Variation in markup of general surgical procedures by hospital market concentration

Marcelo Cerullo [a, b], Sophia Y. Chen [a], Mary Dillhoff [c], Carl R. Schmidt [c], Joseph K. Canner [a], Timothy M. Pawlik [c, *]

[a] *Department of Surgery, Johns Hopkins University School of Medicine, Baltimore, MD, United States*
[b] *Department of Surgery, Duke University Medical Center, Durham, NC, United States*
[c] *Department of Surgery, Wexner Medical Center at the Ohio State University, Columbus, OH, United States*

ARTICLE INFO

ABSTRACT

Background: Increasing hospital market concentration (with concomitantly decreasing hospital market competition) may be associated with rising hospital prices. Hospital markup — the relative increase in price over costs — has been associated with greater hospital market concentration.
Methods: Patients undergoing a cardiothoracic or gastrointestinal procedure in the 2008–2011 Nationwide Inpatient Sample (NIS) were identified and linked to Hospital Market Structure Files. The association between market concentration, hospital markup and hospital for-profit status was assessed using mixed-effects log-linear models.
Results: A weighted total of 1,181,936 patients were identified. In highly concentrated markets, private for-profit status was associated with an 80.8% higher markup compared to public/private not-for-profit status (95%CI: +69.5% - +96.9%; p < 0.001). However, private for-profit status in highly concentrated markets was associated with only a 62.9% higher markup compared to public/private not-for-profit status in unconcentrated markets (95%CI: +45.4% - +81.1%; p < 0.001).
Conclusion: Hospital for-profit status modified the association between hospitals' market concentration and markup. Government and private not-for-profit hospitals employed lower markups in more concentrated markets, whereas private for-profit hospitals employed higher markups in more concentrated markets.

1. Introduction

Hospital charges in the United States are not constrained by formal regulations, despite policies aimed at cost containment. Maryland is currently the only state that sets an all-payer rate for hospitals,[1] while most other hospitals across the nation use a chargemaster (a directory of items and services that are "billable") to determine the total cost of an inpatient stay.[2] The majority of commercial insurers do not pay hospitals the full "charged" price, instead paying an amount predicated on a privately negotiated rate for certain diagnosis-related groups or a total discount of certain components within the total hospital charge. Despite this, hospitals are able to leverage the charges that are set for a particular procedure to achieve other aims, such as part of a negotiating strategy with payers, or more importantly, to anchor the ultimate reimbursement at a higher rate (though not as high as the initial charge).[3] Finally, these calculated charges can often translate into undue financial burdens for private out-of-network or uninsured patients.[4]

The amount that exceeds the cost of the procedure has been defined as both "excess charges" (i.e. the amount charged that exceeds the Medicare allowable payment) and as "markup" (i.e. the ratio of charges to costs and/or payments for a procedure). Several investigators have demonstrated an increase in excess charges or markup on general surgical procedures. For example, Gani et al. reported that a quarter of hospital charges for general surgical procedures were more than four times greater than the estimated cost of the hospitalization.[5,6] In a separate report, Bai and Anderson reported that most general surgical procedures had a charge-to-Medicare payment ratio of 2.9 or greater.[2]

Investigations into the geographic and regional variation in

* Corresponding author. Department of Surgery, The Urban Meyer III and Shelley Meyer Chair for Cancer Research, Wexner Medical Center at The Ohio State University, 395 W. 12th Avenue, Suite 670, Columbus, OH 43210, United States.
E-mail address: tim.pawlik@osumc.edu (T.M. Pawlik).

health care spending have noted that patient characteristics do not fully explain differences in costs or in pricing.[7,8] Instead, excess costs and charges for surgery have been associated with comorbidities and/or post-operative complications.[9,10] The wide variation in procedure-specific excess charges have also been explained, in part, by structural factors that contribute to health care market-specific heterogeneity, such as hospital location, ownership (e.g. not-for-profit/for-profit), or teaching status.[4,11]

Hospital market concentration is a structural factor that may also contribute to hospital price variation. Hospitals with greater market share — as well as hospitals in more concentrated markets with less competition — may be able to negotiate higher payments from private third party payers.[12,13] Conversely, hospitals in less concentrated markets may be less able to negotiate higher payments or charge higher prices.[14,15] The gains in efficiency and quality of patient care that result from hospital system consolidation have been proposed as outweighing the economic risks associated with an unconcentrated hospital market.[16] However, others have argued that, while the efficiency may lead to overall lower costs, hospitals may nevertheless apply a substantial markup.[17,18] In addition, the factors that affect procedural markup across different categories of hospitals (e.g. not-for-profit versus private-for-profit hospitals, teaching versus non-teaching hospitals, and hospitals that care for a disproportionate share of publicly-insured patients) have not been well defined.

Therefore, the objective of the current study was to define the relationship between hospital market concentration and procedural markup using a nationally representative sample of non-Medicare insured patients who underwent an inpatient gastrointestinal or cardiothoracic surgical procedure. In addition, we sought to determine the degree to which the association between market concentration and charge markup varied between public/private not-for-profit hospitals versus private for-profit hospitals.

2. Methods

2.1. Study population

Patients ≥18 years of age with a non-Medicare primary payer who underwent a gastrointestinal or cardiothoracic operation (coronary artery bypass grafting, valve replacement, lung resection, pancreatic resection, liver resection, colon/rectal resection, gastric resection, and/or esophagectomy) within the Nationwide Inpatient Sample (NIS) 2008–2011 were identified using *International Classification of Disease, Ninth Revision, Clinical Manifestation (ICD-9-CM)* procedure codes. These procedures were chosen in accord with prior studies that have defined hospital markup for surgical procedures using both all-payer and Medicare-specific databases.[5,6] Non-Medicare patients were specifically selected as Medicare reimburses hospitals at a fixed rate, and thus differences in total charges and estimated costs may not reflect variation in pricing across hospital markets. The NIS is a stratified, random sample of hospitals represented in all state inpatient databases that contains information on > 7 million patient discharges per year; it represents approximately twenty percent of all hospital discharges in the United States.[19] The NIS is maintained by the Agency for Healthcare Research and Quality (AHRQ) and is publicly available, de-identified, and compliant with the Health Insurance Portability and Accountability Act (HIPAA) of 1996. The study was approved by the Johns Hopkins University Institutional Review Board.

2.2. Patient and hospital characteristics

Patient comorbidity at the time of surgery was classified using the Charlson Comorbidity Index (CCI).[20] Inpatient complications

were identified using a previously validated methodology for administrative data.[21] Hospital length of stay and discharge disposition were dichotomized using previously defined categories.[22] Hospital characteristics including region, teaching status, and bed size were determined using the American Hospital Association Linkage Files provided by the Healthcare Cost and Utilization Project (HCUP). Annual hospital procedure-specific volume was dichotomized at more than highest tercile of procedures.

Hospital market concentration was defined using the Herfindahl-Hirschman Index (HHI), which is calculated by summing the squares of the fraction of discharges from each hospital in an *a priori* defined market.[23] A hospital market was determined using the "variable radius" definition previously described, which is consistent with variations in patient flow across diverse geopolitical boundaries such as counties or metropolitan areas.[24] The HHI for each hospital's market is provided in the Hospital Market Structure (HMS) file, also compiled by HCUP; these files are available every three years up to 2009 and are assembled by the AHRQ and linked via hospital identifiers to the NIS data. The HHI is a validated and widely applied metric of market consolidation that indicates the degree to which any one "firm" (i.e. a hospital) possesses a disproportionate share of the market.[23] The smaller the HHI, the less concentrated (or more competitive) the market. HHI was categorized using previously described limits (greater than or equal to 0.25 was categorized as highly concentrated [i.e. noncompetitive], an HHI 0.15 to 0.25 moderately concentrated [or moderately competitive], and a market with HHI less than 0.15 was deemed unconcentrated [or highly competitive]).[25] As the dispersion of HHI across urban and rural hospitals varied markedly, the analytic cohort was restricted to urban hospitals only, which performed over 95% of all estimated resections. To assess the differences in markup among patients by insurance status, patients were further stratified according to whether they did or did not have private insurance.

2.3. Cost outcomes

As the NIS only reports total billed hospital charges for each inpatient stay, total hospital costs were estimated using hospital-specific cost-to-charge ratios published by HCUP. To account for price factors beyond each hospital's control, the difference between the reported charges and estimated cost was further adjusted for each hospital's wage index, which is provided by the Center for Medicare and Medicaid Services. All financial variables were adjusted to 2011 dollars using the United States Department of Commerce Bureau of Economic Analysis Gross Domestic Product (GDP) Implicit Price Deflator.[26] The raw difference between total charges and estimated costs was winsorized to limit the influence of outliers.[10,27] Hospital markup has been previously described as the ratio of the total charges for an episode of inpatient care (including operating room, anesthesia, and postoperative care) and the costs of care.[4,6] For the current study, procedural markup was determined as the percent increase over the average cost for each category of procedures across hospitals. Specifically, the difference between the reported charges and the estimated cost was adjusted by dividing by the average cost of procedures within each category.

2.4. Statistical analysis

Continuous variables were examined as means and standard deviations (SD) or medians with interquartile range (IQR), and evaluated using Student's *t*-test or non-parametric Kruskal-Wallis test. Categorical variables were compared using Pearson's chi-square or Fisher's exact test, as appropriate. Sampling weights published by the NIS were used to obtain frequency estimates