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Matthew Manary, Richard Staelin, William Boulding, & Seth W. Glickman

abstract

Documented disparities in health care quality in hospitals have been associated with patients' race, gender, age, and insurance coverage. We used a novel data set with detailed hospital-level demographic, financial, quality-of-care, and outcome data across 265 California hospitals to examine the relationship between a hospital's financial health and its quality of care. We found that *payer mix*, the percentage of patients with private insurance coverage, is the key driver of a hospital's financial health. This is important because a hospital's financial health influences its quality of care and patient outcomes. Government policies that financially penalize hospitals on the basis of care quality and/or outcomes may disproportionately impair financial performance and quality investments at hospitals serving fewer privately insured patients. Such policies could exacerbate health disparities among patients at greatest risk of receiving substandard care.

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In recent years, the availability of data measuring the quality of health care in hospitals has expanded dramatically. One important observation is that hospitals with higher numbers of racial minorities and poor people in their patient populations provide lower quality care. A critical question for policymakers is this: Where do these disparities originate? Do they primarily reflect differences in treatment based on patient demographic factors? We explore a second explanation, that disparities may be driven by the underlying financial health of hospitals. Minority and poorer populations are more likely to be under- or uninsured. If hospitals receive lower reimbursements for their services to these populations, they are less able to make the investments that hospitals need to ensure quality care for all patients. Testing for such a possibility requires the right kind of data (demographic, financial, and clinical) and a robust analysis that looks at multiple relevant variables over time.

We began our research into this area aware of evidence that financial health may be a very important driver of quality of care. For one, studies that look at health care quality measures within individual hospitals find much smaller correlations between patients' race

or income and lower quality than do cross-sectional studies that look for relationships by comparing performance across hospitals.[1–3] Another clue is research by Dranove and White dating back to the 1990s.[4] In a longitudinal analysis of how multiple hospitals reacted to Medicare and Medicaid payment reductions in the 1980s and early 1990s, they found that hospitals did not compensate for these reductions by raising prices for patients with private insurance. Instead, they tended to treat the quality of care as a somewhat consistently provided *public good* within their hospital. Thus, the quality of care declined for all patients, albeit more for Medicaid and Medicare patients.

Understanding what causes these disparities is vital today. Medicare, for instance, is shifting from a payment structure based solely on quantity or intensity of services at hospitals to one that creates incentives for improving the quality of health care services.[5,6] For example, the Hospital Value-Based Purchasing Program of the Centers for Medicare & Medicaid Services (CMS) ties hospital Medicare payments to performance in quality measures, outcomes, efficiency, and patient experience. Because these policies are designed also, in part, to limit costs, the incentive programs by design create a system of winners (those that receive financial rewards for high quality) and losers (those that receive financial penalties for low quality). Our findings suggest that such penalties could unintentionally drive quality even lower at already low-performing hospitals. That is, the current rewards and penalties system may lead to institutionalizing inferior health care at hospitals that serve patients at the greatest risk of receiving lower quality care.

What Drives Health Outcomes?

To better understand the factors that ultimately impact health outcomes, we developed a model that recognizes the complex interplay between patient characteristics, reimbursement, organizational behavior, and quality of care and health outcomes. We extended a classic quality assessment framework by Donabedian,[7] which identifies measurable components that contribute to the quality of care in hospitals. This approach allowed us to relate quality of care and health outcomes to organizational behaviors as expressed through capital investments, clinical adherence to standard guidelines,

Figure 1. Hospital quality framework
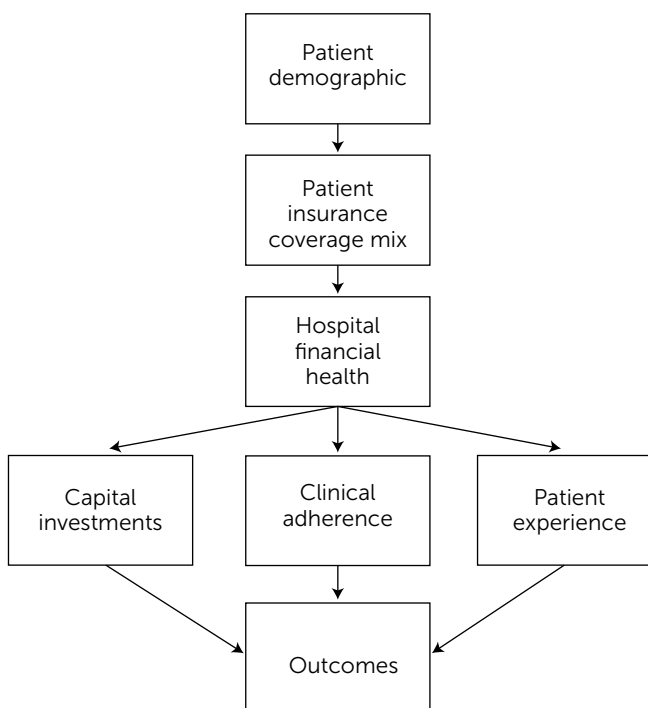
and reported patient experiences. Our resulting hospital quality framework (see Figure 1) was built on the premise that the demographics of a hospital's patient population are significantly correlated with its payer mix, called here the patient insurance coverage mix. Data showing that Spanish-speaking and African American patients are significantly less likely than White patients to have health care insurance support this approach.[8] Caring for substantial numbers of patients without insurance decreases a hospital's revenue. Less income may degrade a hospital's financial health, which leads to lower investment in personnel, information technology, and other key contributors to quality care. Therefore, changes in a hospital's demographic or financial structure (possibly among other factors, many of which we control for in our analyses) will affect downstream institutional processes and, consequently, the quality of care (see Figure 1).

We built our model using a variety of health care quality data from four major sources. The first was the California Office of Statewide Health Planning and Development (COSHPD), from whose website (http://www.oshpd.ca.gov/Healthcare-Data.html) we pulled information for general and acute care hospitals with at

least two years of consecutive data from 2005 to 2011. This source provided detailed audited financial data, which helps overcome the limitations of using cost-accounting data from Medicare cost reports.[9] We also accessed information on payer insurance coverage, patient characteristics such as race, and hospital controls (for example, ownership status, capital investment changes, and licensed bed count).

Our second data source was Yale University's Center for Outcomes Research & Evaluation, which provided annual hospital 30-day risk-standardized readmission and mortality rates for three clinical areas (acute myocardial infarction, heart failure, and pneumonia) for the period 2005–2010. Using annual data rather than CMS's publicly available three-year aggregate data allowed us to better control for unobserved factors and test for causality.

Our third source was the Hospital Compare database compiled by the U.S. Department of Health and Human Services: http://www.medicare.gov/hospitalcompare/search.html. From this database, we obtained data on annual adherence to clinical guidelines for the same three clinical areas for the calendar years 2005–2010.

The fourth source was the annual Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey for the period 2007–2010, from which we obtained patient assessments of their in-hospital care experiences. Note that these experiences were not limited to the above-mentioned clinical areas. Survey scores were adjusted by CMS to account for factors believed to affect patient responses but do not control for patient ethnicity or form of payment.[10]

From these sources, we used multiple measures whenever possible for each component of the quality framework shown in Figure 1. Thus, our results reflect an aggregate view of a hospital's performance and are not indicators of any individual patient status, experience, or outcome, nor do they reveal the performance of a specific clinical area within a hospital.

Our model required annual financial and patient information for the hospitals included in our study. We constructed our data set through a process of elimination. First, we identified 485 health care facilities that reported in California's COSHPD financial database and 515 health care facilities that reported patient demographics, payer coverage, and hospital characteristics (not all facilities were acute care hospitals). We cross-referenced the additional data sources (see above and the Supplemental Material) to find 30-day risk-standardized readmission and mortality rates, adherence to clinical guidelines, and patient surveys. Our final study population was 265 acute care hospitals in California that had complete information for at least two consecutive years and also maintained a one-to-one relation with a Medicare provider number from 2005 through 2010.

This final data set allowed us to draw on the strengths of comparisons both within and between hospitals. In general, analyses across multiple institutions can be useful for identifying correlations between factors such as health outcomes and patient demographics. However, they cannot determine if one factor causes another because they cannot control for unobserved factors that affect the dependent variable of interest and that differ between institutions.[11] In contrast, analyses conducted within a single hospital are more revealing of causal relationships because they hold fixed many of these unobserved factors. That said, considerations unique to each institution might limit the ability to generalize the results. Having data from the same hospitals over multiple years allowed us to control for unobserved fixed and autocorrelated effects while increasing the number and breadth of the hospitals analyzed, thereby allowing us to identify relationships applicable across a variety of health care organizations.

An overview of our data set confirmed that the sample contained data points across a wide enough range for each variable to allow us to estimate relationships. We also compared the general characteristics of our California hospital sample with those of the national hospital data set. Statistical tests show that for the majority of variables recorded, there were no significant differences between our sample and the national sample. However, the hospitals in our sample were larger overall and had lower clinical adherence for pneumonia, higher mortality rates for pneumonia, and lower patient satisfaction. With this noted, we observe that these comparisons suggest that the relationships we identified here are likely to apply to a wider range of health care organizations as well. (Much more detail on our measures and tables of our results are available for review in our Supplemental Material.)

Patient Populations and Hospital Performance

We used several common metrics, described briefly below, to assess different aspects of patient populations and hospital performance.

Patient Demographics and Patient Insurance Coverage

Using the COSHPD database, we calculated the annual percentage of patients covered by private insurers for each hospital (the patient insurance coverage mix), the percentage of underrepresented minorities (African American, Hispanic, and Native American) served by the hospital, and the percentage of a hospital's patients who were 60 years of age or older.

Financial Health

We measured the financial health of a hospital in any given year using the DuPont System, which is widely used in financial statement analysis to assess the overall financial health of an institution.[12] The DuPont System includes three key financial ratios that reflect different aspects of financial health. *Current ratio* provides information about the institution's ability to meet its short-term financial obligations. *Gross operating margin* is a good indicator of the institution's ability to generate profits. And *return on assets* captures how efficiently the institution uses its assets. As detailed in our Supplemental Material, we standardized and combined these ratios to create a single measure of the hospital's annual financial health. This measure reflects a hospital's access to the resources needed to deliver high-quality care, such as staff, managerial talent, and physical assets. Higher scores indicate better financial performance.

Clinical Adherence

We used care performance measures from CMS's Hospital Compare database to report how well a hospital met the objective standards associated with high-quality medical care for each of three clinical areas: acute myocardial infarction, heart failure, and pneumonia. As described further in our Supplemental Material, we created a single measure of the hospital's clinical quality in a given year relative to the other 264

hospitals in our database. For this measure, higher scores reflect greater adherence to clinical standards, an indicator of better care.

Patient Experience

The HCAHPS database contains average patient assessments on 10 dimensions of patient care, derived from 18 survey questions. To generate a single annual hospital value for overall patient experience, we combined responses to two hospital-specific questions ("How do you rate the hospital overall?" and "Would you recommend the hospital to friends and family?"). These two dimensions reflect overall service quality[13,14] and have been found to capture patients' overall satisfaction with their hospital experience.[15] They are also important predictors of health outcomes such as mortality and readmission, as observed across multiple clinical areas and hospital services.[16,17] These yearly aggregated measures were then standardized (see the Supplemental Material for details). As with HCAPHS, better patient experiences are associated with higher scores for this measure.

Hospital Infrastructure

Prior work has shown that hospital investment in infrastructure such as equipment is related to outcomes and quality screens.[18–20] We captured each hospital's new annual capital investment on the basis of annual percentage of change in equipment and net depreciation as determined from audited financial records, which we then standardized across the population within each year. Larger values are associated with greater levels of investment.

Hospital Outcomes

We used two common quality measures, hospital-level 30-day risk-standardized mortality rates and readmission rates, which control a particular hospital's outcome rates for patient demographics (gender and age), cardiovascular condition, and other existing health conditions. As detailed in the Supplemental Material, we combined these two measures for each of our three clinical areas to create a single hospital-wide quality index for each hospital and each year. As with the above measures, this measure should be viewed as a good but not perfect

hospital-level measure of the quality of health care. In this case, smaller values represent better outcomes.

Control Measures

We also controlled for other hospital-observed factors that are not of primary interest in our model but are commonly used in hospital financial research,[9,21] including number of licensed beds, teaching hospital status, ownership (for example, investor, government, or nonprofit), and presence of 24-hour emergency services.

Hospital Finances and Health Care Outcomes

Our primary objective was to identify links between a hospital's patient population and its quality of care, then evaluate whether those relationships are mediated by the financial health of the hospital. We first looked at our data set for evidence that variation in patient demographics, including ethnicity, correlated with variations in health care quality. Using a regression analysis statistical approach, we tested whether the percentage of underrepresented minorities was directly associated with the three performance measures that CMS uses in its pay-for-performance programs: clinical adherence, patient experience, and hospital outcomes. (Note that CMS controls for age when reporting patient experience and outcomes.) Much like the previous studies we mentioned earlier, we found highly statistically significant results showing that hospitals that treated higher percentages of minority patients reported lower clinical adherence scores, worse patient experiences, and poorer health outcomes. However, this regression analysis is designed only to show correlation between factors, not whether one directly causes another.

Given our interest in assessing causality, we next defined a series of linear models to test the relationships we proposed in Figure 1. We used these models to address four main issues. First, the models help identify factors that might separately explain an observed correlational relationship between the variables in question. They do this by controlling for some aspects of unobserved variables (such as managerial expertise) that might cut across equations and/or are related to the independent and dependent variables and thus could affect both. Second, the models test whether an observed statistical association (such as between

ethnic status and measures of financial health) can be accounted for by an intermediate variable (such as insurance status). Third, the models test whether our results might be explained by unaccounted-for contemporaneous factors (for example, economic shocks that lead to lower employment levels, which, in turn, lead to sicker patients because of postponed health care). And finally, the models are used to test for causality among the factors described in Figure 1. We analyzed causality using a methodology proposed by Clive Granger that uses past observations of the dependent variable (such as quality of health care) as a control and then looks to see if an independent variable (such as insurance reimbursements) causes changes in the dependent variable after including additional control variables (such as demographics).[22] The models testing the Figure 1 relationships and their main findings are described below.

1. *Is a hospital's patient insurance coverage mix determined by its patient demographics?* We found that hospitals that treated higher percentages of patients from underrepresented minority populations had fewer privately insured patients.

2. *Is a hospital's financial health determined by its patient insurance coverage mix?* Institutions with a higher percentage of privately insured patients also demonstrated better financial performance. Although hospitals that treat greater numbers of older patients and underrepresented minorities have poorer financial health, these effects are completely mediated once the percentage of privately insured patients is included in the model. That is, the age and racial composition of a patient population are not related to the financial health of a hospital once the insurance coverage of the patients is known. When we tested for causality, we found that the percentage of privately insured patients significantly affects hospital financial performance in the subsequent year. This latter point highlights the potentially complex and long-lasting impact payer coverage has on a hospital's financial health and, indirectly, its ability to provide quality care both today and in the future.

3–5. *Are patient experiences, clinical adherence, and investment in equipment, respectively, determined by the hospital's financial health?* Together, these three separate analyses showed that a hospital's financial health seems to have widespread impact on institutional decisionmaking and structure. Both clinical

performance and changes in equipment investment correlated with the institution's financial health, although patient experiences did not. However, when we tested for causality, we found that last year's financial health negatively affected not only this year's investment in equipment and clinical performance but also this year's patient experience scores.

6. *Are hospital outcomes determined jointly by the hospital's patient experiences, clinical adherence, and investment in equipment?* We found that better adherence to clinical guidelines and positive patient experiences were associated with better hospital-wide outcomes, even after controlling for the effects of the other factors (including investment in equipment).

Implications for Health Care Policy

Our analyses, which are very supportive of the relationships proposed in Figure 1, provide a number of important insights useful to policymakers and researchers. Our results show empirically that the payer mix of a hospital's patients affects the quality of its services and patient outcomes. This is largely due to the payer mix's effects on a hospital's financial condition rather than its patient demographic profile. Controlling for payer coverage absorbed most if not all of the relationship between patient demographics and quality measures. We say "most" because the percentage of privately insured patients did not mediate the relationship between minority percentage and clinical adherence. However, when the percentage of privately insured patients was exchanged for the percentage of payers on Medicaid, demographics were no longer significant. Moreover, because our data do not allow us to identify payment coverage by demographic group within a hospital, we cannot say that demographics play no part in determining quality of care; however, failing to account for payment sources will likely overstate demographic effects.

To provide insights into the magnitude of impact that the hospital's financial health has on downstream measures of performance and outcomes, we segmented our sample into three groups: hospitals in the top 20% of financial health in 2007 (our first year with complete measures), hospitals in the bottom 20%, and those in between. We compared the average performance in patient HCAHPS scores, clinical adherence, and investment in equipment for the top and bottom groups to show the actual average performance for these three downstream measures. Hospitals in the top 20% of financial health, for instance, invested more heavily in equipment (9.3% vs. 8.1%), scored 7 points higher on HCAHPS (80 vs. 73), and scored higher in clinical adherence for heart attack, heart failure, and pneumonia (3.5, 7.7, and 6.7 points higher, respectively). For an average-sized hospital from our sample, our model predicts that being in the top 20% of infrastructure investment, clinical adherence performance, and HCAHPS scores in aggregate in a given year resulted in 6.5 fewer deaths that year (0.4 heart attack, 1.1 heart failure, 5.0 pneumonia) and 11.2 fewer readmissions (1.4 heart attack, 4.1 heart failure, 5.7 pneumonia) compared with an average-sized hospital in the bottom 20%. Note that these differences represent the impact on just the 797 patients treated annually in these three clinical areas in this average hospital; the impact of increased financial health on a hospital's full patient population will likely be much greater.

Taken together, these findings imply that failing to adjust CMS's Hospital Value-Based Performance Program (HVBP) and Readmission Reduction Program (RRP) domain scores to account for patient demographics or payer mix could have unintended consequences. That is, it could set up a cycle of imposing financial penalties on already struggling hospitals, which would cause even worse subsequent relative performance, lower HVBP and RRP scores, and further reductions in reimbursement. In their current form, HVBP and RRP may inadvertently institutionalize substandard care for people already at risk of receiving poorer care.[23,24]

A critical facet of fairly administering health care funding programs is to risk-adjust outcome measures to control for factors that are beyond the control of a hospital. That includes the presence and/or severity of certain diseases such as diabetes, so-called *exogenous* factors, but not for hospital characteristics that are within their control, so-called *endogenous* factors.[25] CMS and other quality assessment bodies such as the National Quality Forum do not risk-adjust for factors such as race and socioeconomic status because they do not want to hold hospitals with different patient demographics to different performance standards.[26] Adjusting for race or socioeconomic status could also obscure real differences that would be important to identify wherever they exist. While valid, these concerns need to be balanced against our findings that failing to

adjust for payer mix or demographic factors could have unintended negative effects on organizational finances and resulting health care quality for underserved populations.

Recent findings show that safety-net hospitals in California already are more likely than other hospitals to be penalized financially by hospital-based quality reimbursement programs such as HVBP, RRP, and the electronic health record meaningful-use program.[27] One potential solution is to handle such hospitals, which treat high proportions of underinsured patients, as a discrete cohort for the purposes of calculating Value-Based Purchasing reimbursement adjustments. Policy-makers could channel a greater proportion of incentive payments to these safety-net hospitals and potentially make some of these payments contingent on specified organizational investments in quality management and systems.

Another option would be to directly incorporate patient insurance coverage profiles into the value-based reimbursement formula for hospitals. This risk-adjustment methodology could be separated from formal reporting of quality and outcome metrics to avoid CMS's and the National Quality Forum's explicit concerns about concealing disparities. Finally, the adverse effects that decreasing insurance payments are likely to have on the quality of care for all patients deserve greater attention. That is particularly true in states that have elected not to expand Medicaid under the Affordable Care Act, as also has been highlighted by Gilman et al.[27] In an era of unsustainable cost increases, hospitals are unlikely to be able to shift costs to the private sector at historical levels.[28] Instead, many hospitals may respond by cutting costs in ways that are likely to reduce their ability to provide quality health care,[29] which could adversely affect care for all patients, regardless of their insurance status.

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supplemental material ⌐↗⌐

- http://behavioralpolicy.org/supplemental-material
- Methods & Analysis
- Data, Analyses & Results
- Additional References

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