)	(0.02)
	0.34	0.01
High	(0.35)	(0.02)
	0.10	0.13
Age	-0.00	0.00**
	(0.01)	(0.00)
Income as percent of federal poverty level	-0.00	0.00***
	(0.00)	(0.00)
Male	-0.23	-0.02
	(0.28)	(0.02)
Race/Ethnicity		
Black non-Hispanic	0.40	-0.03
	(0.40)	(0.03)
Hispanic	-0.34	-0.00
	(0.33)	(0.02)
Asian	-1.63	-0.08**
	(1.06)	(0.03)
Other	-0.90	-0.00
	(0.80)	(0.04)
Region of residence (ref = Northeast)		
Midwest	0.02	-0.02
	(0.41)	(0.04)
South	-0.49	-0.05
	(0.35)	(0.04)
West	-0.04	-0.07*
	(0.40)	(0.04)
Marital status (ref = Married)		
Separated/Widowed/Divorced	0.35	-0.00
	(0.30)	(0.02)
Never married	-0.08	-0.00
	(0.40)	(0.02)
Education (ref = less than HS)		
High school	0.10	0.04

Appendices

	(0.35)	(0.03)
Some college	0.43	0.05**
	(0.36)	(0.03)
Bachelor degree or more	0.39	0.05
	(0.60)	(0.03)
Insurance type (ref = uninsured)		
Medicaid	-0.36	0.06
	(0.58)	(0.04)
Medicare	-0.47	0.14***
	(0.48)	(0.03)
Private	-0.62	0.11***
	(0.49)	(0.03)
Other		0.28***
		(0.05)
Type of usual source of care practice (ref = independent)		
Hospital or academic medical center	-0.31	-0.06***
	(0.38)	(0.02)
Government or non-profit	-0.80*	-0.07**
	(0.45)	(0.03)
Other	-0.71**	-0.06***
	(0.32)	(0.02)

*** p<0.01, ** p<0.05, * p<0.1

APPENDIX 2-1

Adjusted regression with a categorical variable for HVBP adjustment (not moderated)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Direct patient care	Administration	Physicians	Physician assistants/ Nurse practitioners	Registered nurses	Licensed practical nurses	Nursing Aides	Other
	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)
HVBP Adjustment (ref= null)								
Penalty	-0.031	0.153	-0.359***	-0.172	0.007	-0.010	-0.309***	0.020
	(0.035)	(0.286)	(0.112)	(0.147)	(0.040)	(0.073)	(0.094)	(0.024)
Bonus	0.106	0.393**	-0.243	-0.042	0.093**	0.097	-0.098*	0.202***
	(0.072)	(0.194)	(0.274)	(0.307)	(0.041)	(0.068)	(0.058)	(0.056)
High Medicare reliance	0.010	-0.027	0.621**	0.214**	-0.013	-0.019	0.145	-0.066
	(0.055)	(0.085)	(0.247)	(0.085)	(0.044)	(0.061)	(0.092)	(0.044)
Rural	-0.350**	-0.473***	-2.173	-0.692**	-0.470***	-0.141	-0.768***	-0.357***
	(0.153)	(0.145)	(1.923)	(0.352)	(0.147)	(0.150)	(0.226)	(0.118)
Region (ref= Central)								
Eastern	-0.019	0.159	-1.715**	-1.174**	-0.186	0.060	0.105	0.145*
	(0.081)	(0.150)	(0.748)	(0.463)	(0.172)	(0.104)	(0.172)	(0.084)
Northern	-0.269**	-0.036	-1.450***	-0.794***	-0.229***	-1.102***	0.011	-0.102
	(0.111)	(0.199)	(0.210)	(0.226)	(0.059)	(0.332)	(0.137)	(0.139)
Northwest	0.199***	0.221	-0.791	0.162	0.162**	-0.054	0.085	0.303***
	(0.068)	(0.398)	(0.801)	(0.307)	(0.064)	(0.081)	(0.164)	(0.066)
Southwest	0.123*	0.083	-1.052***	-0.079	0.010	0.077	-0.037	0.312***
	(0.064)	(0.194)	(0.371)	(0.329)	(0.063)	(0.105)	(0.245)	(0.076)
CMS provider type (ref=IPPS)								

Rural referral center (RRC)	0.230	0.376	0.907	1.008**	0.240	0.201	0.463	0.320**
	(0.160)	(0.435)	(2.230)	(0.402)	(0.159)	(0.182)	(0.418)	(0.134)
Medicare-dependent hospital (MDH)	-0.477	0.288	-6.547**	-3.740**	-0.221	-0.398	-0.030	-0.159
	(0.343)	(0.268)	(2.791)	(1.532)	(0.332)	(0.262)	(0.314)	(0.290)
Sole community hospital (SCH)	-0.056	0.290	-0.360	-0.372*	-0.011	-0.110	0.203	0.090
	(0.140)	(0.268)	(0.483)	(0.211)	(0.126)	(0.236)	(0.176)	(0.115)
SCH and RRC	0.168	0.493***	0.615	0.216	0.121	0.317**	0.299***	0.344***
	(0.113)	(0.152)	(0.474)	(0.328)	(0.096)	(0.132)	(0.111)	(0.086)
Not-for-profit	0.290***	0.426**	2.846***	1.986***	0.131	0.148	-0.043	0.394***
	(0.086)	(0.199)	(0.799)	(0.433)	(0.102)	(0.117)	(0.120)	(0.100)
Health system affiliation	-0.031	0.061	2.940***	0.548***	0.027	-0.056	0.063	-0.014
	(0.052)	(0.196)	(0.878)	(0.102)	(0.068)	(0.052)	(0.092)	(0.061)
Total number of patient days	0.000***	0.000***	0.000***	0.000***	0.000***	-0.000	0.000	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Prior year operating margin	0.340	1.645**	-13.334***	-8.090***	0.748	-0.545	0.117	0.969**
	(0.395)	(0.640)	(3.605)	(1.856)	(0.474)	(0.440)	(0.545)	(0.386)
Case mix index	0.727***	0.342	0.713	1.220**	0.625***	0.688**	0.463**	0.627***
	(0.171)	(0.363)	(1.235)	(0.614)	(0.228)	(0.274)	(0.190)	(0.175)
Readmission penalty	0.031	-0.155*	1.265*	0.316	-0.033	0.088	0.213***	-0.040
	(0.055)	(0.090)	(0.711)	(0.395)	(0.063)	(0.080)	(0.068)	(0.035)
Prior year FTE	0.000***	0.001**	0.002**	0.001	0.000	0.015***	0.004***	0.000***
	(0.000)	(0.000)	(0.001)	(0.002)	(0.000)	(0.002)	(0.001)	(0.000)
Panel fixed effects								
Panel 2	0.026	-0.052	0.132***	0.073	0.070	0.073	0.001	-0.085**
	(0.028)	(0.045)	(0.029)	(0.049)	(0.044)	(0.048)	(0.024)	(0.034)
Panel 3	0.100	0.033	-0.043	0.138***	0.004	0.046	-0.153	-0.034
	(0.087)	(0.043)	(0.113)	(0.051)	(0.020)	(0.074)	(0.115)	(0.024)
Panel 4	0.016	-0.111	-1.043	-0.154	0.013	-0.078	-0.260**	-0.047

	(0.061)	(0.224)	(0.714)	(0.428)	(0.059)	(0.089)	(0.122)	(0.038)
Panel 5	-0.061	-0.150	-0.697	-0.050	-0.035	-0.055	-0.088	-0.131***
	(0.052)	(0.197)	(0.637)	(0.427)	(0.058)	(0.088)	(0.101)	(0.043)
Panel 6	-0.054	-0.095	-1.324*	-0.133	-0.040	-0.294**	-0.253**	-0.104**
	(0.062)	(0.138)	(0.755)	(0.433)	(0.062)	(0.121)	(0.124)	(0.050)
Panel 7	-0.098	-0.196	-0.785	-0.008	-0.067	-0.342***	-0.109	-0.245***
	(0.076)	(0.188)	(0.658)	(0.462)	(0.064)	(0.118)	(0.112)	(0.063)

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Appendices

APPENDIX 2-2

HVBP penalty on provider FTEs (moderated)

	Direct patient care	Administration	Physicians	Physician assistants/ Nurse practitioners	Registered nurses	Licensed practical nurses	Nursing Aides	Other
	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)
	P	P	P	P	P	P	P	P
Penalty	-0.049	-0.031	-0.302*	-0.184	-0.016	-0.072	-0.297**	-0.017
	(0.044)	(0.291)	(0.160)	(0.175)	(0.050)	(0.070)	(0.127)	(0.040)
High Medicare reliance	0.030	0.025	0.707***	0.174*	-0.000	-0.034	0.108	-0.034
	(0.058)	(0.124)	(0.260)	(0.101)	(0.059)	(0.072)	(0.102)	(0.056)
Penalty*High Medicare reliance	-0.022	-0.038	-0.114	0.062	-0.004	0.091	0.129	-0.037
	(0.049)	(0.232)	(0.180)	(0.217)	(0.078)	(0.091)	(0.191)	(0.051)
Rural	-0.367**	-0.526***	-2.293	-0.649*	-0.487***	-0.155	-0.750***	-0.390***
	(0.156)	(0.165)	(1.905)	(0.337)	(0.152)	(0.155)	(0.225)	(0.133)
Region (ref= Central)								
Eastern	-0.018	0.189	-1.718**	-1.173**	-0.179	0.076	0.094	0.160*
	(0.081)	(0.159)	(0.739)	(0.461)	(0.175)	(0.109)	(0.171)	(0.089)
Northern	-0.265**	-0.005	-1.515***	-0.780***	-0.215***	-1.090***	0.004	-0.078
	(0.117)	(0.204)	(0.176)	(0.253)	(0.061)	(0.341)	(0.136)	(0.152)
Northwest	0.198***	0.196	-0.831	0.195	0.163**	-0.044	0.081	0.305***
	(0.070)	(0.393)	(0.677)	(0.350)	(0.066)	(0.084)	(0.164)	(0.066)
Southwest	0.120*	0.085	-1.073***	-0.056	0.011	0.085	-0.036	0.316***
	(0.063)	(0.192)	(0.344)	(0.365)	(0.063)	(0.107)	(0.242)	(0.078)
CMS provider type (ref=IPPS)								
RRC	0.239	0.424	0.806	0.955***	0.249	0.209	0.457	0.334**

	(0.160)	(0.439)	(2.219)	(0.370)	(0.160)	(0.179)	(0.423)	(0.134)
MDH	-0.477	0.256	-7.041***	-3.608**	-0.220	-0.378	-0.015	-0.167
	(0.335)	(0.260)	(2.613)	(1.562)	(0.327)	(0.261)	(0.322)	(0.283)
SCH	-0.030	0.357	-0.504	-0.387**	0.014	-0.084	0.205	0.154
	(0.140)	(0.286)	(0.421)	(0.167)	(0.130)	(0.249)	(0.179)	(0.123)
SCH and RRC	0.170	0.537***	0.531	0.198	0.123	0.325**	0.269***	0.361***
	(0.127)	(0.168)	(0.485)	(0.311)	(0.103)	(0.138)	(0.104)	(0.107)
Not-for-profit	0.269***	0.337*	2.977***	1.990***	0.108	0.126	-0.019	0.350***
	(0.086)	(0.205)	(0.771)	(0.438)	(0.106)	(0.118)	(0.120)	(0.104)
Health system affiliation	-0.032	0.036	3.022***	0.551***	0.024	-0.056	0.070	-0.020
	(0.055)	(0.224)	(0.862)	(0.099)	(0.072)	(0.056)	(0.097)	(0.071)
Total number of patient days	0.000***	0.000**	0.000***	0.000***	0.000***	-0.000	0.000	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Prior year operating margin	0.386	1.734***	-14.226***	-7.886***	0.775*	-0.475	0.092	1.021***
	(0.395)	(0.651)	(3.497)	(1.895)	(0.471)	(0.429)	(0.535)	(0.363)
Case mix index	0.737***	0.327	0.773	1.216**	0.627***	0.695**	0.447**	0.634***
	(0.172)	(0.373)	(1.178)	(0.609)	(0.235)	(0.278)	(0.191)	(0.182)
Readmission penalty	0.020	-0.140	1.442	0.307	-0.045	0.095	0.232***	-0.058
	(0.062)	(0.103)	(0.916)	(0.397)	(0.070)	(0.073)	(0.073)	(0.047)
Prior year FTE	0.000***	0.001**	0.002**	0.001	0.000	0.015***	0.004***	0.000***
	(0.000)	(0.000)	(0.001)	(0.002)	(0.000)	(0.002)	(0.001)	(0.000)
Panel fixed effects								
Panel 2	0.026	-0.051	0.140***	0.072	0.070	0.078	-0.002	-0.083**
	(0.028)	(0.045)	(0.027)	(0.049)	(0.044)	(0.049)	(0.025)	(0.033)
Panel 3	0.102	0.030	-0.049	0.140***	0.005	0.051	-0.158	-0.033
	(0.088)	(0.045)	(0.107)	(0.047)	(0.019)	(0.074)	(0.119)	(0.023)
Panel 4	0.052	0.036	-1.189	-0.159	0.046	-0.058	-0.328***	0.010
	(0.062)	(0.167)	(0.912)	(0.409)	(0.066)	(0.085)	(0.125)	(0.044)
Panel 5	-0.024	0.041	-0.872	-0.047	0.003	-0.023	-0.161*	-0.072
	(0.048)	(0.128)	(0.837)	(0.414)	(0.066)	(0.082)	(0.096)	(0.048)

Panel 6	-0.012	0.081	-1.484	-0.136	-0.001	-0.257**	-0.310**	-0.036
	(0.069)	(0.151)	(0.947)	(0.411)	(0.071)	(0.113)	(0.131)	(0.058)
Panel 7	-0.048	-0.001	-0.983	-0.002	-0.021	-0.313**	-0.168	-0.161**
	(0.072)	(0.137)	(0.857)	(0.452)	(0.072)	(0.123)	(0.106)	(0.068)
Constant	4.906***	4.045***	-3.749**	-2.101*	4.504***	1.898***	3.421***	4.753***
	(0.265)	(0.799)	(1.843)	(1.076)	(0.404)	(0.361)	(0.279)	(0.259)
	0.000	0.000	0.042	0.051	0.000	0.000	0.000	0.000

*** p<0.01, ** p<0.05, * p<0.1

HVBP bonus on provider FTEs (moderated)

	Direct patient care	Administration	Physicians	Physician assistants/ Nurse practitioners	Registered nurses	Licensed practical nurses	Nursing Aides	Other
	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)
Bonus	0.152*	0.402***	0.425	0.224	0.119**	0.147**	0.016	0.236***
	(0.089)	(0.088)	(0.716)	(0.488)	(0.048)	(0.072)	(0.078)	(0.054)
High Medicare reliance	0.027	0.022	0.540**	0.224**	0.009	0.016	0.130	-0.040
	(0.054)	(0.074)	(0.226)	(0.107)	(0.047)	(0.069)	(0.094)	(0.055)
Bonus*High Medicare reliance	-0.104	-0.267*	-0.853	-0.232	-0.110	-0.156	0.035	-0.142
	(0.089)	(0.138)	(1.249)	(0.502)	(0.070)	(0.102)	(0.151)	(0.086)
Rural	-0.361**	-0.503***	-1.121	-0.633*	-0.483***	-0.166	-0.806***	-0.377***
	(0.157)	(0.141)	(0.973)	(0.341)	(0.152)	(0.159)	(0.272)	(0.123)
Region (ref= Central)								
Eastern	-0.013	0.152	-1.405*	-1.126**	-0.182	0.059	0.134	0.141*
	(0.078)	(0.135)	(0.793)	(0.525)	(0.170)	(0.101)	(0.171)	(0.081)
Northern	-0.277**	-0.047	-1.839***	-0.894***	-0.226***	-1.109***	-0.011	-0.105
	(0.110)	(0.184)	(0.333)	(0.217)	(0.062)	(0.328)	(0.160)	(0.133)
Northwest	0.184***	0.177	-0.131	0.182	0.156**	-0.066	0.045	0.297***
	(0.066)	(0.355)	(0.850)	(0.343)	(0.066)	(0.078)	(0.201)	(0.067)
Southwest	0.123*	0.092	-1.104**	-0.071	0.014	0.076	-0.030	0.314***
	(0.064)	(0.189)	(0.507)	(0.351)	(0.063)	(0.103)	(0.257)	(0.075)
CMS provider type (ref=IPPS)								
RRC	0.234	0.409	1.620	0.961**	0.246	0.222	0.366	0.331**
	(0.167)	(0.452)	(2.216)	(0.387)	(0.165)	(0.199)	(0.472)	(0.142)

MDH	-0.478	0.247	-6.985**	-3.935**	-0.222	-0.380	0.015	-0.154
	(0.339)	(0.259)	(3.041)	(1.709)	(0.324)	(0.266)	(0.305)	(0.280)
SCH	-0.031	0.333	-0.457	-0.369	0.013	-0.081	0.265	0.132
	(0.156)	(0.213)	(0.544)	(0.231)	(0.139)	(0.255)	(0.207)	(0.135)
SCH and RRC	0.163	0.554***	0.997	0.153	0.127	0.331**	0.246*	0.352***
	(0.122)	(0.147)	(0.784)	(0.333)	(0.100)	(0.143)	(0.131)	(0.091)
Not-for-profit	0.293***	0.418**	3.722***	2.108***	0.133	0.154	-0.073	0.400***
	(0.087)	(0.184)	(0.905)	(0.519)	(0.103)	(0.116)	(0.137)	(0.100)
Health system affiliation	-0.037	0.049	3.123***	0.553***	0.024	-0.054	0.006	-0.013
	(0.050)	(0.171)	(1.110)	(0.107)	(0.065)	(0.053)	(0.080)	(0.058)
Total number of patient days	0.000***	0.000***	0.000***	0.000***	0.000***	-0.000	0.000	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Prior year operating margin	0.311	1.471**	-12.047***	-8.368***	0.731	-0.523	0.330	0.943***
	(0.383)	(0.590)	(3.974)	(2.155)	(0.466)	(0.434)	(0.548)	(0.366)
Case mix index	0.695***	0.318	-0.831	1.055	0.619***	0.656**	0.458**	0.628***
	(0.161)	(0.340)	(1.262)	(0.698)	(0.220)	(0.261)	(0.193)	(0.175)
Readmission penalty	0.034	-0.111	1.258**	0.374	-0.023	0.070	0.191***	-0.028
	(0.054)	(0.076)	(0.518)	(0.447)	(0.062)	(0.078)	(0.071)	(0.032)
Prior year FTE	0.000***	0.001***	0.001	0.000	0.000	0.015***	0.004***	0.000***
	(0.000)	(0.000)	(0.001)	(0.002)	(0.000)	(0.002)	(0.001)	(0.000)
Panel fixed effects								
Panel 2	0.027	-0.047	0.132***	0.088*	0.070	0.072	0.001	-0.084**
	(0.027)	(0.044)	(0.039)	(0.050)	(0.044)	(0.049)	(0.026)	(0.034)
Panel 3	0.102	0.033	0.095	0.173***	0.005	0.046	-0.158	-0.034
	(0.086)	(0.045)	(0.112)	(0.034)	(0.019)	(0.074)	(0.113)	(0.024)
Panel 4	0.002	-0.066	-1.118**	-0.235	0.005	-0.065	-0.314**	-0.051
	(0.063)	(0.153)	(0.488)	(0.466)	(0.054)	(0.090)	(0.133)	(0.037)
Panel 5	-0.075	-0.059	-0.791*	-0.156	-0.038	-0.042	-0.208*	-0.129***
	(0.053)	(0.070)	(0.432)	(0.463)	(0.052)	(0.085)	(0.117)	(0.043)
Panel 6	-0.080	-0.040	-1.493***	-0.278	-0.043	-0.285**	-0.397**	-0.102**

	(0.064)	(0.138)	(0.562)	(0.496)	(0.058)	(0.131)	(0.195)	(0.047)
Panel 7	-0.112	-0.111	-0.882**	-0.133	-0.069	-0.314**	-0.260***	-0.242***
	(0.080)	(0.106)	(0.447)	(0.471)	(0.058)	(0.126)	(0.086)	(0.061)
Constant	4.935***	3.948***	-2.726	-2.095*	4.482***	1.917***	3.508***	4.688***
	(0.252)	(0.688)	(1.716)	(1.230)	(0.379)	(0.343)	(0.283)	(0.250)
	0.000	0.000	0.112	0.088	0.000	0.000	0.000	0.000

*** p<0.01, ** p<0.05, * p<0.1

Appendices

APPENDIX 2-4

Series of sensitivity analyses for penalties on direct patient care FTEs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	GLM			**Panel**			**Accumulation**			**At least 3**		
	coef	se	pval	coef	se	pval	coef	se	pval	coef	se	pval
Penalty	-0.094*	(0.056)	0.096	0.077**	(0.031)	0.014						
High Medicare reliance	0.072	(0.062)	0.245	-0.036	(0.032)	0.262	0.045	(0.077)	0.561	0.024	(0.061)	0.693
Penalty*High Medicare reliance	-0.050	(0.064)	0.441	-0.098**	(0.047)	0.037						
Cumulative penalty							-0.040	(0.043)	0.346			
Cumulative penalty*High Medicare reliance							0.007	(0.038)	0.850			
At least 3 penalties										-0.120	(0.103)	0.243
At least 3 penalties*High Medicare reliance										0.170*	(0.092)	0.066
Rural	-0.239*	(0.131)	0.067	-0.030	(0.044)	0.503	-0.247*	(0.136)	0.069	-0.246*	(0.139)	0.077
Region (ref= Central)												
Eastern	-0.286***	(0.104)	0.006				-0.285***	(0.105)	0.007	-0.267***	(0.102)	0.009
Northern	-0.571***	(0.143)	0.000				-0.574***	(0.149)	0.000	-0.588***	(0.151)	0.000
Northwest	0.147*	(0.076)	0.055				0.152*	(0.084)	0.072	0.143*	(0.074)	0.053
Southwest	-0.025	(0.090)	0.783				-0.030	(0.091)	0.740	-0.021	(0.091)	0.814
CMS provider type (ref=IPPS)												
RRC	0.139	(0.149)	0.350	-0.139	(0.128)	0.277	0.145	(0.145)	0.319	0.142	(0.151)	0.349
MDH	-0.464	(0.305)	0.127	-0.193***	(0.062)	0.002	-0.443	(0.307)	0.149	-0.412	(0.294)	0.161
SCH	-0.166**	(0.078)	0.033	0.049	(0.132)	0.710	-0.135	(0.087)	0.123	-0.101	(0.090)	0.258
SCH and RRC	0.105	(0.104)	0.314	-0.039	(0.105)	0.707	0.070	(0.109)	0.519	0.061	(0.116)	0.598

Not-for-profit	0.571***	(0.146)	0.000	0.109	(0.119)	0.363	0.572***	(0.149)	0.000	0.566***	(0.152)	0.000
Health system affiliation	0.044	(0.081)	0.585	-0.022	(0.038)	0.571	0.036	(0.080)	0.649	0.036	(0.081)	0.654
Total number of patient days	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000
Prior year operating margin	0.876*	(0.522)	0.093	-0.557***	(0.154)	0.000	0.872*	(0.508)	0.086	1.001*	(0.520)	0.054
Case mix index	1.039***	(0.250)	0.000	-0.156	(0.151)	0.301	1.025***	(0.265)	0.000	0.995***	(0.248)	0.000
Readmission penalty	-7.156	(4.495)	0.111	5.519***	(1.874)	0.003	-5.709	(4.190)	0.173	-4.292	(4.024)	0.286
Panel fixed effects												
Panel 2	0.036	(0.032)	0.270	0.023	(0.029)	0.418	0.035	(0.033)	0.283	0.034	(0.033)	0.306
Panel 3	0.138	(0.104)	0.185	0.069**	(0.029)	0.019	0.139	(0.105)	0.187	0.139	(0.103)	0.179
Panel 4	0.172**	(0.080)	0.032	0.075**	(0.031)	0.016	0.150*	(0.090)	0.095	0.146*	(0.087)	0.094
Panel 5	0.124*	(0.074)	0.095	0.069**	(0.032)	0.033	0.112	(0.084)	0.185	0.088	(0.087)	0.315
Panel 6	0.093	(0.102)	0.361	0.127***	(0.038)	0.001	0.079	(0.105)	0.449	0.030	(0.107)	0.783
Panel 7	0.058	(0.097)	0.550	0.122***	(0.040)	0.003	0.089	(0.121)	0.465	0.058	(0.114)	0.611
Constant	11.266**	(4.433)	0.011	0.386	(1.861)	0.836	9.859**	(4.134)	0.017	8.484**	(3.990)	0.033

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

APPENDIX 2-5

Series of sensitivity analyses for bonuses on direct patient care FTEs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	GLM			**Panel**			**Accumulation**			**At least 3**		
	coef	se	pval	coef	se	pval	coef	se	pval	coef	se	pval
Bonus	0.118	(0.099)	0.231	0.015	(0.031)	0.626						
High Medicare reliance	0.063	(0.055)	0.254	-0.036	(0.033)	0.284	0.054	(0.051)	0.295	0.066	(0.051)	0.194
Bonus*High Medicare reliance	-0.107	(0.112)	0.342	-0.064	(0.044)	0.147						
Cumulative bonus							0.091*	(0.053)	0.083			
Cumulative bonus*High Medicare reliance							-0.059	(0.052)	0.260			
At least 3 bonuses										0.383***	(0.135)	0.005
At least 3 bonuses*High Medicare reliance										-0.341**	(0.144)	0.018
Rural	-0.236*	(0.135)	0.080	-0.032	(0.044)	0.469	-0.224*	(0.127)	0.078	-0.249*	(0.131)	0.058
Region (ref= Central)												
Eastern	-0.277***	(0.099)	0.005				-0.278***	(0.101)	0.006	-0.269***	(0.096)	0.005
Northern	-0.621***	(0.149)	0.000				-0.623***	(0.145)	0.000	-0.641***	(0.141)	0.000
Northwest	0.115	(0.074)	0.121				0.126*	(0.073)	0.084	0.109	(0.071)	0.123
Southwest	-0.037	(0.098)	0.701				-0.026	(0.103)	0.803	-0.055	(0.093)	0.556
CMS provider type (ref=IPPS)												
RRC	0.133	(0.159)	0.403	-0.107	(0.129)	0.409	0.129	(0.156)	0.409	0.158	(0.154)	0.304
MDH	-0.461	(0.301)	0.125	-0.176***	(0.062)	0.005	-0.445	(0.293)	0.129	-0.452	(0.296)	0.127
SCH	-0.136	(0.092)	0.136	0.075	(0.135)	0.581	-0.171*	(0.101)	0.089	-0.148	(0.104)	0.156
SCH and RRC	0.066	(0.116)	0.568	-0.040	(0.106)	0.706	0.058	(0.101)	0.565	0.052	(0.110)	0.640

Not-for-profit	0.607***	(0.159)	0.000	0.100	(0.120)	0.404	0.662***	(0.172)	0.000	0.617***	(0.149)	0.000
Health system affiliation	0.039	(0.078)	0.618	-0.012	(0.039)	0.761	0.041	(0.076)	0.586	0.046	(0.074)	0.533
Total number of patient days	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000
Prior year operating margin	0.817	(0.497)	0.100	-0.592***	(0.155)	0.000	0.869*	(0.490)	0.076	0.742	(0.488)	0.129
Case mix index	0.955***	(0.247)	0.000	-0.162	(0.151)	0.281	0.975***	(0.248)	0.000	0.915***	(0.235)	0.000
Readmission penalty	-6.664	(4.461)	0.135	5.198***	(1.885)	0.006	-5.615	(3.953)	0.155	-5.941	(4.205)	0.158
Panel fixed effects												
Panel 2	0.035	(0.031)	0.252	0.023	(0.029)	0.421	0.036	(0.031)	0.236	0.035	(0.030)	0.248
Panel 3	0.142	(0.103)	0.170	0.069**	(0.029)	0.020	0.140	(0.104)	0.179	0.143	(0.102)	0.160
Panel 4	0.131	(0.094)	0.166	0.089***	(0.032)	0.006	0.135	(0.092)	0.141	0.143	(0.088)	0.103
Panel 5	0.081	(0.092)	0.381	0.084**	(0.033)	0.012	0.074	(0.094)	0.433	0.094	(0.083)	0.258
Panel 6	0.020	(0.100)	0.841	0.139***	(0.038)	0.000	0.008	(0.102)	0.937	0.017	(0.095)	0.854
Panel 7	0.004	(0.127)	0.975	0.146***	(0.043)	0.001	-0.011	(0.130)	0.935	0.014	(0.112)	0.904
Constant	10.860**	(4.389)	0.013	0.719	(1.872)	0.701	9.711**	(3.929)	0.013	10.186**	(4.182)	0.015

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

APPENDIX 2-6

Series of sensitivity analyses for penalties on administrative FTEs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
		GLM			Panel			Accumulation			At least 3	
	coef	se	pval	coef	se	pval	coef	se	pval	coef	se	pval
Penalty	-0.065	(0.110)	0.555	-0.076	(0.098)	0.437						
High Medicare reliance	-0.203	(0.163)	0.212	-0.192*	(0.099)	0.052	-0.044	(0.195)	0.821	-0.044	(0.141)	0.758
Penalty*High Medicare reliance	0.332**	(0.152)	0.029	0.216	(0.146)	0.139						
Cumulative penalty							0.066	(0.087)	0.452			
Cumulative penalty*High Medicare reliance							0.014	(0.088)	0.872			
At least 3 penalties										0.252	(0.161)	0.118
At least 3 penalties*High Medicare reliance										-0.021	(0.224)	0.924
Rural	-0.770***	(0.230)	0.001	0.226	(0.138)	0.102	-0.759***	(0.229)	0.001	-0.739***	(0.218)	0.001
Region (ref= Central)												
Eastern	0.407*	(0.215)	0.058				0.408*	(0.217)	0.060	0.374*	(0.212)	0.077
Northern	0.468**	(0.228)	0.040				0.412*	(0.234)	0.078	0.393*	(0.226)	0.082
Northwest	1.403***	(0.235)	0.000				1.279***	(0.241)	0.000	1.264***	(0.226)	0.000
Southwest	0.307	(0.313)	0.327				0.304	(0.308)	0.324	0.274	(0.301)	0.363
CMS provider type (ref=IPPS)												
RRC	0.435	(0.510)	0.393	0.307	(0.399)	0.443	0.342	(0.631)	0.588	0.308	(0.617)	0.617
MDH	1.097***	(0.397)	0.006	0.200	(0.194)	0.302	0.901**	(0.403)	0.025	0.854*	(0.481)	0.076
SCH	1.323***	(0.280)	0.000	-0.030	(0.412)	0.942	1.200***	(0.292)	0.000	1.181***	(0.273)	0.000
SCH and RRC	0.354***	(0.128)	0.006	0.886***	(0.327)	0.007	0.409***	(0.117)	0.000	0.417***	(0.113)	0.000
Not-for-profit	0.661**	(0.257)	0.010	0.226	(0.371)	0.543	0.631**	(0.253)	0.013	0.644**	(0.257)	0.012
Health system affiliation	0.559***	(0.157)	0.000	-0.083	(0.119)	0.488	0.517***	(0.169)	0.002	0.511***	(0.163)	0.002
Total number of patient days	0.000***	(0.000)	0.002	0.000***	(0.000)	0.000	0.000***	(0.000)	0.004	0.000***	(0.000)	0.003
Prior year operating margin	2.776**	(1.095)	0.011	-0.829*	(0.481)	0.086	2.585**	(1.046)	0.013	2.621**	(1.085)	0.016
Case mix index	1.359***	(0.398)	0.001	-0.873*	(0.471)	0.065	1.298***	(0.450)	0.004	1.314***	(0.408)	0.001
Readmission penalty	12.395	(12.438)	0.319	6.074	(5.848)	0.300	9.424	(10.647)	0.376	9.124	(10.545)	0.387
Panel fixed effects												

Panel 2	-0.113**	(0.056)	0.043	0.011	(0.089)	0.902	-0.107*	(0.056)	0.057	-0.106*	(0.056)	0.059
Panel 3	-0.080	(0.052)	0.123	0.089	(0.091)	0.331	-0.074	(0.052)	0.156	-0.072	(0.052)	0.166
Panel 4	-0.277*	(0.157)	0.077	0.101	(0.097)	0.299	-0.199	(0.157)	0.205	-0.160	(0.177)	0.364
Panel 5	-0.235	(0.174)	0.177	0.115	(0.101)	0.252	-0.285	(0.179)	0.112	-0.206	(0.173)	0.233
Panel 6	-0.140	(0.090)	0.119	0.252**	(0.117)	0.032	-0.194	(0.155)	0.211	-0.159	(0.111)	0.150
Panel 7	-0.097	(0.089)	0.275	0.227*	(0.126)	0.072	-0.250	(0.191)	0.190	-0.237*	(0.123)	0.055
Constant	-10.920	(12.296)	0.374	-1.208	(5.813)	0.835	-7.767	(10.713)	0.468	-7.477	(10.524)	0.477

*** p<0.01, ** p<0.05, * p<0.1

APPENDIX 2-7

Series of sensitivity analyses for bonuses on administrative FTEs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	GLM			**Panel**			**Accumulation**			**At least 3**		
	coef	se	pval	coef	se	pval	coef	se	pval	coef	se	pval
Bonus	0.352***	(0.117)	0.003	0.195**	(0.095)	0.041						
High Medicare reliance	-0.033	(0.103)	0.753	-0.147	(0.103)	0.153	-0.016	(0.107)	0.884	-0.036	(0.095)	0.702
Bonus*High Medicare reliance	-0.289**	(0.145)	0.046	-0.035	(0.137)	0.800						
Cumulative bonus							0.182***	(0.053)	0.001			
Cumulative bonus*High Medicare reliance							-0.207***	(0.077)	0.007			
At least 3 bonuses										0.377**	(0.182)	0.039
At least 3 bonuses*High Medicare reliance										-0.465*	(0.248)	0.060
Rural	-0.765***	(0.196)	0.000	0.193	(0.135)	0.155	-0.828***	(0.209)	0.000	-0.801***	(0.216)	0.000
Region (ref= Central)												
Eastern	0.342	(0.219)	0.118				0.358	(0.220)	0.104	0.377	(0.230)	0.101
Northern	0.431*	(0.226)	0.056				0.413*	(0.217)	0.058	0.440*	(0.231)	0.057
Northwest	1.323***	(0.227)	0.000				1.316***	(0.226)	0.000	1.330***	(0.230)	0.000
Southwest	0.258	(0.312)	0.409				0.258	(0.314)	0.411	0.278	(0.326)	0.394
CMS provider type (ref=IPPS)												
RRC	0.393	(0.549)	0.473	0.243	(0.398)	0.541	0.476	(0.542)	0.380	0.458	(0.513)	0.372
MDH	0.926*	(0.473)	0.050	0.182	(0.192)	0.344	0.991**	(0.405)	0.014	0.956**	(0.440)	0.030
SCH	1.183***	(0.235)	0.000	-0.093	(0.417)	0.823	1.280***	(0.247)	0.000	1.254***	(0.239)	0.000
SCH and RRC	0.371***	(0.108)	0.001	0.847***	(0.326)	0.010	0.421***	(0.107)	0.000	0.404***	(0.103)	0.000
Not-for-profit	0.700***	(0.260)	0.007	0.200	(0.370)	0.588	0.756***	(0.265)	0.004	0.680**	(0.266)	0.010
Health system affiliation	0.498***	(0.144)	0.001	-0.081	(0.119)	0.498	0.514***	(0.132)	0.000	0.505***	(0.143)	0.000
Total number of patient days	0.000***	(0.000)	0.002	0.000***	(0.000)	0.000	0.000***	(0.000)	0.001	0.000***	(0.000)	0.002
Prior year operating margin	2.082**	(1.032)	0.044	-0.838*	(0.478)	0.081	2.081**	(0.940)	0.027	2.257**	(0.983)	0.022
Case mix index	1.377***	(0.412)	0.001	-0.820*	(0.467)	0.080	1.362***	(0.367)	0.000	1.382***	(0.382)	0.000
Readmission penalty	6.407	(10.328)	0.535	5.753	(5.825)	0.324	8.380	(9.619)	0.384	9.777	(9.703)	0.314
Panel fixed effects												
Panel 2	-0.100*	(0.058)	0.084	0.010	(0.089)	0.907	-0.100*	(0.058)	0.088	-0.103*	(0.059)	0.079

Panel 3	-0.071	(0.047)	0.133	0.086	(0.091)	0.343	-0.070	(0.048)	0.150	-0.072	(0.049)	0.144
Panel 4	-0.201	(0.192)	0.297	0.035	(0.099)	0.727	-0.175	(0.180)	0.330	-0.164	(0.178)	0.357
Panel 5	-0.234	(0.191)	0.220	0.040	(0.102)	0.697	-0.214	(0.185)	0.248	-0.207	(0.184)	0.260
Panel 6	-0.101	(0.171)	0.554	0.204*	(0.116)	0.079	-0.098	(0.169)	0.563	-0.068	(0.153)	0.658
Panel 7	-0.150	(0.143)	0.294	0.110	(0.132)	0.403	-0.119	(0.141)	0.397	-0.083	(0.116)	0.474
Constant	-4.950	(10.163)	0.626	-0.952	(5.788)	0.869	-6.989	(9.472)	0.461	-8.302	(9.575)	0.386

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

APPENDIX 2-8

Series of sensitivity analyses for penalties on physician FTEs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	GLM			Panel			Accumulation			At least 3		
	coef	se	pval	coef	se	pval	coef	se	pval	coef	se	pval
Penalty	-0.197	(0.185)	0.286	-0.046	(0.135)	0.733						
High Medicare reliance	0.751**	(0.312)	0.016	-0.081	(0.183)	0.657	0.130	(0.770)	0.866	0.486	(0.567)	0.392
Penalty*High Medicare reliance	-0.172	(0.209)	0.409	0.102	(0.222)	0.647						
Cumulative penalty							-0.273*	(0.153)	0.074			
Cumulative penalty*High Medicare reliance							0.111	(0.240)	0.645			
At least 3 penalties										-0.341	(0.289)	0.239
At least 3 penalties*High Medicare reliance										0.220	(0.461)	0.633
Rural	-2.377	(1.779)	0.182	-0.042	(0.210)	0.840	-0.946	(3.145)	0.763	-1.423	(4.563)	0.755
Region (ref= Central)												
Eastern	-2.353**	(0.975)	0.016				-2.249**	(1.035)	0.030	-2.177	(1.341)	0.104
Northern	-0.950***	(0.247)	0.000				-0.949***	(0.242)	0.000	-1.009**	(0.446)	0.024
Northwest	0.380	(0.341)	0.265				1.220	(0.915)	0.182	0.696	(1.050)	0.507
Southwest	-0.008	(0.233)	0.972				-0.126	(0.189)	0.504	0.008	(0.456)	0.986
CMS provider type (ref=IPPS)												
RRC	-0.267	(1.925)	0.890	0.350	(0.469)	0.457	1.530	(1.243)	0.218	0.767	(5.636)	0.892
MDH	-6.138**	(2.528)	0.015	-0.217	(0.405)	0.593	-7.934***	(2.362)	0.001	-6.570	(4.772)	0.169
SCH	-0.872***	(0.232)	0.000	0.133	(0.476)	0.780	-0.260	(0.488)	0.594	-0.485	(0.515)	0.346
SCH and RRC	-0.038	(0.350)	0.914	0.271	(0.364)	0.457	-0.665	(0.894)	0.457	-0.310	(0.570)	0.586
Not-for-profit	3.292***	(1.211)	0.007	-1.429***	(0.453)	0.002	5.177**	(2.024)	0.011	3.519***	(1.313)	0.007
Health system affiliation	3.487***	(0.760)	0.000	-0.064	(0.172)	0.712	3.147***	(0.927)	0.001	3.073	(2.353)	0.192
Total number of patient days	0.000***	(0.000)	0.001	-0.000	(0.000)	0.530	0.000**	(0.000)	0.020	0.000	(0.000)	0.219
Prior year operating margin	-13.377***	(3.420)	0.000	-0.064	(0.982)	0.948	-12.617**	(6.296)	0.045	-11.765**	(5.385)	0.029
Case mix index	2.211*	(1.216)	0.069	0.062	(0.715)	0.931	1.039	(1.420)	0.464	1.518	(3.294)	0.645
Readmission penalty	12.117	(11.134)	0.276	-3.283	(9.545)	0.731	48.935	(32.433)	0.131	55.572	(58.303)	0.341
Panel fixed effects												
Panel 2	0.101***	(0.023)	0.000	0.101	(0.133)	0.449	0.101**	(0.042)	0.016	0.093***	(0.022)	0.000

Panel 3	-0.173	(0.120)	0.148	0.058	(0.138)	0.674	-0.083	(0.147)	0.572	-0.106	(0.287)	0.712
Panel 4	0.072	(0.118)	0.542	-0.191	(0.145)	0.190	0.154	(0.127)	0.223	0.021	(0.305)	0.946
Panel 5	0.385***	(0.148)	0.009	-0.061	(0.152)	0.689	0.451	(0.289)	0.119	0.253*	(0.137)	0.065
Panel 6	-0.114	(0.115)	0.322	0.097	(0.178)	0.587	0.304	(0.230)	0.186	-0.025	(0.325)	0.939
Panel 7	0.223	(0.177)	0.209	0.090	(0.199)	0.651	0.932**	(0.413)	0.024	0.528	(0.413)	0.202
Constant	-19.020	(12.099)	0.116	6.712	(9.444)	0.478	-55.695	(35.073)	0.112	-61.249	(63.382)	0.334

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Appendices

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APPENDIX 2-9

Series of sensitivity analyses for bonuses on physician FTEs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	GLM			Panel			Accumulation			At least 3		
	coef	se	pval	coef	se	pval	coef	se	pval	coef	se	pval
Bonus	0.502	(0.496)	0.311	-0.020	(0.142)	0.887						
High Medicare reliance	0.562**	(0.238)	0.018	-0.159	(0.192)	0.407	0.557**	(0.234)	0.017	0.486	(0.567)	0.392
Bonus*High Medicare reliance	-1.507	(1.189)	0.205	0.304	(0.246)	0.218						
Cumulative bonus							0.399	(0.319)	0.211			
Cumulative bonus*High Medicare reliance							-0.678*	(0.379)	0.073			
At least 3 bonuses										-0.341	(0.289)	0.239
At least 3 bonuses*High Medicare reliance										0.220	(0.461)	0.633
Rural	-1.081**	(0.500)	0.031	-0.036	(0.207)	0.861	-1.248**	(0.587)	0.034	-1.423	(4.563)	0.755
Region (ref= Central)												
Eastern	-2.090*	(1.075)	0.052				-1.943*	(1.066)	0.068	-2.177	(1.341)	0.104
Northern	-1.314***	(0.179)	0.000				-1.360***	(0.211)	0.000	-1.009**	(0.446)	0.024
Northwest	0.682**	(0.299)	0.023				0.784**	(0.353)	0.026	0.696	(1.050)	0.507
Southwest	-0.217	(0.236)	0.358				-0.257	(0.221)	0.245	0.008	(0.456)	0.986
CMS provider type (ref=IPPS)												
RRC	0.396	(1.637)	0.809	0.247	(0.466)	0.597	0.610	(2.020)	0.763	0.767	(5.636)	0.892
MDH	-6.754**	(2.936)	0.021	-0.160	(0.405)	0.693	-6.343**	(2.804)	0.024	-6.570	(4.772)	0.169
SCH	-0.112	(0.786)	0.887	-0.050	(0.493)	0.919	-0.352	(0.460)	0.444	-0.485	(0.515)	0.346
SCH and RRC	1.048	(0.917)	0.253	0.264	(0.363)	0.467	1.091	(0.744)	0.143	-0.310	(0.570)	0.586
Not-for-profit	3.842***	(1.398)	0.006	-1.471***	(0.453)	0.001	4.795**	(2.269)	0.035	3.519***	(1.313)	0.007
Health system affiliation	3.825***	(1.077)	0.000	-0.105	(0.174)	0.547	3.933***	(1.106)	0.000	3.073	(2.353)	0.192
Total number of patient days	0.000***	(0.000)	0.002	-0.000	(0.000)	0.650	0.000***	(0.000)	0.007	0.000	(0.000)	0.219
Prior year operating margin	-11.713***	(4.096)	0.004	0.100	(0.987)	0.919	-11.767***	(4.196)	0.005	-11.765**	(5.385)	0.029
Case mix index	0.727	(1.069)	0.497	0.134	(0.710)	0.850	0.376	(1.128)	0.739	1.518	(3.294)	0.645
Readmission penalty	26.256	(25.254)	0.298	-3.660	(9.449)	0.699	18.765	(17.091)	0.272	55.572	(58.303)	0.341
Panel fixed effects												

Panel 2	0.100***	(0.031)	0.001	0.106	(0.132)	0.423	0.104***	(0.034)	0.002	0.093***	(0.022)	0.000
Panel 3	-0.036	(0.101)	0.719	0.063	(0.137)	0.645	-0.007	(0.101)	0.942	-0.106	(0.287)	0.712
Panel 4	0.030	(0.110)	0.781	-0.213	(0.148)	0.152	0.050	(0.118)	0.675	0.021	(0.305)	0.946
Panel 5	0.341*	(0.178)	0.055	-0.075	(0.151)	0.619	0.364*	(0.208)	0.079	0.253*	(0.137)	0.065
Panel 6	-0.211*	(0.111)	0.057	0.072	(0.172)	0.676	-0.218*	(0.113)	0.053	-0.025	(0.325)	0.939
Panel 7	0.281	(0.228)	0.219	0.023	(0.203)	0.910	0.295	(0.244)	0.227	0.528	(0.413)	0.202
Constant	-32.231	(27.402)	0.240	6.996	(9.354)	0.455	-25.459	(18.777)	0.175	-61.249	(63.382)	0.334

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Appendices

APPENDIX 2-10

Series of sensitivity analyses for penalties on NP/PA FTEs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	GLM			**Panel**			**Accumulation**			**At least 3**		
	coef	se	pval	coef	se	pval	coef	se	pval	coef	se	pval
Penalty	-0.164	(0.162)	0.310	0.079	(0.160)	0.624						
High Medicare reliance	0.148	(0.102)	0.147	0.323*	(0.182)	0.078	0.029	(0.169)	0.866	-0.010	(0.091)	0.909
Penalty*High Medicare reliance	0.087	(0.197)	0.657	-0.428	(0.278)	0.126						
Cumulative penalty							-0.110	(0.084)	0.192			
Cumulative penalty*High Medicare reliance							0.083	(0.105)	0.428			
At least 3 penalties										-0.585**	(0.237)	0.013
At least 3 penalties*High Medicare reliance										0.623**	(0.258)	0.016
Rural	-0.585**	(0.295)	0.047	0.112	(0.280)	0.690	-0.559*	(0.297)	0.060	-0.495*	(0.274)	0.071
Region (ref= Central)												
Eastern	-1.326***	(0.397)	0.001				-1.401***	(0.425)	0.001	-1.345***	(0.414)	0.001
Northern	-0.737***	(0.181)	0.000				-0.727***	(0.173)	0.000	-0.593***	(0.158)	0.000
Northwest	0.274	(0.206)	0.185				0.367*	(0.207)	0.076	0.477***	(0.177)	0.007
Southwest	0.066	(0.150)	0.659				0.082	(0.157)	0.601	0.276	(0.182)	0.130
CMS provider type (ref=IPPS)												
RRC	0.853**	(0.389)	0.028	-1.222**	(0.586)	0.038	0.795**	(0.388)	0.040	0.644*	(0.334)	0.054
MDH	-3.388**	(1.512)	0.025	0.361	(0.412)	0.382	-3.246**	(1.614)	0.044	-2.631**	(1.284)	0.040
SCH	-0.348	(0.225)	0.122	-0.121	(0.586)	0.836	-0.120	(0.391)	0.759	-0.026	(0.332)	0.938
SCH and RRC	0.123	(0.307)	0.689	-1.133**	(0.459)	0.014	0.058	(0.299)	0.846	-0.030	(0.271)	0.912
Not-for-profit	1.924***	(0.418)	0.000	-0.518	(0.662)	0.434	1.967***	(0.520)	0.000	1.817***	(0.475)	0.000
Health system affiliation	0.531***	(0.078)	0.000	-0.317	(0.213)	0.139	0.533***	(0.079)	0.000	0.422***	(0.083)	0.000
Total number of patient days	0.000***	(0.000)	0.000	0.000	(0.000)	0.260	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000
Prior year operating margin	-7.578***	(1.843)	0.000	-1.151	(0.884)	0.194	-7.518***	(1.995)	0.000	-6.501***	(1.505)	0.000
Case mix index	1.364**	(0.533)	0.010	-0.124	(0.828)	0.881	1.515**	(0.709)	0.033	1.682***	(0.630)	0.008
Readmission penalty	11.286	(13.039)	0.387	19.028*	(11.431)	0.097	30.075	(28.217)	0.286	51.134	(31.454)	0.104
Panel fixed effects												
Panel 2	0.082*	(0.044)	0.061	0.129	(0.143)	0.369	0.079*	(0.044)	0.071	0.074*	(0.043)	0.087

Panel 3	0.145***	(0.045)	0.001	-0.030	(0.150)	0.840	0.131**	(0.054)	0.015	0.115**	(0.046)	0.012
Panel 4	0.169**	(0.077)	0.029	0.337**	(0.165)	0.043	0.176**	(0.085)	0.038	0.200**	(0.091)	0.029
Panel 5	0.264***	(0.080)	0.001	0.298*	(0.175)	0.091	0.257***	(0.077)	0.001	0.153**	(0.067)	0.022
Panel 6	0.218*	(0.112)	0.052	0.516**	(0.202)	0.011	0.298*	(0.160)	0.063	0.300***	(0.091)	0.001
Panel 7	0.356**	(0.154)	0.021	0.497**	(0.228)	0.030	0.533**	(0.262)	0.042	0.640***	(0.177)	0.000
Constant	-13.564	(13.425)	0.312	-17.264	(11.310)	0.128	-32.560	(29.052)	0.262	-53.667*	(32.114)	0.095

*** p<0.01, ** p<0.05, * p<0.1

Appendices

APPENDIX 2-11

Series of sensitivity analyses for bonuses on NP/PA FTEs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	GLM			**Panel**			**Accumulation**			**At least 3**		
	coef	se	pval	coef	se	pval	coef	se	pval	coef	se	pval
Bonus	0.064	(0.435)	0.882	-0.059	(0.157)	0.710						
High Medicare reliance	0.216*	(0.111)	0.051	0.261	(0.184)	0.156	0.208**	(0.104)	0.046	0.215**	(0.106)	0.043
Bonus*High Medicare reliance	-0.099	(0.388)	0.798	-0.143	(0.263)	0.589						
Cumulative bonus							0.281	(0.251)	0.262			
Cumulative bonus*High Medicare reliance							-0.175	(0.216)	0.418	-0.148	(0.238)	0.535
At least 3 bonuses										1.086	(0.782)	0.165
At least 3 bonuses*High Medicare reliance										-0.113	(0.982)	0.908
Rural	-0.608*	(0.343)	0.076	0.224	(0.269)	0.405	-0.528*	(0.273)	0.053	-0.559*	(0.310)	0.072
Region (ref= Central)												
Eastern	-1.314***	(0.419)	0.002				-1.242**	(0.495)	0.012	-1.265***	(0.434)	0.004
Northern	-0.884***	(0.100)	0.000				-0.929***	(0.124)	0.000	-0.922***	(0.094)	0.000
Northwest	0.182	(0.209)	0.385				0.249	(0.222)	0.264	0.190	(0.196)	0.332
Southwest	-0.001	(0.105)	0.996				-0.010	(0.105)	0.921	-0.024	(0.110)	0.826
CMS provider type (ref=IPPS)												
RRC	0.920**	(0.435)	0.034	-1.083*	(0.585)	0.066	0.901**	(0.389)	0.020	0.902**	(0.415)	0.030
MDH	-3.702**	(1.671)	0.027	0.402	(0.413)	0.331	-3.838**	(1.757)	0.029	-3.848**	(1.761)	0.029
SCH	-0.261	(0.353)	0.460	0.026	(0.608)	0.966	-0.434	(0.301)	0.150	-0.467	(0.355)	0.188
SCH and RRC	0.104	(0.328)	0.751	-1.123**	(0.461)	0.016	0.075	(0.291)	0.796	0.067	(0.314)	0.830
Not-for-profit	1.922***	(0.436)	0.000	-0.434	(0.664)	0.514	2.421***	(0.854)	0.005	2.434**	(1.080)	0.024
Health system affiliation	0.533***	(0.090)	0.000	-0.225	(0.212)	0.291	0.535***	(0.077)	0.000	0.546***	(0.088)	0.000
Total number of patient days	0.000***	(0.000)	0.000	0.000	(0.000)	0.305	0.000***	(0.000)	0.001	0.000***	(0.000)	0.000
Prior year operating margin	-8.029***	(2.102)	0.000	-1.069	(0.886)	0.229	-8.301***	(2.243)	0.000	-8.143***	(2.182)	0.000
Case mix index	1.229**	(0.606)	0.042	-0.204	(0.833)	0.807	1.111*	(0.614)	0.070	1.154*	(0.606)	0.057
Readmission penalty	19.647	(23.654)	0.406	20.056*	(11.495)	0.082	16.325	(20.769)	0.432	20.714	(23.050)	0.369
Panel fixed effects												

Panel 2	0.087**	(0.044)	0.046	0.125	(0.144)	0.385	0.088**	(0.044)	0.046	0.090**	(0.044)	0.038
Panel 3	0.162***	(0.041)	0.000	-0.037	(0.150)	0.803	0.167***	(0.042)	0.000	0.169***	(0.043)	0.000
Panel 4	0.172*	(0.101)	0.091	0.369**	(0.170)	0.031	0.171*	(0.093)	0.066	0.186*	(0.098)	0.058
Panel 5	0.232***	(0.066)	0.000	0.316*	(0.176)	0.075	0.220***	(0.060)	0.000	0.246***	(0.067)	0.000
Panel 6	0.183**	(0.090)	0.043	0.508**	(0.199)	0.011	0.161**	(0.079)	0.041	0.190**	(0.080)	0.018
Panel 7	0.330	(0.208)	0.113	0.610**	(0.242)	0.013	0.296*	(0.173)	0.088	0.339*	(0.199)	0.089
Constant	-21.743	(23.946)	0.364	-18.313	(11.373)	0.109	-18.941	(21.063)	0.369	-23.250	(23.679)	0.326

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Appendices

APPENDIX 2-12

Series of sensitivity analyses for penalties on RN FTEs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	GLM			Panel			Accumulation			At least 3		
	coef	se	pval	coef	se	pval	coef	se	pval	coef	se	pval
Penalty	-0.030	(0.050)	0.552	-0.017	(0.018)	0.356						
High Medicare reliance	0.000	(0.063)	0.998	-0.043**	(0.019)	0.023	0.006	(0.073)	0.934	-0.001	(0.055)	0.986
Penalty*High Medicare reliance	0.013	(0.086)	0.878	-0.026	(0.027)	0.347						
Cumulative penalty							0.001	(0.041)	0.986			
Cumulative penalty*High Medicare reliance							-0.002	(0.052)	0.974			
At least 3 penalties										0.077	(0.081)	0.343
At least 3 penalties*High Medicare reliance										0.010	(0.128)	0.937
Rural	-0.455***	(0.138)	0.001	0.023	(0.026)	0.370	-0.457***	(0.138)	0.001	-0.448***	(0.138)	0.001
Region (ref= Central)												
Eastern	-0.239**	(0.110)	0.029				-0.234**	(0.117)	0.045	-0.233**	(0.105)	0.027
Northern	-0.235***	(0.054)	0.000				-0.243***	(0.058)	0.000	-0.257***	(0.059)	0.000
Northwest	0.154**	(0.064)	0.016				0.146**	(0.066)	0.027	0.131**	(0.059)	0.027
Southwest	-0.012	(0.054)	0.833				-0.013	(0.055)	0.817	-0.017	(0.055)	0.760
CMS provider type (ref=IPPS)												
RRC	0.229	(0.147)	0.119	-0.047	(0.075)	0.536	0.224	(0.149)	0.133	0.211	(0.158)	0.182
MDH	-0.231	(0.329)	0.481	-0.117***	(0.037)	0.002	-0.238	(0.333)	0.474	-0.245	(0.339)	0.469
SCH	-0.012	(0.114)	0.919	-0.117	(0.078)	0.135	-0.009	(0.122)	0.944	-0.003	(0.125)	0.978
SCH and RRC	0.121	(0.099)	0.221	0.000	(0.062)	0.995	0.116	(0.097)	0.236	0.121	(0.098)	0.217
Not-for-profit	0.167**	(0.083)	0.046	0.164**	(0.070)	0.019	0.165*	(0.084)	0.051	0.168**	(0.084)	0.046
Health system affiliation	0.035	(0.062)	0.573	-0.003	(0.022)	0.878	0.029	(0.067)	0.662	0.035	(0.059)	0.550

Total number of patient days	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000
Prior year operating margin	0.836*	(0.475)	0.078	0.193**	(0.091)	0.034	0.830*	(0.484)	0.086	0.837*	(0.503)	0.096
Case mix index	0.747***	(0.170)	0.000	0.019	(0.089)	0.830	0.735***	(0.192)	0.000	0.721***	(0.167)	0.000
Readmission penalty	-3.399	(4.253)	0.424	0.718	(1.081)	0.507	-3.127	(5.040)	0.535	-3.309	(5.029)	0.511
Panel fixed effects												
Panel 2	0.066	(0.047)	0.167	0.024	(0.017)	0.156	0.066	(0.047)	0.163	0.066	(0.047)	0.160
Panel 3	0.024	(0.021)	0.257	0.021	(0.017)	0.215	0.024	(0.021)	0.251	0.024	(0.020)	0.229
Panel 4	0.000	(0.022)	0.994	0.034*	(0.018)	0.062	-0.003	(0.022)	0.889	-0.003	(0.021)	0.884
Panel 5	-0.038	(0.028)	0.179	0.018	(0.019)	0.340	-0.048	(0.032)	0.130	-0.049*	(0.028)	0.082
Panel 6	-0.064	(0.050)	0.205	0.050**	(0.022)	0.026	-0.079	(0.060)	0.189	-0.095*	(0.051)	0.065
Panel 7	-0.074*	(0.039)	0.055	0.040*	(0.024)	0.095	-0.086	(0.072)	0.233	-0.115**	(0.054)	0.032
Constant	7.685*	(4.274)	0.072	4.214***	(1.075)	0.000	7.439	(5.136)	0.147	7.637	(5.081)	0.133

*** p<0.01, ** p<0.05, * p<0.1

APPENDIX 2-13

Series of sensitivity analyses for bonuses on RN FTEs

VARIABLES	(1) GLM coef	(2) se	(3) pval	(4) Panel coef	(5) se	(6) pval	(7) Accumulation coef	(8) se	(9) pval	(10) At least 3 coef	(11) se	(12) pval
Bonus	0.139***	(0.049)	0.005	0.008	(0.018)	0.659						
High Medicare reliance	0.016	(0.048)	0.744	-0.051***	(0.020)	0.010	0.004	(0.048)	0.941	0.009	(0.050)	0.861
Bonus*High Medicare reliance	-0.123*	(0.071)	0.080	0.008	(0.026)	0.767						
Cumulative bonus							0.082***	(0.025)	0.001			
Cumulative bonus*High Medicare reliance							-0.056**	(0.025)	0.025	0.001	(0.039)	0.973
At least 3 bonuses										0.250***	(0.096)	0.009
At least 3 bonuses*High Medicare reliance										-0.197	(0.133)	0.139
Rural	-0.449***	(0.133)	0.001	0.033	(0.026)	0.200	-0.438***	(0.130)	0.001	-0.453***	(0.138)	0.001
Region (ref= Central)												
Eastern	-0.248**	(0.105)	0.018				-0.252**	(0.107)	0.019	-0.241**	(0.107)	0.024
Northern	-0.249***	(0.051)	0.000				-0.256***	(0.048)	0.000	-0.266***	(0.055)	0.000
Northwest	0.141**	(0.062)	0.023				0.153***	(0.059)	0.010	0.142**	(0.062)	0.022
Southwest	-0.011	(0.052)	0.830				-0.001	(0.053)	0.989	-0.027	(0.054)	0.612
CMS provider type (ref=IPPS)												
RRC	0.228	(0.153)	0.135	-0.041	(0.076)	0.585	0.227	(0.147)	0.124	0.239	(0.148)	0.105
MDH	-0.243	(0.327)	0.456	-0.119***	(0.037)	0.001	-0.224	(0.316)	0.478	-0.233	(0.324)	0.472
SCH	-0.021	(0.113)	0.854	-0.118	(0.079)	0.138	-0.035	(0.115)	0.762	-0.032	(0.125)	0.795
SCH and RRC	0.126	(0.093)	0.176	0.000	(0.062)	0.994	0.119	(0.088)	0.177	0.110	(0.094)	0.243
Not-for-profit	0.199***	(0.077)	0.009	0.164**	(0.070)	0.020	0.231***	(0.077)	0.003	0.191***	(0.073)	0.009
Health system affiliation	0.036	(0.054)	0.507	-0.006	(0.023)	0.799	0.044	(0.055)	0.428	0.043	(0.056)	0.436
Total number of patient days	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000
Prior year operating margin	0.754	(0.475)	0.112	0.197**	(0.091)	0.031	0.851*	(0.466)	0.068	0.767	(0.474)	0.106
Case mix index	0.742***	(0.163)	0.000	0.001	(0.088)	0.989	0.758***	(0.159)	0.000	0.696***	(0.165)	0.000
Readmission penalty	-5.166	(3.991)	0.196	0.676	(1.084)	0.533	-2.940	(3.986)	0.461	-3.372	(4.022)	0.402
Panel fixed effects												
Panel 2	0.066	(0.047)	0.160	0.024	(0.017)	0.152	0.066	(0.048)	0.165	0.066	(0.046)	0.155

Panel 3	0.024	(0.021)	0.241	0.023	(0.017)	0.192	0.023	(0.021)	0.282	0.025	(0.020)	0.200
Panel 4	-0.027	(0.020)	0.165	0.024	(0.019)	0.193	-0.015	(0.018)	0.404	-0.003	(0.018)	0.889
Panel 5	-0.071***	(0.027)	0.009	0.006	(0.019)	0.742	-0.073***	(0.027)	0.007	-0.047*	(0.027)	0.085
Panel 6	-0.102**	(0.050)	0.042	0.038*	(0.022)	0.087	-0.112**	(0.052)	0.031	-0.095*	(0.050)	0.061
Panel 7	-0.121***	(0.040)	0.003	0.029	(0.025)	0.236	-0.133***	(0.043)	0.002	-0.103***	(0.038)	0.007
Constant	9.419**	(4.019)	0.019	4.271***	(1.078)	0.000	7.124*	(4.050)	0.079	7.701*	(4.061)	0.058

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

APPENDIX 2-14

Series of sensitivity analyses for penalties on LPN FTEs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	GLM			**Panel**			**Accumulation**			**At least 3**		
	coef	se	pval	coef	se	pval	coef	se	pval	coef	se	pval
Penalty	-0.016	(0.121)	0.897	0.278***	(0.093)	0.003						
High Medicare reliance	-0.001	(0.116)	0.993	0.037	(0.089)	0.675	-0.026	(0.131)	0.845	-0.091	(0.134)	0.496
Penalty*High Medicare reliance	-0.279	(0.205)	0.173	-0.083	(0.133)	0.533						
Cumulative penalty							-0.028	(0.074)	0.706			
Cumulative penalty*High Medicare reliance							-0.077	(0.088)	0.380			
At least 3 penalties										-0.032	(0.176)	0.854
At least 3 penalties*High Medicare reliance										0.003	(0.167)	0.985
Rural	-0.036	(0.165)	0.826	-0.063	(0.123)	0.610	-0.029	(0.170)	0.865	-0.001	(0.181)	0.994
Region (ref= Central)												
Eastern	-0.397***	(0.151)	0.008				-0.410***	(0.153)	0.007	-0.386**	(0.155)	0.013
Northern	-2.338***	(0.203)	0.000				-2.321***	(0.202)	0.000	-2.339***	(0.205)	0.000
Northwest	-0.091	(0.135)	0.499				-0.089	(0.146)	0.541	-0.090	(0.138)	0.516
Southwest	-0.238**	(0.100)	0.017				-0.241**	(0.100)	0.016	-0.232**	(0.104)	0.026
CMS provider type (ref=IPPS)												
RRC	-0.037	(0.306)	0.904	-0.096	(0.356)	0.787	-0.038	(0.309)	0.903	-0.060	(0.309)	0.846
MDH	-0.451	(0.316)	0.154	-0.199	(0.173)	0.251	-0.472	(0.323)	0.144	-0.419	(0.330)	0.203
SCH	-0.117	(0.189)	0.535	0.292	(0.367)	0.427	-0.125	(0.196)	0.524	-0.097	(0.221)	0.660
SCH and RRC	0.501**	(0.203)	0.014	0.080	(0.291)	0.783	0.469**	(0.200)	0.019	0.438**	(0.213)	0.040
Not-for-profit	0.683***	(0.137)	0.000	0.285	(0.331)	0.389	0.694***	(0.140)	0.000	0.677***	(0.135)	0.000

Health system affiliation	0.242**	(0.096)	0.012	-0.131	(0.106)	0.220	0.241**	(0.094)	0.010	0.253***	(0.096)	0.008
Total number of patient days	0.000***	(0.000)	0.000	0.000**	(0.000)	0.027	0.000***	(0.000)	0.000	0.000***	(0.000)	0.001
Prior year operating margin	-0.641	(0.782)	0.412	-0.865**	(0.433)	0.047	-0.715	(0.787)	0.364	-0.558	(0.811)	0.492
Case mix index	0.862***	(0.314)	0.006	-0.550	(0.445)	0.217	0.879***	(0.330)	0.008	0.835**	(0.347)	0.016
Readmission penalty	-3.036	(7.356)	0.680	15.075***	(5.170)	0.004	-3.908	(7.393)	0.597	-2.843	(6.713)	0.672
Panel fixed effects												
Panel 2	0.043	(0.033)	0.184	0.027	(0.081)	0.742	0.043	(0.033)	0.195	0.042	(0.034)	0.211
Panel 3	0.062	(0.062)	0.318	0.028	(0.083)	0.739	0.063	(0.063)	0.318	0.064	(0.062)	0.303
Panel 4	0.059	(0.068)	0.384	-0.042	(0.089)	0.635	0.017	(0.075)	0.822	-0.003	(0.075)	0.969
Panel 5	0.060	(0.099)	0.547	-0.122	(0.093)	0.190	0.058	(0.107)	0.590	0.017	(0.101)	0.864
Panel 6	0.014	(0.101)	0.886	-0.218**	(0.110)	0.048	0.022	(0.115)	0.847	-0.035	(0.111)	0.750
Panel 7	-0.056	(0.098)	0.571	-0.161	(0.117)	0.170	-0.010	(0.130)	0.942	-0.063	(0.123)	0.611
Constant	4.299	(7.251)	0.553	-12.077**	(5.138)	0.019	5.166	(7.257)	0.477	4.154	(6.634)	0.531

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Appendices

APPENDIX 2-15

Series of sensitivity analyses for bonuses on LPN FTEs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	GLM			Panel			Accumulation			At least 3		
	coef	se	pval	coef	se	pval	coef	se	pval	coef	se	pval
Bonus	0.193	(0.144)	0.180	0.024	(0.087)	0.780						
High Medicare reliance	-0.081	(0.122)	0.507	0.125	(0.093)	0.181	-0.098	(0.116)	0.397	-0.120	(0.138)	0.382
Bonus*High Medicare reliance	-0.072	(0.181)	0.691	-0.331***	(0.124)	0.008						
Cumulative bonus							0.135	(0.102)	0.188			
Cumulative bonus*High Medicare reliance							-0.019	(0.098)	0.846	0.083	(0.093)	0.370
At least 3 bonuses										0.272	(0.272)	0.318
At least 3 bonuses*High Medicare reliance										-0.208	(0.279)	0.455
Rural	0.001	(0.165)	0.993	-0.138	(0.122)	0.257	0.022	(0.160)	0.890	0.024	(0.180)	0.893
Region (ref= Central)												
Eastern	-0.402***	(0.150)	0.007				-0.414***	(0.146)	0.005	-0.404***	(0.153)	0.008
Northern	-2.356***	(0.205)	0.000				-2.369***	(0.200)	0.000	-2.366***	(0.204)	0.000
Northwest	-0.100	(0.121)	0.408				-0.099	(0.109)	0.365	-0.098	(0.121)	0.419
Southwest	-0.236**	(0.104)	0.023				-0.226**	(0.105)	0.031	-0.249**	(0.104)	0.016
CMS provider type (ref=IPPS)												
RRC	-0.069	(0.314)	0.826	-0.015	(0.357)	0.966	-0.078	(0.311)	0.802	-0.069	(0.307)	0.823
MDH	-0.423	(0.330)	0.200	-0.144	(0.172)	0.405	-0.432	(0.328)	0.188	-0.435	(0.329)	0.186
SCH	-0.139	(0.219)	0.526	0.435	(0.373)	0.244	-0.221	(0.198)	0.265	-0.204	(0.205)	0.320
SCH and RRC	0.432**	(0.181)	0.017	0.074	(0.292)	0.799	0.410***	(0.152)	0.007	0.419**	(0.171)	0.014
Not-for-profit	0.752***	(0.156)	0.000	0.286	(0.332)	0.389	0.845***	(0.210)	0.000	0.724***	(0.145)	0.000

Health system affiliation	0.259***	(0.090)	0.004	-0.086	(0.107)	0.424	0.254***	(0.088)	0.004	0.261***	(0.095)	0.006
Total number of patient days	0.000***	(0.000)	0.000	0.000*	(0.000)	0.056	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000
Prior year operating margin	-0.649	(0.862)	0.452	-0.978**	(0.433)	0.025	-0.737	(0.908)	0.417	-0.679	(0.851)	0.425
Case mix index	0.829**	(0.325)	0.011	-0.497	(0.443)	0.263	0.876***	(0.317)	0.006	0.825**	(0.327)	0.012
Readmission penalty	-4.715	(6.495)	0.468	14.927***	(5.174)	0.004	-4.324	(6.592)	0.512	-3.674	(6.900)	0.594
Panel fixed effects												
Panel 2	0.044	(0.033)	0.189	0.025	(0.081)	0.754	0.045	(0.034)	0.182	0.043	(0.034)	0.212
Panel 3	0.066	(0.062)	0.288	0.020	(0.083)	0.808	0.068	(0.064)	0.288	0.066	(0.064)	0.303
Panel 4	-0.039	(0.088)	0.653	0.057	(0.092)	0.535	-0.020	(0.074)	0.791	-0.001	(0.077)	0.992
Panel 5	-0.016	(0.111)	0.884	-0.016	(0.095)	0.870	-0.027	(0.108)	0.804	0.012	(0.109)	0.911
Panel 6	-0.076	(0.106)	0.474	-0.118	(0.109)	0.279	-0.114	(0.106)	0.283	-0.075	(0.107)	0.480
Panel 7	-0.139	(0.124)	0.262	-0.032	(0.124)	0.796	-0.182	(0.124)	0.143	-0.127	(0.129)	0.323
Constant	5.941	(6.427)	0.355	-11.983**	(5.141)	0.020	5.395	(6.513)	0.407	4.952	(6.858)	0.470

*** p<0.01, ** p<0.05, * p<0.1

Appendices

APPENDIX 2-16

Series of sensitivity analyses for penaltiess on nursing aide FTEs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	GLM			**Panel**			**Accumulation**			**At least 3**		
	coef	se	pval	coef	se	pval	coef	se	pval	coef	se	pval
Penalty	-0.160	(0.111)	0.151	-0.150**	(0.075)	0.048						
High Medicare reliance	0.281	(0.171)	0.100	0.079	(0.075)	0.298	0.269	(0.180)	0.135	0.260	(0.167)	0.118
Penalty*High Medicare reliance	-0.129	(0.204)	0.526	0.224**	(0.111)	0.045						
Cumulative penalty							-0.095	(0.077)	0.220			
Cumulative penalty*High Medicare reliance							-0.020	(0.095)	0.835			
At least 3 penalties										-0.186	(0.153)	0.226
At least 3 penalties*High Medicare reliance										0.006	(0.249)	0.980
Rural	-1.176***	(0.401)	0.003	0.222**	(0.105)	0.035	-1.206***	(0.399)	0.002	-1.226***	(0.401)	0.002
Region (ref= Central)												
Eastern	-0.010	(0.199)	0.960				-0.014	(0.211)	0.947	0.024	(0.202)	0.904
Northern	-0.403***	(0.142)	0.005				-0.391***	(0.134)	0.003	-0.393***	(0.149)	0.008
Northwest	-0.251*	(0.134)	0.062				-0.237*	(0.134)	0.077	-0.257*	(0.136)	0.059
Southwest	-0.678*	(0.395)	0.086				-0.680*	(0.400)	0.089	-0.644*	(0.388)	0.097
CMS provider type (ref=IPPS)												
RRC	0.831*	(0.502)	0.098	-0.027	(0.305)	0.930	0.892*	(0.497)	0.073	0.834	(0.536)	0.120
MDH	0.564	(0.459)	0.219	-0.011	(0.148)	0.941	0.606	(0.481)	0.208	0.621	(0.471)	0.187
SCH	0.711*	(0.382)	0.063	0.042	(0.314)	0.894	0.733*	(0.393)	0.062	0.755*	(0.389)	0.053
SCH and RRC	0.257	(0.231)	0.265	-0.069	(0.249)	0.781	0.192	(0.227)	0.398	0.128	(0.225)	0.570
Not-for-profit	-0.408*	(0.228)	0.073	0.199	(0.283)	0.482	-0.406*	(0.238)	0.088	-0.439*	(0.237)	0.064

Health system affiliation	-0.170	(0.135)	0.208	-0.026	(0.091)	0.777	-0.186	(0.145)	0.199	-0.210	(0.131)	0.110
Total number of patient days	0.000***	(0.000)	0.000	0.000	(0.000)	0.192	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000
Prior year operating margin	1.071	(0.936)	0.253	-0.166	(0.378)	0.660	1.003	(0.958)	0.295	1.099	(0.930)	0.237
Case mix index	0.276	(0.429)	0.520	0.097	(0.359)	0.787	0.306	(0.420)	0.466	0.326	(0.423)	0.441
Readmission penalty	-15.689*	(8.521)	0.066	4.348	(4.380)	0.321	-14.110	(8.583)	0.100	-13.360	(8.370)	0.110
Panel fixed effects												
Panel 2	0.058	(0.044)	0.190	0.031	(0.068)	0.645	0.059	(0.044)	0.177	0.059	(0.044)	0.183
Panel 3	0.084	(0.060)	0.160	-0.002	(0.070)	0.983	0.083	(0.060)	0.166	0.078	(0.058)	0.179
Panel 4	-0.013	(0.096)	0.894	0.021	(0.074)	0.780	-0.024	(0.093)	0.796	-0.039	(0.088)	0.654
Panel 5	0.020	(0.085)	0.818	0.050	(0.077)	0.518	0.016	(0.085)	0.848	-0.017	(0.072)	0.812
Panel 6	-0.195*	(0.112)	0.081	0.126	(0.090)	0.163	-0.178	(0.117)	0.128	-0.255*	(0.151)	0.091
Panel 7	-0.086	(0.083)	0.305	0.200**	(0.096)	0.038	-0.027	(0.108)	0.798	-0.094	(0.096)	0.326
Constant	19.833**	(8.528)	0.020	-1.233	(4.353)	0.777	18.245**	(8.526)	0.032	17.499**	(8.302)	0.035

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Appendices

APPENDIX 2-17

Series of sensitivity analyses for bonuses on nursing aide FTEs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	GLM			Panel			Accumulation			At least 3		
	coef	se	pval	coef	se	pval	coef	se	pval	coef	se	pval
Bonus	0.028	(0.110)	0.800	-0.023	(0.074)	0.753						
High Medicare reliance	0.213	(0.148)	0.151	0.109	(0.079)	0.171	0.171	(0.157)	0.277	0.223	(0.155)	0.149
Bonus*High Medicare reliance	0.107	(0.236)	0.651	0.053	(0.106)	0.619						
Cumulative bonus							0.071	(0.063)	0.257			
Cumulative bonus*High Medicare reliance							0.054	(0.080)	0.494			
At least 3 bonuses										-0.372	(0.272)	0.171
At least 3 bonuses*High Medicare reliance										0.584*	(0.309)	0.059
Rural	-1.166***	(0.434)	0.007	0.211**	(0.104)	0.044	-1.094***	(0.420)	0.009	-1.158***	(0.420)	0.006
Region (ref= Central)												
Eastern	0.006	(0.196)	0.976				-0.032	(0.193)	0.869	0.009	(0.190)	0.963
Northern	-0.420***	(0.156)	0.007				-0.447***	(0.159)	0.005	-0.381**	(0.175)	0.029
Northwest	-0.272**	(0.138)	0.049				-0.250*	(0.133)	0.060	-0.279**	(0.127)	0.028
Southwest	-0.655*	(0.379)	0.084				-0.673*	(0.401)	0.093	-0.651*	(0.375)	0.082
CMS provider type (ref=IPPS)												
RRC	0.772	(0.525)	0.142	-0.077	(0.307)	0.803	0.778	(0.502)	0.122	0.735	(0.534)	0.169
MDH	0.581	(0.461)	0.208	-0.045	(0.148)	0.763	0.574	(0.500)	0.250	0.584	(0.475)	0.219
SCH	0.726*	(0.385)	0.059	0.033	(0.321)	0.918	0.630	(0.409)	0.123	0.670*	(0.383)	0.080
SCH and RRC	0.172	(0.214)	0.423	-0.067	(0.251)	0.790	0.164	(0.202)	0.417	0.149	(0.191)	0.435
Not-for-profit	-0.421*	(0.222)	0.058	0.231	(0.285)	0.418	-0.351	(0.237)	0.137	-0.460**	(0.223)	0.039

Health system affiliation	-0.189	(0.127)	0.138	-0.038	(0.092)	0.681	-0.165	(0.133)	0.217	-0.201	(0.124)	0.104
Total number of patient days	0.000***	(0.000)	0.000	0.000	(0.000)	0.194	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000
Prior year operating margin	1.151	(0.942)	0.222	-0.119	(0.380)	0.753	1.046	(0.958)	0.275	1.282	(0.966)	0.185
Case mix index	0.318	(0.426)	0.455	0.122	(0.359)	0.733	0.315	(0.400)	0.431	0.376	(0.438)	0.391
Readmission penalty	-14.538*	(7.727)	0.060	4.915	(4.404)	0.265	-14.692*	(8.547)	0.086	-12.655	(7.748)	0.102
Panel fixed effects												
Panel 2	0.060	(0.044)	0.178	0.032	(0.069)	0.642	0.061	(0.043)	0.160	0.060	(0.044)	0.170
Panel 3	0.081	(0.058)	0.162	-0.002	(0.070)	0.973	0.082	(0.058)	0.156	0.080	(0.056)	0.155
Panel 4	-0.061	(0.103)	0.556	0.003	(0.076)	0.971	-0.064	(0.086)	0.455	-0.027	(0.084)	0.742
Panel 5	-0.040	(0.089)	0.654	0.030	(0.079)	0.707	-0.079	(0.082)	0.340	-0.007	(0.068)	0.920
Panel 6	-0.295*	(0.161)	0.066	0.108	(0.090)	0.228	-0.352**	(0.145)	0.015	-0.251	(0.163)	0.122
Panel 7	-0.158	(0.102)	0.122	0.168*	(0.101)	0.097	-0.266*	(0.138)	0.054	-0.108	(0.093)	0.243
Constant	18.658**	(7.670)	0.015	-1.851	(4.376)	0.672	18.765**	(8.505)	0.027	16.747**	(7.583)	0.027

*** p<0.01, ** p<0.05, * p<0.1

APPENDIX 2-18

Series of sensitivity analyses for penalties on all nursing FTEs (RN and LPN)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	GLM			**Panel**			**Accumulation**			**At least 3**		
	coef	se	pval	coef	se	pval	coef	se	pval	coef	se	pval
Penalty	-0.023	(0.049)	0.636	-0.003	(0.019)	0.859						
High Medicare reliance	0.008	(0.063)	0.903	-0.042**	(0.020)	0.035	0.013	(0.072)	0.857	0.002	(0.055)	0.972
Penalty*High Medicare reliance	-0.007	(0.090)	0.936	-0.031	(0.029)	0.280						
Cumulative penalty							0.004	(0.040)	0.911			
Cumulative penalty*High Medicare reliance							-0.009	(0.051)	0.861			
At least 3 penalties										0.086	(0.077)	0.263
At least 3 penalties*High Medicare reliance										-0.004	(0.123)	0.973
Rural	-0.411***	(0.139)	0.003	0.014	(0.027)	0.602	-0.413***	(0.140)	0.003	-0.404***	(0.140)	0.004
Region (ref= Central)												
Eastern	-0.251**	(0.108)	0.020				-0.245**	(0.114)	0.032	-0.244**	(0.104)	0.018
Northern	-0.296***	(0.055)	0.000				-0.305***	(0.059)	0.000	-0.318***	(0.060)	0.000
Northwest	0.131**	(0.065)	0.044				0.122*	(0.067)	0.070	0.108*	(0.060)	0.073
Southwest	-0.029	(0.054)	0.599				-0.030	(0.055)	0.586	-0.034	(0.054)	0.531
CMS provider type (ref=IPPS)												
RRC	0.208	(0.142)	0.143	-0.071	(0.080)	0.376	0.201	(0.144)	0.162	0.189	(0.152)	0.213
MDH	-0.252	(0.327)	0.441	-0.108***	(0.039)	0.005	-0.260	(0.330)	0.432	-0.263	(0.336)	0.435
SCH	-0.021	(0.119)	0.862	-0.092	(0.082)	0.264	-0.019	(0.126)	0.881	-0.012	(0.129)	0.927
SCH and RRC	0.151	(0.108)	0.159	0.007	(0.065)	0.920	0.144	(0.108)	0.180	0.148	(0.108)	0.169
Not-for-profit	0.196**	(0.082)	0.017	0.158**	(0.074)	0.034	0.194**	(0.083)	0.020	0.197**	(0.083)	0.017

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Health system affiliation	0.048	(0.060)	0.423	-0.019	(0.024)	0.418	0.043	(0.065)	0.510	0.050	(0.057)	0.381
Total number of patient days	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000
Prior year operating margin	0.724	(0.464)	0.119	0.083	(0.096)	0.387	0.721	(0.469)	0.124	0.734	(0.486)	0.131
Case mix index	0.754***	(0.169)	0.000	0.025	(0.093)	0.786	0.738***	(0.189)	0.000	0.725***	(0.166)	0.000
Readmission penalty	-3.225	(4.060)	0.427	1.473	(1.142)	0.198	-3.038	(4.708)	0.519	-3.143	(4.720)	0.506
Panel fixed effects												
Panel 2	0.064	(0.045)	0.160	0.020	(0.018)	0.267	0.064	(0.045)	0.156	0.064	(0.045)	0.153
Panel 3	0.024	(0.021)	0.261	0.019	(0.018)	0.308	0.025	(0.021)	0.251	0.025	(0.021)	0.235
Panel 4	0.000	(0.023)	0.999	0.025	(0.019)	0.193	-0.005	(0.022)	0.824	-0.005	(0.022)	0.810
Panel 5	-0.036	(0.027)	0.185	0.006	(0.020)	0.780	-0.045	(0.031)	0.145	-0.045	(0.029)	0.117
Panel 6	-0.064	(0.049)	0.194	0.034	(0.023)	0.146	-0.079	(0.058)	0.170	-0.094*	(0.050)	0.060
Panel 7	-0.076**	(0.037)	0.044	0.021	(0.025)	0.404	-0.089	(0.067)	0.188	-0.116**	(0.052)	0.025
Constant	7.562*	(4.069)	0.063	3.558***	(1.135)	0.002	7.406	(4.789)	0.122	7.522	(4.761)	0.114

*** p<0.01, ** p<0.05, * p<0.1

APPENDIX 2-19

Series of sensitivity analyses for bonuses on all nursing FTEs (RN and LPN)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	GLM			Panel			Accumulation			At least 3		
	coef	se	pval	coef	se	pval	coef	se	pval	coef	se	pval
Bonus	0.136***	(0.049)	0.005	0.017	(0.019)	0.359						
High Medicare reliance	0.015	(0.049)	0.759	-0.040*	(0.021)	0.055	0.002	(0.049)	0.962	0.009	(0.047)	0.844
Bonus*High Medicare reliance	-0.115*	(0.069)	0.095	-0.029	(0.027)	0.293						
Cumulative bonus							0.082***	(0.024)	0.001			
Cumulative bonus*High Medicare reliance							-0.050**	(0.024)	0.036			
At least 3 bonuses										0.248***	(0.086)	0.004
At least 3 bonuses*High Medicare reliance										-0.177**	(0.089)	0.047
Rural	-0.404***	(0.135)	0.003	0.019	(0.027)	0.495	-0.392***	(0.131)	0.003	-0.407***	(0.138)	0.003
Region (ref= Central)												
Eastern	-0.260**	(0.104)	0.012				-0.264**	(0.105)	0.012	-0.253**	(0.102)	0.014
Northern	-0.309***	(0.052)	0.000				-0.315***	(0.049)	0.000	-0.325***	(0.055)	0.000
Northwest	0.119*	(0.062)	0.056				0.131**	(0.060)	0.028	0.119*	(0.061)	0.050
Southwest	-0.028	(0.053)	0.598				-0.018	(0.053)	0.742	-0.043	(0.053)	0.418
CMS provider type (ref=IPPS)												
RRC	0.206	(0.147)	0.161	-0.056	(0.080)	0.486	0.204	(0.142)	0.152	0.217	(0.142)	0.126
MDH	-0.258	(0.326)	0.428	-0.107***	(0.038)	0.005	-0.241	(0.317)	0.448	-0.250	(0.324)	0.441
SCH	-0.028	(0.119)	0.812	-0.076	(0.084)	0.364	-0.048	(0.118)	0.687	-0.044	(0.128)	0.730
SCH and RRC	0.153	(0.101)	0.129	0.006	(0.065)	0.931	0.145	(0.094)	0.124	0.136	(0.101)	0.176
Not-for-profit	0.229***	(0.076)	0.003	0.160**	(0.074)	0.032	0.261***	(0.078)	0.001	0.220***	(0.073)	0.002

	(1)			(2)			(3)			(4)		
Health system affiliation	0.051	(0.053)	0.332	-0.017	(0.024)	0.466	0.058	(0.053)	0.273	0.058	(0.053)	0.271
Total number of patient days	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000
Prior year operating margin	0.656	(0.464)	0.158	0.078	(0.096)	0.414	0.742	(0.456)	0.104	0.664	(0.464)	0.152
Case mix index	0.749***	(0.163)	0.000	0.008	(0.093)	0.934	0.767***	(0.159)	0.000	0.706***	(0.161)	0.000
Readmission penalty	-4.945	(3.869)	0.201	1.391	(1.142)	0.224	-2.808	(3.797)	0.460	-3.229	(3.857)	0.403
Panel fixed effects												
Panel 2	0.065	(0.045)	0.154	0.020	(0.018)	0.255	0.064	(0.046)	0.160	0.064	(0.044)	0.150
Panel 3	0.024	(0.021)	0.255	0.019	(0.018)	0.291	0.022	(0.021)	0.298	0.025	(0.020)	0.212
Panel 4	-0.029	(0.022)	0.189	0.020	(0.020)	0.314	-0.017	(0.020)	0.388	-0.005	(0.020)	0.806
Panel 5	-0.067**	(0.030)	0.022	-0.002	(0.020)	0.908	-0.070**	(0.029)	0.017	-0.043	(0.027)	0.106
Panel 6	-0.102**	(0.050)	0.043	0.025	(0.023)	0.277	-0.112**	(0.052)	0.032	-0.094*	(0.050)	0.058
Panel 7	-0.120***	(0.042)	0.005	0.018	(0.026)	0.500	-0.133***	(0.046)	0.004	-0.103***	(0.038)	0.007
Constant	9.244**	(3.886)	0.017	3.652***	(1.135)	0.001	7.039*	(3.851)	0.068	7.601*	(3.887)	0.051

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Appendices

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APPENDIX 2-20

Series of sensitivity analyses for penalties on nursing and nursing aide FTEs (RN, LPN and aide)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	GLM			Panel			Accumulation			At least 3		
	coef	se	pval	coef	se	pval	coef	se	pval	coef	se	pval
Penalty	-0.042	(0.053)	0.429	-0.022	(0.023)	0.336						
High Medicare reliance	0.058	(0.073)	0.425	-0.013	(0.023)	0.569	0.063	(0.080)	0.427	0.052	(0.065)	0.426
Penalty*High Medicare reliance	-0.026	(0.100)	0.797	0.005	(0.034)	0.875						
Cumulative penalty							-0.006	(0.042)	0.882			
Cumulative penalty*High Medicare reliance							-0.017	(0.053)	0.751			
At least 3 penalties										0.064	(0.080)	0.426
At least 3 penalties*High Medicare reliance										-0.026	(0.133)	0.846
Rural	-0.504***	(0.171)	0.003	0.046	(0.032)	0.152	-0.510***	(0.172)	0.003	-0.502***	(0.174)	0.004
Region (ref= Central)												
Eastern	-0.223**	(0.107)	0.038				-0.219*	(0.113)	0.052	-0.213**	(0.103)	0.038
Northern	-0.311***	(0.053)	0.000				-0.317***	(0.056)	0.000	-0.331***	(0.059)	0.000
Northwest	0.059	(0.068)	0.381				0.054	(0.069)	0.437	0.038	(0.063)	0.549
Southwest	-0.154***	(0.057)	0.006				-0.155***	(0.056)	0.006	-0.156***	(0.057)	0.006
CMS provider type (ref=IPPS)												
RRC	0.295*	(0.168)	0.078	-0.057	(0.093)	0.540	0.291*	(0.168)	0.083	0.275	(0.178)	0.121
MDH	-0.137	(0.346)	0.691	-0.106**	(0.045)	0.020	-0.143	(0.346)	0.679	-0.146	(0.356)	0.682
SCH	0.100	(0.133)	0.449	-0.075	(0.096)	0.435	0.103	(0.137)	0.452	0.112	(0.145)	0.442
SCH and RRC	0.169	(0.121)	0.161	-0.006	(0.076)	0.941	0.156	(0.120)	0.195	0.153	(0.122)	0.210
Not-for-profit	0.088	(0.060)	0.145	0.174**	(0.086)	0.044	0.086	(0.062)	0.163	0.086	(0.060)	0.149

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Health system affiliation	0.024	(0.065)	0.710	-0.019	(0.028)	0.487	0.015	(0.069)	0.822	0.021	(0.061)	0.734
Total number of patient days	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000
Prior year operating margin	0.757	(0.483)	0.117	0.035	(0.112)	0.753	0.750	(0.480)	0.118	0.775	(0.503)	0.123
Case mix index	0.693***	(0.175)	0.000	0.013	(0.109)	0.904	0.680***	(0.194)	0.000	0.667***	(0.173)	0.000
Readmission penalty	-6.083*	(3.412)	0.075	2.216*	(1.332)	0.097	-5.690	(3.730)	0.127	-5.778	(3.910)	0.140
Panel fixed effects												
Panel 2	0.064	(0.044)	0.147	0.025	(0.021)	0.227	0.064	(0.044)	0.144	0.064	(0.044)	0.141
Panel 3	0.036***	(0.014)	0.008	0.019	(0.021)	0.360	0.037***	(0.014)	0.008	0.037***	(0.014)	0.008
Panel 4	0.002	(0.021)	0.932	0.029	(0.022)	0.190	-0.006	(0.020)	0.762	-0.010	(0.020)	0.616
Panel 5	-0.021	(0.028)	0.467	0.024	(0.023)	0.314	-0.030	(0.029)	0.302	-0.037	(0.027)	0.166
Panel 6	-0.085*	(0.051)	0.092	0.057**	(0.027)	0.036	-0.097*	(0.057)	0.088	-0.121**	(0.058)	0.036
Panel 7	-0.074**	(0.033)	0.025	0.059**	(0.029)	0.042	-0.075	(0.061)	0.218	-0.110**	(0.048)	0.022
Constant	10.839***	(3.434)	0.002	2.939**	(1.324)	0.027	10.477***	(3.817)	0.006	10.580***	(3.968)	0.008

*** p<0.01, ** p<0.05, * p<0.1

APPENDIX 2-21

Series of sensitivity analyses for bonuses on nursing and nursing aide FTEs (RN, LPN and aide)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	GLM			Panel			Accumulation			At least 3		
	coef	se	pval	coef	se	pval	coef	se	pval	coef	se	pval
Bonus	0.114**	(0.050)	0.023	0.007	(0.022)	0.754						
High Medicare reliance	0.052	(0.062)	0.405	-0.015	(0.024)	0.537	0.036	(0.061)	0.558	0.048	(0.059)	0.415
Bonus*High Medicare reliance	-0.066	(0.079)	0.405	0.008	(0.032)	0.806						
Cumulative bonus							0.076***	(0.025)	0.002			
Cumulative bonus*High Medicare reliance							-0.027	(0.031)	0.385			
At least 3 bonuses										0.159*	(0.083)	0.057
At least 3 bonuses*High Medicare reliance										-0.043	(0.100)	0.669
Rural	-0.492***	(0.172)	0.004	0.050	(0.032)	0.113	-0.472***	(0.166)	0.005	-0.493***	(0.176)	0.005
Region (ref= Central)												
Eastern	-0.228**	(0.103)	0.026				-0.237**	(0.103)	0.022	-0.220**	(0.102)	0.031
Northern	-0.329***	(0.052)	0.000				-0.337***	(0.050)	0.000	-0.339***	(0.057)	0.000
Northwest	0.046	(0.065)	0.478				0.059	(0.063)	0.343	0.047	(0.064)	0.455
Southwest	-0.153***	(0.057)	0.007				-0.145**	(0.056)	0.010	-0.166***	(0.057)	0.004
CMS provider type (ref=IPPS)												
RRC	0.287*	(0.174)	0.099	-0.059	(0.093)	0.527	0.280*	(0.168)	0.095	0.291*	(0.170)	0.087
MDH	-0.141	(0.348)	0.686	-0.110**	(0.045)	0.015	-0.129	(0.342)	0.707	-0.136	(0.350)	0.698
SCH	0.093	(0.139)	0.505	-0.078	(0.097)	0.425	0.059	(0.136)	0.661	0.068	(0.150)	0.650
SCH and RRC	0.162	(0.116)	0.160	-0.006	(0.076)	0.934	0.151	(0.105)	0.150	0.139	(0.113)	0.218
Not-for-profit	0.116**	(0.059)	0.049	0.176**	(0.086)	0.043	0.151**	(0.064)	0.019	0.104*	(0.060)	0.085

Health system affiliation	0.026	(0.057)	0.652	-0.021	(0.028)	0.441	0.034	(0.058)	0.556	0.028	(0.057)	0.632
Total number of patient days	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000
Prior year operating margin	0.721	(0.492)	0.143	0.042	(0.112)	0.709	0.771	(0.485)	0.112	0.717	(0.489)	0.142
Case mix index	0.684***	(0.167)	0.000	0.005	(0.108)	0.962	0.700***	(0.160)	0.000	0.648***	(0.171)	0.000
Readmission penalty	-7.356**	(3.479)	0.034	2.233*	(1.332)	0.094	-5.407*	(3.222)	0.093	-5.450	(3.537)	0.123
Panel fixed effects												
Panel 2	0.064	(0.044)	0.144	0.025	(0.021)	0.224	0.064	(0.044)	0.148	0.064	(0.043)	0.140
Panel 3	0.036***	(0.014)	0.008	0.020	(0.021)	0.346	0.035**	(0.014)	0.014	0.037***	(0.013)	0.006
Panel 4	-0.033	(0.024)	0.162	0.021	(0.023)	0.356	-0.022	(0.019)	0.243	-0.007	(0.018)	0.683
Panel 5	-0.061**	(0.030)	0.044	0.014	(0.024)	0.560	-0.066**	(0.028)	0.018	-0.035	(0.025)	0.165
Panel 6	-0.136**	(0.057)	0.018	0.048*	(0.027)	0.074	-0.150***	(0.058)	0.009	-0.123**	(0.057)	0.031
Panel 7	-0.126***	(0.044)	0.005	0.049	(0.030)	0.109	-0.148***	(0.049)	0.003	-0.105***	(0.040)	0.008
Constant	12.090***	(3.503)	0.001	2.927**	(1.324)	0.028	10.076***	(3.260)	0.002	10.258***	(3.570)	0.004

*** p<0.01, ** p<0.05, * p<0.1

APPENDIX 2-22

Series of sensitivity analyses for penalties on other staff FTEs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	GLM			Panel			Accumulation			At least 3		
	coef	se	pval	coef	se	pval	coef	se	pval	coef	se	pval
Penalty	-0.093	(0.064)	0.149	-0.012	(0.027)	0.647						
High Medicare reliance	-0.116**	(0.059)	0.048	-0.046*	(0.027)	0.089	-0.129**	(0.060)	0.032	-0.106**	(0.048)	0.027
Penalty*High Medicare reliance	0.094	(0.087)	0.280	0.007	(0.040)	0.852						
Cumulative penalty							-0.039	(0.041)	0.331			
Cumulative penalty*High Medicare reliance							0.052**	(0.024)	0.030			
At least 3 penalties										0.030	(0.089)	0.734
At least 3 penalties*High Medicare reliance										0.114**	(0.057)	0.046
Rural	-0.276**	(0.121)	0.023	-0.079**	(0.038)	0.037	-0.284**	(0.125)	0.023	-0.268**	(0.127)	0.034
Region (ref= Central)												
Eastern	-0.096	(0.060)	0.107				-0.099	(0.063)	0.117	-0.079	(0.057)	0.166
Northern	-0.534***	(0.162)	0.001				-0.540***	(0.173)	0.002	-0.585***	(0.178)	0.001
Northwest	0.330***	(0.070)	0.000				0.337***	(0.074)	0.000	0.304***	(0.067)	0.000
Southwest	0.459***	(0.074)	0.000				0.457***	(0.074)	0.000	0.450***	(0.077)	0.000
CMS provider type (ref=IPPS)												
RRC	0.110	(0.144)	0.444	0.132	(0.109)	0.229	0.124	(0.137)	0.366	0.098	(0.149)	0.512
MDH	-0.294	(0.315)	0.351	-0.139***	(0.053)	0.009	-0.271	(0.310)	0.382	-0.295	(0.308)	0.339
SCH	0.020	(0.089)	0.820	0.028	(0.113)	0.805	0.051	(0.096)	0.591	0.054	(0.093)	0.566
SCH and RRC	0.300***	(0.092)	0.001	0.247***	(0.089)	0.006	0.291***	(0.088)	0.001	0.304***	(0.092)	0.001
Not-for-profit	0.761***	(0.107)	0.000	-0.001	(0.101)	0.995	0.757***	(0.107)	0.000	0.755***	(0.111)	0.000

Health system affiliation	0.076	(0.077)	0.323	-0.015	(0.033)	0.645	0.076	(0.079)	0.338	0.073	(0.081)	0.363
Total number of patient days	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000
Prior year operating margin	1.193**	(0.475)	0.012	-0.170	(0.131)	0.197	1.200**	(0.467)	0.010	1.226***	(0.445)	0.006
Case mix index	1.168***	(0.250)	0.000	0.152	(0.128)	0.237	1.179***	(0.260)	0.000	1.101***	(0.246)	0.000
Readmission penalty	-6.680	(4.301)	0.120	2.111	(1.565)	0.178	-4.720	(4.276)	0.270	-4.200	(4.466)	0.347
Panel fixed effects											
Panel 2	-0.071***	(0.025)	0.004	-0.025	(0.024)	0.307	-0.072***	(0.025)	0.005	-0.070***	(0.025)	0.004
Panel 3	-0.066	(0.040)	0.102	0.031	(0.025)	0.217	-0.066*	(0.040)	0.094	-0.062	(0.039)	0.108
Panel 4	-0.093**	(0.047)	0.048	0.015	(0.026)	0.570	-0.092**	(0.040)	0.021	-0.087**	(0.041)	0.035
Panel 5	-0.145***	(0.053)	0.006	-0.012	(0.027)	0.671	-0.154***	(0.053)	0.004	-0.166***	(0.052)	0.001
Panel 6	-0.145*	(0.079)	0.066	0.019	(0.032)	0.558	-0.152**	(0.077)	0.048	-0.191***	(0.071)	0.007
Panel 7	-0.222***	(0.081)	0.006	-0.034	(0.034)	0.327	-0.201**	(0.085)	0.018	-0.257***	(0.077)	0.001
Constant	10.324**	(4.279)	0.016	3.315**	(1.556)	0.034	8.360**	(4.262)	0.050	7.935*	(4.467)	0.076

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

APPENDIX 2-23

Series of sensitivity analyses for bonuses on other staff FTEs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	GLM			**Panel**			**Accumulation**			**At least 3**		
	coef	se	pval	coef	se	pval	coef	se	pval	coef	se	pval
Bonus	0.268***	(0.075)	0.000	0.047*	(0.026)	0.070						
High Medicare reliance	-0.066	(0.049)	0.180	-0.031	(0.028)	0.265	-0.068	(0.047)	0.149	-0.064	(0.046)	0.161
Bonus*High Medicare reliance	-0.183*	(0.101)	0.070	-0.048	(0.037)	0.198						
Cumulative bonus							0.166***	(0.039)	0.000			
Cumulative bonus*High Medicare reliance							-0.114**	(0.045)	0.012			
At least 3 bonuses										0.454***	(0.133)	0.001
At least 3 bonuses*High Medicare reliance										-0.409**	(0.189)	0.031
Rural	-0.275**	(0.109)	0.011	-0.083**	(0.037)	0.025	-0.272**	(0.107)	0.011	-0.294**	(0.122)	0.016
Region (ref= Central)												
Eastern	-0.112**	(0.056)	0.046				-0.101**	(0.050)	0.045	-0.088*	(0.051)	0.083
Northern	-0.575***	(0.156)	0.000				-0.574***	(0.141)	0.000	-0.583***	(0.148)	0.000
Northwest	0.299***	(0.068)	0.000				0.308***	(0.065)	0.000	0.292***	(0.065)	0.000
Southwest	0.450***	(0.073)	0.000				0.469***	(0.070)	0.000	0.438***	(0.069)	0.000
CMS provider type (ref=IPPS)												
RRC	0.104	(0.158)	0.509	0.139	(0.109)	0.201	0.122	(0.149)	0.412	0.139	(0.146)	0.343
MDH	-0.326	(0.314)	0.299	-0.140***	(0.053)	0.008	-0.308	(0.306)	0.314	-0.320	(0.317)	0.311
SCH	-0.017	(0.085)	0.838	0.043	(0.114)	0.707	-0.055	(0.106)	0.604	0.001	(0.133)	0.994
SCH and RRC	0.292***	(0.077)	0.000	0.240***	(0.089)	0.007	0.278***	(0.072)	0.000	0.285***	(0.080)	0.000
Not-for-profit	0.816***	(0.106)	0.000	0.000	(0.101)	0.999	0.886***	(0.109)	0.000	0.793***	(0.093)	0.000
Health system affiliation	0.063	(0.071)	0.375	-0.011	(0.033)	0.733	0.058	(0.061)	0.342	0.064	(0.068)	0.348
Total number of patient days	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000	0.000***	(0.000)	0.000
Prior year operating margin	0.943**	(0.450)	0.036	-0.177	(0.131)	0.175	0.983**	(0.438)	0.025	0.940**	(0.455)	0.039
Case mix index	1.135***	(0.240)	0.000	0.143	(0.127)	0.261	1.163***	(0.225)	0.000	1.106***	(0.230)	0.000
Readmission penalty	-7.949**	(3.221)	0.014	2.021	(1.558)	0.195	-6.504*	(3.408)	0.056	-6.402	(3.966)	0.106
Panel fixed effects												
Panel 2	-0.068***	(0.025)	0.006	-0.024	(0.024)	0.315	-0.069***	(0.025)	0.006	-0.069***	(0.025)	0.006

Panel 3	-0.063	(0.040)	0.112	0.031	(0.025)	0.216	-0.066	(0.041)	0.104	-0.061	(0.039)	0.118
Panel 4	-0.120***	(0.040)	0.003	0.002	(0.027)	0.927	-0.108***	(0.041)	0.008	-0.093**	(0.040)	0.020
Panel 5	-0.191***	(0.053)	0.000	-0.028	(0.028)	0.314	-0.194***	(0.055)	0.000	-0.162***	(0.052)	0.002
Panel 6	-0.200***	(0.077)	0.010	0.005	(0.031)	0.878	-0.216***	(0.080)	0.007	-0.187**	(0.077)	0.015
Panel 7	-0.308***	(0.066)	0.000	-0.050	(0.036)	0.161	-0.317***	(0.071)	0.000	-0.264***	(0.073)	0.000
Constant	11.570***	(3.210)	0.000	3.405**	(1.548)	0.028	9.998***	(3.410)	0.003	10.105**	(3.965)	0.011

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Appendices

Provider FTEs following implementation of HVBP (post)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Direct patient care	Administration	Physicians	Physician assistants/ Nurse practitioners	Registered nurses	Licensed practical nurses	Nursing Aides	Other
	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)
Post HVBP	-0.058	-0.019	-0.852	-0.091	-0.026	-0.317**	-0.250***	-0.170***
	(0.077)	(0.123)	(0.605)	(0.419)	(0.070)	(0.124)	(0.080)	(0.066)
High Medicare reliance	0.023	0.011	0.596*	0.223**	-0.002	-0.014	0.145	-0.049
	(0.052)	(0.082)	(0.314)	(0.104)	(0.044)	(0.066)	(0.097)	(0.048)
Rural	-0.372**	-0.533***	-1.578	-0.669**	-0.488***	-0.148	-0.818***	-0.389***
	(0.162)	(0.158)	(2.583)	(0.340)	(0.151)	(0.158)	(0.263)	(0.135)
Region (ref= Central)								
Eastern	-0.005	0.196	-1.583**	-1.163**	-0.176	0.082	0.140	0.164*
	(0.080)	(0.144)	(0.773)	(0.456)	(0.169)	(0.112)	(0.171)	(0.087)
Northern	-0.274**	0.000	-1.820***	-0.874***	-0.219***	-1.082***	-0.009	-0.087
	(0.117)	(0.193)	(0.297)	(0.217)	(0.064)	(0.338)	(0.161)	(0.151)
Northwest	0.184***	0.212	-0.548	0.164	0.159**	-0.053	0.040	0.302***
	(0.063)	(0.370)	(0.945)	(0.328)	(0.065)	(0.082)	(0.201)	(0.067)
Southwest	0.119*	0.093	-1.197**	-0.059	0.010	0.079	-0.027	0.317***
	(0.063)	(0.192)	(0.502)	(0.353)	(0.063)	(0.106)	(0.262)	(0.080)
CMS provider type (ref=IPPS)								
Rural referral center (RRC)	0.238	0.416	1.474	1.003**	0.247	0.195	0.362	0.330**
	(0.164)	(0.438)	(3.481)	(0.412)	(0.162)	(0.178)	(0.480)	(0.135)
Medicare-dependent hospital (MDH)	-0.474	0.275	-6.799*	-3.885**	-0.221	-0.392	0.011	-0.158
	(0.338)	(0.242)	(3.475)	(1.663)	(0.330)	(0.266)	(0.313)	(0.284)
Sole community hospital (SCH)	-0.018	0.391*	-0.589	-0.385**	0.018	-0.096	0.275	0.165
	(0.153)	(0.216)	(0.498)	(0.174)	(0.134)	(0.251)	(0.196)	(0.128)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SCH and RRC	0.151	0.522***	0.610	0.162	0.117	0.339**	0.247*	0.349***
	(0.130)	(0.156)	(0.488)	(0.330)	(0.102)	(0.138)	(0.135)	(0.107)
Not-for-profit	0.260***	0.342*	3.324***	2.003***	0.107	0.127	-0.079	0.350***
	(0.086)	(0.206)	(0.940)	(0.413)	(0.105)	(0.116)	(0.135)	(0.103)
Health system affiliation	-0.040	0.051	3.011*	0.557***	0.022	-0.056	0.004	-0.018
	(0.055)	(0.209)	(1.565)	(0.109)	(0.065)	(0.057)	(0.081)	(0.069)
Total number of patient days	0.000***	0.000***	0.000***	0.000***	0.000***	-0.000	0.000	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Prior year operating margin	0.392	1.785***	-12.544***	-8.329***	0.777*	-0.494	0.340	1.069***
	(0.381)	(0.617)	(4.325)	(2.128)	(0.460)	(0.438)	(0.536)	(0.373)
Case mix index	0.699***	0.338	-0.335	1.126*	0.620***	0.664**	0.462**	0.620***
	(0.163)	(0.357)	(1.271)	(0.654)	(0.221)	(0.263)	(0.191)	(0.182)
Readmission penalty	0.007	-0.147	1.171*	0.330	-0.049	0.094	0.190***	-0.060
	(0.063)	(0.104)	(0.652)	(0.378)	(0.076)	(0.077)	(0.068)	(0.046)
Prior year FTE	0.000***	0.001***	0.002*	0.000	0.000	0.015***	0.004***	0.000***
	(0.000)	(0.000)	(0.001)	(0.002)	(0.000)	(0.002)	(0.001)	(0.000)
Panel fixed effects								
Panel 2	0.026	-0.053	0.133***	0.088*	0.070	0.078	0.002	-0.084**
	(0.028)	(0.046)	(0.037)	(0.051)	(0.044)	(0.049)	(0.025)	(0.034)
	0.339	0.248	0.000	0.087	0.111	0.113	0.951	0.013
Panel 3	0.103	0.028	0.054	0.171***	0.005	0.052	-0.157	-0.033
	(0.086)	(0.043)	(0.124)	(0.034)	(0.019)	(0.074)	(0.112)	(0.024)
	0.227	0.510	0.662	0.000	0.804	0.484	0.163	0.168
Panel 4	0.101**	0.036	-0.236	-0.101	0.070***	0.260***	-0.053	0.169***
	(0.048)	(0.206)	(0.184)	(0.113)	(0.024)	(0.079)	(0.119)	(0.041)
	0.035	0.863	0.199	0.371	0.003	0.001	0.658	0.000
Panel 5	0.023	0.038	0.114	-0.021	0.025	0.286***	0.054	0.089***
	(0.040)	(0.082)	(0.094)	(0.093)	(0.018)	(0.086)	(0.110)	(0.033)
	0.558	0.646	0.223	0.820	0.171	0.001	0.622	0.007
Panel 6	0.017	0.067	-0.606**	-0.143	0.017	0.027	-0.139	0.117***
	(0.027)	(0.078)	(0.270)	(0.191)	(0.031)	(0.052)	(0.203)	(0.037)
	0.527	0.393	0.025	0.454	0.591	0.599	0.495	0.001
Constant	4.977***	4.017***	-2.597	-2.050*	4.517***	1.934***	3.507***	4.772***
	(0.247)	(0.761)	(1.941)	(1.130)	(0.373)	(0.340)	(0.287)	(0.260)
	0.000	0.000	0.181	0.070	0.000	0.000	0.000	0.000

Appendices

APPENDIX 2-25

Ratio of possible substitute FTEs following implementation of HVBP (post)

	(1) Ratio of physician to NP/PA FTEs	(2) Ratio of RN to LPN FTEs	(3) Ratio of RN to nursing aide FTEs
	(SE)	(SE)	(SE)
Post HVBP	-4.600***	-1.503	-0.125
	(0.766)	(1.738)	(0.390)
High Medicare reliance	4.066***	-0.156	0.175
	(0.680)	(0.556)	(0.338)
Rural	-4.995***	2.670***	0.192
	(1.702)	(0.487)	(0.770)
Region (ref= Central)			
Eastern	0.606	2.169	0.330
	(1.566)	(1.701)	(0.721)
Northern	-1.258	7.005***	-0.358
	(1.776)	(0.834)	(0.584)
Northwest	2.391	7.043***	-5.646***
	(1.721)	(1.177)	(1.045)
Southwest	-4.185***	4.469***	0.784*
	(1.483)	(1.000)	(0.447)
CMS provider type (ref=IPPS)			
Rural referral center (RRC)	5.346***	-1.424*	1.305*
	(1.921)	(0.752)	(0.785)
Medicare-dependent hospital (MDH)	1.933	-2.905*	-0.906
	(1.320)	(1.681)	(0.860)
Sole community hospital (SCH)	2.648*	-0.138	-0.629
	(1.391)	(0.416)	(0.599)
SCH and RRC	-3.627**	-4.560***	0.269
	(1.559)	(1.016)	(0.760)
Not-for-profit	4.158***	-0.448	1.254
	(1.516)	(0.378)	(1.166)
Health system affiliation	6.749***	2.893***	0.001
	(1.526)	(0.821)	(0.514)
Total number of patient days	-0.000**	0.000***	0.000
	(0.000)	(0.000)	(0.000)
Prior year operating margin	-5.870*	-10.377***	-2.384***
	(3.282)	(2.056)	(0.806)
Case mix index	2.536***	4.699***	-3.503
	(0.894)	(1.178)	(2.925)
Readmission penalty	-0.875	1.093	0.052
	(0.616)	(1.602)	(0.329)
Prior year FTE	-0.007***	-0.009***	0.012***

Appendices

		(0.001)	(0.001)	(0.004)
Panel fixed effects				
	Panel 2	-0.639	0.470	0.500***
		(0.923)	(0.370)	(0.179)
	Panel 3	-0.287	2.003***	-0.021
		(0.921)	(0.234)	(0.233)
	Panel 4	4.259***	1.882***	0.518**
		(0.144)	(0.678)	(0.216)
	Panel 5	3.832***	0.520***	0.193
		(0.102)	(0.141)	(0.177)
	Panel 6	4.469***	4.072***	0.246
		(0.639)	(0.749)	(0.156)
Constant		-13.579***	-15.137***	4.413*
		(3.871)	(3.160)	(2.389)

*** p<0.01, ** p<0.05, * p<0.1

APPENDIX 2-26

Ratio of possible substitute FTEs following HVBP penalty

	(1) Ratio of physician to NP/PA FTEs	(2) Ratio of RN to LPN FTEs	(3) Ratio of RN to nursing aide FTEs
	(SE)	(SE)	(SE)
Penalty	-0.091	-5.172***	-0.385
	(0.284)	(1.651)	(0.518)
High Medicare reliance	4.087***	-7.647***	0.249
	(0.707)	(2.871)	(0.397)
Rural	-4.995***	-6.492***	0.086
	(1.757)	(2.515)	(0.880)
Region (ref= Central)			
Eastern	0.592	-5.525***	0.321
	(1.592)	(0.496)	(0.688)
Northern	-1.281	6.667***	0.252
	(1.801)	(2.588)	(0.951)
Northwest	2.430	5.552***	-6.129***
	(1.728)	(1.984)	(1.556)
Southwest	-4.190***	-0.713	0.878*
	(1.508)	(0.943)	(0.489)
CMS provider type (ref=IPPS)			
Rural referral center (RRC)	5.402***	8.218***	1.334
	(2.061)	(2.316)	(0.894)
Medicare-dependent hospital (MDH)	1.956	8.261***	-0.952
	(1.375)	(2.333)	(0.908)
Sole community hospital (SCH)	2.650*	11.922***	-0.548
	(1.454)	(3.385)	(0.579)
SCH and RRC	-3.591**	3.401***	0.203
	(1.532)	(0.800)	(0.858)
Not-for-profit	4.239***	-2.672*	1.050
	(1.550)	(1.523)	(1.153)
Health system affiliation	6.743***	0.887	0.162
	(1.484)	(1.677)	(0.705)
Total number of patient days	-0.000**	0.000**	0.000
	(0.000)	(0.000)	(0.000)
Prior year operating margin	-5.872*	-7.158***	-2.424***
	(3.263)	(1.547)	(0.876)
Case mix index	2.628***	-3.594	-3.228
	(0.935)	(4.837)	(2.730)
Readmission penalty	-0.847	-1.241	-0.011
	(0.609)	(1.634)	(0.293)

		-0.007***	0.007	0.013***
Prior year FTE		-0.007***	0.007	0.013***
		(0.001)	(0.004)	(0.005)
Panel fixed effects				
	Panel 2	-0.654	0.102**	0.509***
		(0.916)	(0.046)	(0.190)
	Panel 3	-0.292	2.939***	-0.058
		(0.918)	(0.531)	(0.211)
	Panel 4	-0.342	4.412***	0.477
		(0.836)	(0.918)	(0.396)
	Panel 5	-0.765	5.877***	0.115
		(0.783)	(0.819)	(0.364)
	Panel 6	-0.143	6.682***	0.164
		(0.998)	(0.922)	(0.357)
	Panel 7	-4.695***	5.890***	0.245
		(0.719)	(0.826)	(0.821)
Constant		-13.768***	-1.670	4.192*
		(3.980)	(5.421)	(2.367)

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

APPENDIX 2-27

Ratio of possible substitute FTEs following HVBP bonus

	(1) Ratio of physician to NP/PA FTEs	(2) Ratio of RN to LPN FTEs	(3) Ratio of RN to nursing aide FTEs
	(SE)	(SE)	(SE)
Bonus	0.324	0.605	0.521***
	(0.294)	(0.371)	(0.199)
High Medicare reliance	4.080***	0.079	0.095
	(0.693)	(0.713)	(0.398)
Rural	-5.051**	2.811***	0.221
	(2.055)	(0.851)	(0.800)
Region (ref= Central)			
Eastern	0.468	-2.270***	0.194
	(1.634)	(0.738)	(0.664)
Northern	-1.498	6.099***	-0.346
	(1.926)	(0.730)	(0.571)
Northwest	2.361	5.889***	-5.592***
	(1.760)	(1.019)	(1.003)
Southwest	-4.600**	3.420***	0.792*
	(1.909)	(0.708)	(0.429)
CMS provider type (ref=IPPS)			
Rural referral center (RRC)	5.664**	-1.596	1.305*
	(2.386)	(1.185)	(0.666)
Medicare-dependent hospital (MDH)	2.303	-3.693*	-0.817
	(1.686)	(2.021)	(0.918)
Sole community hospital (SCH)	2.699	-3.157*	-0.688
	(1.775)	(1.689)	(0.531)
SCH and RRC	-3.858**	-4.928***	0.259
	(1.626)	(1.347)	(0.683)
Not-for-profit	4.562***	-0.026	1.208
	(1.476)	(0.430)	(0.864)
Health system affiliation	6.930***	2.683***	0.115
	(1.487)	(0.411)	(0.555)
Total number of patient days	-0.000***	0.000***	0.000
	(0.000)	(0.000)	(0.000)
Prior year operating margin	-6.004*	-10.654***	-2.344***
	(3.211)	(2.351)	(0.800)
Case mix index	2.843***	3.962***	-3.566
	(0.901)	(1.328)	(3.034)
Readmission penalty	-0.676	-2.730***	0.084
	(0.716)	(0.535)	(0.295)

Prior year FTE		-0.007***	-0.009***	0.012***
		(0.001)	(0.001)	(0.003)
Panel fixed effects				
	Panel 2	-0.640	0.451	0.504***
		(0.924)	(0.356)	(0.180)
	Panel 3	-0.254	2.080***	-0.020
		(0.935)	(0.235)	(0.241)
	Panel 4	-0.615	4.300***	0.363
		(0.703)	(0.566)	(0.297)
	Panel 5	-1.041	2.936***	0.036
		(0.640)	(0.596)	(0.315)
	Panel 6	-0.286	6.359***	0.094
		(0.961)	(0.835)	(0.315)
	Panel 7	-5.230***	2.423***	-0.154
		(0.582)	(0.644)	(0.454)
Constant		-14.463***	-13.352***	4.401*
		(3.775)	(2.824)	(2.431)

*** p<0.01, ** p<0.05, * p<0.1

APPENDIX 2-28

Effect of penalties of all provider type FTEs, using total margins as a covariate

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Direct patient care	Administration	Physicians	Physician assistants/ Nurse practitioners	Registered nurses	Licensed practical nurses	Nursing Aides	Other
	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)
Penalty	-0.057	-0.068	-0.353**	-0.156	-0.021	-0.045	-0.271***	-0.035
	(0.044)	(0.226)	(0.139)	(0.146)	(0.044)	(0.065)	(0.094)	(0.042)
High Medicare reliance	0.022	0.026	0.318	0.123	0.000	-0.007	0.141	-0.039
	(0.054)	(0.087)	(0.251)	(0.097)	(0.047)	(0.065)	(0.093)	(0.053)
Rural	-0.372**	-0.582***	-0.461	-0.410*	-0.503***	-0.149	-0.767***	-0.412***
	(0.158)	(0.181)	(0.794)	(0.224)	(0.158)	(0.154)	(0.224)	(0.147)
Region (ref= Central)								
Eastern	-0.016	0.183	-1.490**	-1.174**	-0.173	0.068	0.082	0.147*
	(0.082)	(0.152)	(0.717)	(0.471)	(0.171)	(0.111)	(0.170)	(0.084)
Northern	-0.263**	-0.005	-1.543***	-0.830***	-0.212***	-1.087***	-0.004	-0.091
	(0.113)	(0.212)	(0.297)	(0.236)	(0.058)	(0.342)	(0.142)	(0.141)
Northwest	0.196***	0.147	-0.140	0.440	0.152**	-0.047	0.064	0.283***
	(0.067)	(0.413)	(0.495)	(0.354)	(0.063)	(0.083)	(0.163)	(0.062)
Southwest	0.114*	0.078	-0.777**	0.103	0.000	0.085	-0.050	0.298***
	(0.062)	(0.199)	(0.344)	(0.362)	(0.061)	(0.106)	(0.249)	(0.075)
CMS provider type (ref=IPPS)								
Rural referral center (RRC)	0.238	0.457	0.720	0.649*	0.257	0.212	0.473	0.349**
	(0.163)	(0.460)	(1.972)	(0.350)	(0.165)	(0.180)	(0.418)	(0.139)
Medicare-dependent hospital (MDH)	-0.456	0.273	-2.886*	-1.890**	-0.200	-0.412*	-0.041	-0.143
	(0.333)	(0.294)	(1.595)	(0.918)	(0.328)	(0.244)	(0.325)	(0.289)
Sole community hospital (SCH)	-0.010	0.422	-1.369***	-0.958***	0.045	-0.095	0.197	0.201
	(0.153)	(0.322)	(0.203)	(0.140)	(0.151)	(0.237)	(0.168)	(0.149)
SCH and RRC	0.168	0.558***	0.489*	0.096	0.129	0.341**	0.288***	0.363***

	(0.125)	(0.173)	(0.260)	(0.322)	(0.105)	(0.139)	(0.108)	(0.109)
	0.181	0.001	0.059	0.766	0.220	0.014	0.007	0.001
Not-for-profit	0.267***	0.320	2.993***	1.872***	0.098	0.139	-0.026	0.349***
	(0.083)	(0.202)	(0.525)	(0.252)	(0.101)	(0.117)	(0.121)	(0.101)
Health system affiliation	-0.029	0.044	2.720**	0.545***	0.027	-0.057	0.063	-0.011
	(0.052)	(0.220)	(1.147)	(0.100)	(0.068)	(0.058)	(0.090)	(0.065)
Total number of patient days	0.000***	0.000**	0.000***	0.000***	0.000***	-0.000	0.000	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Prior year total margin	0.411	1.259**	-5.761***	-4.532***	0.713**	-0.593*	-0.137	0.826***
	(0.324)	(0.534)	(1.880)	(1.572)	(0.328)	(0.320)	(0.486)	(0.303)
Case mix index	0.735***	0.342	-0.353	0.784	0.620***	0.706***	0.468**	0.662***
	(0.168)	(0.376)	(1.223)	(0.718)	(0.228)	(0.272)	(0.189)	(0.174)
Readmission penalty	0.023	-0.141	0.958**	0.149	-0.043	0.098	0.219***	-0.055
	(0.060)	(0.096)	(0.476)	(0.343)	(0.072)	(0.078)	(0.070)	(0.045)
Prior year FTE	0.000***	0.001**	0.002***	0.001	0.000	0.015***	0.004***	0.000***
	(0.000)	(0.000)	(0.001)	(0.003)	(0.000)	(0.002)	(0.001)	(0.000)
Panel fixed effects								
Panel 2	0.024	-0.060	0.163*	0.040	0.068	0.078	-0.004	-0.084**
	(0.028)	(0.045)	(0.091)	(0.097)	(0.043)	(0.048)	(0.025)	(0.035)
Panel 3	0.102	0.037	-0.031	0.135	0.005	0.051	-0.160	-0.035
	(0.087)	(0.041)	(0.141)	(0.092)	(0.020)	(0.076)	(0.119)	(0.025)
Panel 4	0.043	0.017	-0.583	0.088	0.037	-0.044	-0.312***	-0.010
	(0.062)	(0.205)	(0.505)	(0.382)	(0.068)	(0.086)	(0.114)	(0.043)
Panel 5	-0.031	0.043	-0.331	0.150	-0.004	-0.017	-0.150*	-0.080
	(0.047)	(0.128)	(0.503)	(0.366)	(0.067)	(0.086)	(0.091)	(0.050)
Panel 6	-0.012	0.094	-0.946*	-0.031	0.002	-0.259**	-0.299**	-0.028
	(0.068)	(0.124)	(0.520)	(0.367)	(0.073)	(0.117)	(0.127)	(0.051)
Panel 7	-0.046	0.035	-0.489	0.124	-0.016	-0.320**	-0.168	-0.149**
	(0.072)	(0.124)	(0.523)	(0.388)	(0.072)	(0.126)	(0.103)	(0.067)
Constant	4.906***	4.069***	-2.173	-1.550	4.519***	1.876***	3.430***	4.730***
	(0.265)	(0.823)	(2.042)	(1.078)	(0.384)	(0.358)	(0.283)	(0.257)

APPENDIX 2-29

Effect of bonuses of all provider type FTEs, using total margins as a covariate

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Direct patient care	Administration	Physicians	Physician assistants/ Nurse practitioners	Registered nurses	Licensed practical nurses	Nursing Aides	Other
	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)
Bonus	0.120	0.309***	0.097	0.085	0.091**	0.099	0.032	0.196***
	(0.075)	(0.081)	(0.343)	(0.238)	(0.042)	(0.063)	(0.062)	(0.052)
High Medicare reliance	0.010	-0.008	0.368	0.126	-0.010	-0.015	0.154	-0.056
	(0.056)	(0.088)	(0.257)	(0.121)	(0.047)	(0.062)	(0.100)	(0.049)
Rural	-0.356**	-0.519***	-0.455	-0.393	-0.486***	-0.135	-0.831***	-0.378***
	(0.158)	(0.155)	(0.847)	(0.257)	(0.154)	(0.147)	(0.270)	(0.131)
Region (ref= Central)								
Eastern	-0.013	0.146	-1.369*	-1.145**	-0.180	0.058	0.120	0.132*
	(0.078)	(0.136)	(0.728)	(0.478)	(0.167)	(0.104)	(0.168)	(0.079)
Northern	-0.275**	-0.045	-1.961***	-0.911***	-0.225***	-1.093***	-0.017	-0.109
	(0.109)	(0.194)	(0.405)	(0.226)	(0.061)	(0.332)	(0.165)	(0.131)
Northwest	0.186***	0.147	-0.116	0.450	0.152**	-0.055	0.017	0.281***
	(0.062)	(0.370)	(0.668)	(0.402)	(0.065)	(0.077)	(0.198)	(0.061)
Southwest	0.117*	0.065	-1.002**	0.124	-0.001	0.080	-0.038	0.293***
	(0.064)	(0.192)	(0.464)	(0.380)	(0.061)	(0.102)	(0.266)	(0.072)
CMS provider type (ref=IPPS)								
Rural referral center (RRC)	0.229	0.432	1.138	0.660*	0.248	0.205	0.394	0.338**
	(0.165)	(0.430)	(1.736)	(0.366)	(0.163)	(0.182)	(0.481)	(0.136)
Medicare-dependent hospital (MDH)	-0.471	0.273	-2.799*	-2.003*	-0.203	-0.414*	-0.007	-0.149
	(0.340)	(0.269)	(1.661)	(1.058)	(0.329)	(0.243)	(0.323)	(0.294)
Sole community hospital (SCH)	-0.044	0.313	-1.394***	-0.986***	0.018	-0.116	0.272	0.127
	(0.155)	(0.250)	(0.221)	(0.184)	(0.144)	(0.224)	(0.193)	(0.134)

	SCH and RRC	0.162	0.542***	0.555	0.067	0.129	0.322**	0.250*	0.355***
		(0.118)	(0.121)	(0.374)	(0.325)	(0.096)	(0.136)	(0.133)	(0.087)
Not-for-profit		0.285***	0.388**	3.428***	1.917***	0.121	0.156	-0.073	0.390***
		(0.083)	(0.183)	(0.613)	(0.242)	(0.099)	(0.116)	(0.135)	(0.098)
Health system affiliation		-0.034	0.045	2.712***	0.543***	0.029	-0.056	0.011	-0.008
		(0.049)	(0.171)	(0.851)	(0.106)	(0.064)	(0.054)	(0.080)	(0.057)
Total number of patient days		0.000***	0.000***	0.000***	0.000***	0.000***	-0.000	0.000	0.000***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Prior year total margin		0.316	1.112**	-5.855***	-4.906**	0.684**	-0.610*	-0.019	0.736**
		(0.319)	(0.520)	(2.233)	(1.919)	(0.322)	(0.323)	(0.491)	(0.286)
Case mix index		0.705***	0.342	-1.373	0.691	0.619***	0.692***	0.484**	0.658***
		(0.161)	(0.357)	(1.490)	(0.765)	(0.218)	(0.254)	(0.188)	(0.171)
Readmission penalty		0.026	-0.136	0.820*	0.162	-0.029	0.091	0.189***	-0.037
		(0.054)	(0.085)	(0.473)	(0.330)	(0.064)	(0.080)	(0.072)	(0.034)
Prior year FTE		0.000***	0.001***	0.002**	0.000	0.000	0.015***	0.004***	0.000***
		(0.000)	(0.000)	(0.001)	(0.003)	(0.000)	(0.002)	(0.001)	(0.000)
Panel fixed effects									
	Panel 2	0.025	-0.056	0.157	0.039	0.068	0.075	-0.003	-0.085**
		(0.027)	(0.042)	(0.099)	(0.108)	(0.043)	(0.048)	(0.027)	(0.036)
	Panel 3	0.102	0.042	0.063	0.168***	0.004	0.048	-0.162	-0.036
		(0.086)	(0.042)	(0.143)	(0.064)	(0.020)	(0.076)	(0.116)	(0.026)
	Panel 4	0.006	-0.070	-0.612	0.048	0.005	-0.076	-0.321**	-0.056
		(0.063)	(0.158)	(0.535)	(0.375)	(0.055)	(0.092)	(0.128)	(0.040)
	Panel 5	-0.075	-0.063	-0.281	0.097	-0.040	-0.054	-0.213*	-0.132***
		(0.053)	(0.073)	(0.502)	(0.356)	(0.052)	(0.088)	(0.113)	(0.044)
	Panel 6	-0.073	0.007	-1.052*	-0.127	-0.034	-0.304**	-0.399**	-0.085**
		(0.063)	(0.133)	(0.550)	(0.381)	(0.058)	(0.131)	(0.194)	(0.043)
	Panel 7	-0.106	-0.086	-0.470	0.040	-0.061	-0.354***	-0.263***	-0.230***
		(0.083)	(0.113)	(0.543)	(0.375)	(0.059)	(0.127)	(0.084)	(0.062)
Constant		4.928***	3.989***	-1.335	-1.547	4.491***	1.877***	3.497***	4.675***
		(0.253)	(0.750)	(1.529)	(1.177)	(0.367)	(0.342)	(0.284)	(0.250)

Appendices

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APPENDIX 3-1

Hospital in center bandwidth as estimated by hospitals with an adjustment between 0.999 and 1.001

	Hospitals below adjustment threshold (penalty)	Hospitals above adjustment threshold (bonus)
	N = 40	N = 37
	%	%
Uninsured rate (mean)	12.9	12.9
Rural	25.0	16.22
Region		
Central	22.5	24.3
Eastern	27.5	24.3
Northern	10.0	21.6
Northwest	15.0	5.4
Southwest	25.0	24.3
Not-for-profit	87.5	62.2
Health system	80.0	89.2
Provider type		
IPPS	85.0	86.5
Rural referral center (RRC)	2.5	0.0
Medicare dependent hospital	7.5	5.4
Sole community hospital (SCH)	5.0	8.1
SCH/RRC	0.0	0.0
High Medicare reliance	20.0	16.2
Total patient days (mean)	72,869	56,807
Prior year total margins	5.1	7.4
HRRP penalty	85.0	94.6
Case mix index (mean)	1.5	1.5
Net charity care	$21,300,000	$9,767,260
Charity care for patients under 100% FPL	$14,500,000	$1,823,210
Charity care for patients 100% - 200% FPL	$8,428,630	$7,602,625
All uncompensated care	$28,800,000	$15,100,000
Uncompensated care as percent of total operating expenses	7.0	5.7
Charity care for patients under 100% FPL as percent of total operating expenses	2.5	0.8

Note: Hospitals with 0% adjustment are not included

APPENDIX 3-2

Panel analysis of HVBP bonuses on charity care

	Net charity care	Charity care < 100% FPL	Charity care 100-200% FPL	Uncompensated care
	coef (SE)	coef (SE)	coef (SE)	coef (SE)
Bonus	-0.024 (0.040)	-0.835 (0.458)	0.097 (0.297)	0.010 (0.027)
High uninsured rate	0.048 (0.065)	-0.823 (0.572)	0.499 (0.452)	0.017 (0.046)
Bonus*High uninsured rate	0.037 (0.063)	-0.053 (0.628)	0.318 (0.430)	0.015 (0.049)
High Medicare reliance	-0.006 (0.058)	-0.045 (0.674)	-0.288 (0.358)	-0.082 (0.049)
Rural	-0.079 (0.066)	0.879 (0.793)	-0.990 (0.933)	-0.040 (0.052)
Region				
Eastern	0.099 (0.213)	-7.536 (2.031)	3.401 (1.791)	0.099 (0.181)
Northern	-0.406 (0.229)	-1.284 (2.750)	1.432 (1.629)	-0.336 (0.251)
Northwest	-0.120 (0.212)	-0.291 (1.687)	-2.937 (2.439)	-0.049 (0.167)
Southwest	-0.582 (0.192)	1.724 (1.546)	-3.894 (2.526)	-0.485 (0.180)
CMS provider type				
Rural referral center	-0.198 (0.667)	1.611 (2.796)	-3.828 (4.353)	0.705 (0.155)
Medicare-dependent hospital	-0.216 (0.131)	0.166 (0.503)	-1.871 (1.877)	-0.239 (0.104)
Sole community hospital	-0.975 (0.215)	-0.657 (1.682)	-2.981 (2.187)	-0.491 (0.194)
Sole community and rural referral center	0.251 (0.165)	-4.640 (2.841)	1.282 (1.111)	0.130 (0.088)
Not-for-profit	0.688 (0.138)	-3.662 (1.422)	-2.884 (1.716)	0.198 (0.170)
Health system	0.071 (0.074)	-4.526 (1.394)	-0.574 (0.852)	0.029 (0.065)
Total patient days	0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)
Prior year operating margins	0.770 (0.256)	-0.776 (3.207)	-1.014 (7.123)	-0.066 (0.623)
Case mix index	0.317 (0.370)	-1.893 (3.365)	3.630 (2.716)	0.361 (0.285)
HRRP penalty	-0.046 (0.054)	0.519 (1.064)	-0.840 (0.482)	-0.029 (0.038)

APPENDIX 3-3

RD model with charity care as percent of operating costs

Appendices