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ORIGINAL SCIENTIFIC REPORT

Understanding Disparities in Surgical Outcomes for Medicaid Beneficiaries

Jake Claflin[1] · Justin B. Dimick[1,2,3] · Darrell A. Campbell[1,2] · Michael J. Englesbe[1,2,3] · Kyle H. Sheetz[1,2,3]

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Abstract

Background Few studies have evaluated whether outcome disparities between Medicaid and private insurance beneficiaries are driven by the hospital at which the patient receives care. The purpose of this study was to evaluate the effect of the hospital on surgical outcomes in Medicaid beneficiaries.

Methods We identified 139,566 non-elderly Medicaid and private insurance beneficiaries undergoing general, vascular, or gynecological surgery between 2012 and 2017 using a statewide clinical registry in Michigan. We calculated risk-adjusted rates of complications, readmissions, emergency department (ED) visits, and post-acute care utilization using multivariable logistic regression, accounting for patient and procedural factors. We then evaluated whether, and to what extent, the hospital influenced outcome disparities between Medicaid and privately insured beneficiaries.

Results Risk-adjusted rates for all outcomes were higher in Medicaid beneficiaries. For example, overall post-discharge ED visit rates were 14.3% (95% CI 13.7% to 14.9%) for Medicaid compared to 7.5% (95% CI 7.1% to 7.9%, $P < 0.01$) for private insurance beneficiaries. Hospital factors explained 3.9% of the observed difference in complication rates between Medicaid and private insurance beneficiaries. In contrast, hospital factors explained a greater proportion of the disparities in readmissions (30.6%), ED visits (33.0%), and post-acute care utilization (16.1%). Results were similar when restricting the study population to elective cases only.

Conclusions Hospital factors account for a significant proportion of the disparities in post-discharge resource utilization between Medicaid and private insurance beneficiaries. Policies aiming to improve the quality and equity of surgical care for Medicaid beneficiaries should focus on the post-discharge period.

Introduction

Disparities are a central focus of healthcare reform throughout the world. In the USA, Medicaid beneficiaries continue to have poor outcomes. Medicaid, a government sponsored insurance program for predominately low-income citizens, is run individual states with additional funding from the federal government. Disparities for this population are a particular concern following surgical care where Medicaid beneficiaries present with more comorbidities, are twice as likely to smoke, and use more resources than other non-elderly adults [1–5]. Medicaid beneficiaries also concentrate in certain hospitals. For

✉ Kyle H. Sheetz
ksheetz@med.umich.edu

1 Department of Surgery, University of Michigan Medical School, 1500 E. Medical Center Drive, 2110 Taubman Center, Ann Arbor, MI 48109, USA

2 Michigan Surgical Quality Collaborative, Ann Arbor, MI, USA

3 Center for Healthcare Outcomes and Policy, Ann Arbor, MI, USA

example, in Michigan, 20% of the State's surgical providers care for over 35% of the Medicaid population [6, 7].

However, the source of disparities in surgical outcomes between Medicaid and privately insured patients is unclear. On the one hand, comorbidities and social risk factors like smoking and socioeconomic status may increase disparities. On the other hand, if Medicaid beneficiaries are more likely to receive care at low quality hospitals, for example, this may also influence outcomes. Where Medicaid patients receive care is also important considering the well-known variation in surgical outcomes across hospitals and policies that expand the Medicaid population [8–13]. While access to healthcare may increase the overall health status of surgical patients in the long term, the site of care may have a greater impact on outcomes and disparities in the near term until the maximum benefits of insurance coverage are realized.

Using data from a regional quality improvement collaborative, we conducted a population-based study of general, vascular, and gynecological surgical outcomes for non-elderly patients in Michigan. We evaluated the extent to which the hospital, relative to other patient and procedural factors, explained disparities in surgical outcomes between Medicaid and other non-elderly, private insurance beneficiaries.

Materials and methods

Data source and study population

We used data from the Michigan Surgical Quality Collaborative (MSQC) clinical registry. The MSQC is a payer-sponsored 73-hospital regional consortium, and details about data collection and integrity have been described previously [14, 15]. Trained personnel within each hospital collect data on demographics and comorbidities, intra- and postoperative process details, and 30-day outcomes from the medical record for patients undergoing general, gynecologic, or vascular surgery. The MSQC uses a case-sampling method designed to minimize selection bias. Regular data audits ensure data accuracy.

We identified all patients undergoing general, gynecologic, or vascular surgery using relevant Current Procedural Terminology (CPT) codes. The MSQC captures data on numerous types of procedures, but focuses on common operations such as laparoscopic cholecystectomy or hysterectomy that are performed across diverse practice settings. We excluded patients younger than 18 years of age. For analyses comparing Medicaid beneficiaries to non-elderly adults (private insurance beneficiaries), we defined the non-elderly as those 18–64 years of age as has been previously described [6, 13].

Outcomes

The main outcome measures in this study were the incidence of postoperative 30-day complications, 30-day readmissions, emergency department (ED) visits, and the use of any home health or rehabilitation services at discharge. Complications were derived from standardized registry definitions and included cardiopulmonary problems (cardiac arrest, myocardial infarction, unplanned intubation, pneumonia), surgical site infection (superficial, deep or organ-space) (SSI), venous thromboembolism (deep venous thrombosis or pulmonary embolism), sepsis or septic shock, stroke, and acute renal insufficiency [16, 17]. The utilization of post-discharge care was confirmed by review of the medical and billing records within each participating hospital.

Statistical analysis

This analysis was designed to quantify the extent to which the hospital impacts the disparity in outcomes between Medicaid and other non-elderly adult patients. In this framework, hospital factors constitute overall quality of the hospital. We used hierarchical multivariable logistical regression models, accounting for patient (age, race, sex, comorbidities) and procedural characteristics (including conversion to open procedures), to generate risk-adjusted rates for each outcome. Each model's performance was evaluated by receiver operator curves (C statistics) and goodness-of-fit testing across deciles of risk. We estimated relative differences between risk-adjusted outcomes using odds ratios (OR) with privately insured, non-elderly adults as a reference. We used marginal means to generate absolute risk-adjusted outcome rates for each group. We reported results across hospitals stratified by the proportion of Medicaid versus all other patients within each facility during the study period.

In order to quantify the effect of the hospital (relative to other factors such as patient characteristics), we created models in a stepwise fashion. We first fit a model including only insurance status comparing Medicaid to the reference population. Next, we included patient and procedural characteristics. To address the overall effect of the hospital, we included a categorical dummy variable for each hospital, modeling it as a fixed effect as has been previously described [18].

We then calculated the proportion of the overall disparity explained by patient and procedural factors and the hospital. The relative change in the OR between the base model and subsequently analyzed model describes this proportion and is defined as [(ORb − ORa)/(ORb − 1)], where ORb is the OR for the base model (including insurance status only) and ORa is the OR after adjustment for the subsequent variable (hospital effect). For all estimates, we used bootstrapping to generate confidence intervals and the corresponding t-statistics. The *t*-statistics were generated from normal-based confidence intervals derived from bootstrapping with 1000 replications, where draws were made at the hospital level to deal with clustering at the hospital level. We conducted several sensitivity analyses, restricting the patient population by surgical priority (elective vs. emergent) and specific procedures, to ensure generalizability of the results.

All statistical analyses were performed using STATA statistical software version 14 (College Station, Texas). We employed a two-sided approach at the 5% significance level for all hypothesis testing. This study was deemed exempt by the Institutional Review Board at the University of Michigan.

Results

Differences in patient characteristics

Differences in patient demographics, comorbidities, and surgical case mix between Medicaid and privately insured patients are displayed in Table 1. The mean age of private insurance beneficiaries was 46.5 years compared to 41.7 years for Medicaid beneficiaries ($P < 0.01$). Medicaid beneficiaries were more likely to be of black race (22.9% vs. 13.1%, $P < 0.01$). Medicaid beneficiaries were also more likely to have chronic obstructive pulmonary disease (8.1% vs. 5.2%, $P < 0.01$) and be active smokers at the time of their operation (46.9% vs. 27.1%, $P < 0.01$). The procedural case mix was similar between Medicaid and private insurance beneficiaries.

Concentration of Medicaid beneficiaries in Michigan hospitals

Hospitals were stratified by the overall proportion of Medicaid beneficiaries having surgery within each center, which ranged from 2.3 to 24.7% (mean 9.5%). Hospitals were then organized into quartiles based on the proportion of Medicaid beneficiaries. The middle quartiles were combined for display of results. Figure 1 shows the overall proportion of Medicaid and private insurance beneficiaries in each quartile of hospitals. This figure shows that Medicaid beneficiaries concentrated in certain hospitals. For example, the 25% of hospitals with the highest proportion of Medicaid beneficiaries cared for 46.8% of the total Medicaid population. In contrast, private insurance beneficiaries did not concentrate in certain hospitals and instead were evenly distributed across each quartile of hospitals.

Table 1 Patient and procedural characteristics for Medicaid and privately insured patients

	No. of patients (%)		
	Privately insured patients	Medicaid patients	*P* value
No. of patients	120,265	19,301	
Demographics			
Age, mean (SD), year	46.5 (11.8)	41.7 (12.8)	<0.01
Men	40,774 (33.9)	5920 (30.7)	<0.01
White	97,781 (81.3)	13,452 (69.7)	<0.01
Black	15,715 (13.1)	4617 (22.9)	<0.01
Comorbidities			
Body mass index, mean (SD)	31.0 (7.9)	31.2 (8.7)	0.22
Current smoker	32,593 (27.1)	9048 (46.9)	<0.01
Hypertension	39,318 (32.7)	6030 (31.2)	<0.01
Diabetes mellitus	15,509 (12.9)	2689 (13.9)	<0.01
Chronic pulmonary disease	6252 (5.2)	1562 (8.1)	<0.01
Coronary artery disease	7453 (6.2)	1210 (6.3)	0.70
Peripheral vascular disease	4343 (3.6)	830 (4.3)	<0.01
Malignancy	2509 (2.1)	475 (2.5)	<0.01
Dialysis	1088 (0.9)	127 (0.7)	<0.01
Type of admission			
Elective	86,508 (71.9)	12,739 (66.0)	<0.01
Urgent	16,649 (13.8)	3523 (18.3)	
Emergent	17,108 (14.2)	3039 (15.8)	
Type of procedure			
Laparoscopic cholecystectomy	26,433 (22.0)	4883 (25.3)	<0.01
Hysterectomy	8683 (7.2)	1153 (6.0)	<0.01
Laparoscopic appendectomy	12,512 (10.4)	2032 (10.5)	0.60
Colectomy	28,577 (23.8)	4059 (21.0)	<0.01
Carotid endarterectomy	1501 (1.3)	221 (1.2)	0.18

Outcomes between Medicaid and private insurance beneficiaries

Medicaid beneficiaries had higher rates of risk-adjusted complication, readmission, ED visit, and post-acute care utilization than private insurance beneficiaries. For example, overall post-discharge ED visit rates were 14.3% (95% CI 13.7% to 14.9%) for Medicaid beneficiaries compared to 7.5% (95% CI 7.1% to 7.9%, $P < 0.01$) for private insurance beneficiaries. Risk-adjusted outcome rates for Medicaid and private insurance beneficiaries across quartiles of hospitals grouped by the overall proportion of

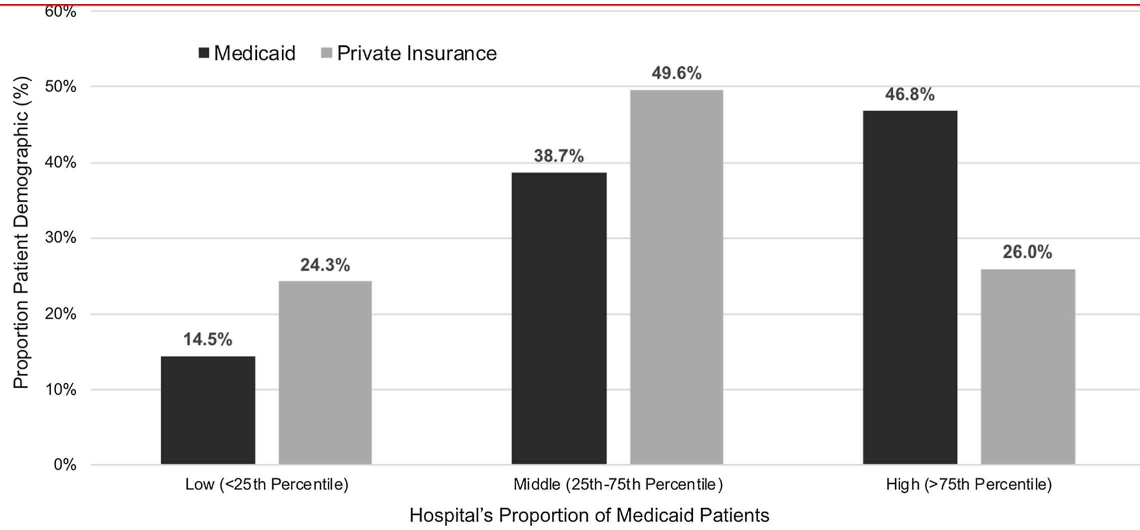

Fig. 1 Distribution of Medicaid and privately insured patient populations. Figure shows the overall proportion of each patient demographic across hospitals grouped by the proportion of Medicaid patients. Privately insured patients distribute evenly across hospitals. In contrast, Medicaid patients concentrate within certain hospitals. For example, the 25% of hospitals with the largest proportion of Medicaid patients care for almost half (46.8%) of the entire demographic

Medicaid beneficiaries are displayed in Fig. 2. There were no significant differences between hospital quartiles and any risk-adjusted outcomes for private insurance beneficiaries. Risk-adjusted complication rates were not significantly different for Medicaid beneficiaries treated by a hospital in the high (highest proportion of Medicaid beneficiaries) (7.4%, 95% CI 6.6% to 8.1%) or low (lowest proportion of Medicaid beneficiaries) quartile (7.4%, 95% CI 6.9% to 7.9%, $P = 0.69$). In contrast, readmission rates were higher for Medicaid beneficiaries treated by the low 7.3% (95% CI 6.8% to 7.9%) versus high quartile hospital 6.1% (95% CI 5.7% to 6.6%, $P = 0.03$). ED visits, however, were lower for Medicaid beneficiaries treated by the low 12.9% (95% CI 12.1% to 13.6%) versus high quartile 15.2% (95% CI 14.6% to 15.8%, $P < 0.01$) of hospitals.

Hospital contribution to disparities

The proportions of the differences in risk-adjusted outcome rates between Medicaid and private insurance beneficiaries explained by patient and procedural factors and the hospital overall are displayed in Table 2. Hospitals accounted for 3.9% of the difference in complication rates between Medicaid and private insurance beneficiaries. The effect of the hospital on disparities was greater for all other outcomes. For example, hospital factors accounted for 30.6% of the difference in readmission rates, while patient and procedural factors accounted for just 11.1%. Because hospital choice may be limited in cases of urgent or emergent surgery, we performed a sensitivity analysis restricting our patient population to elective procedures only and obtained similar results (Table 2).

Discussion

In this population-based study of Medicaid beneficiaries from the State of Michigan, there are three principal findings. Medicaid beneficiaries continue to concentrate within certain hospitals for surgical care. Hospital factors explained a greater proportion of the disparities in outcomes between Medicaid and private insurance beneficiaries than patient and procedural factors. Hospital factors had a greater effect on disparities for post-discharge resource utilization (readmissions, ED visits, post-acute care) than postoperative compilations.

This study corroborates the findings of numerous prior studies demonstrating that Medicaid beneficiaries have more complications and use more resources after discharge than private insurance beneficiaries. For example, in one large retrospective study, Medicaid beneficiaries undergoing major surgery had two times higher odds of in-hospital mortality, a 23% higher risk of wound complications, and 24% higher risk of infectious complications compared to private insurance beneficiaries [3]. Medicaid beneficiaries undergoing surgical treatment for cancer stayed in the hospital three days longer and had 20% higher inpatient costs compared to private insurance beneficiaries [2]. These studies cite numerous factors contributing to this disparity including comorbid disease burden and socioeconomic status. There is considerable debate about whether

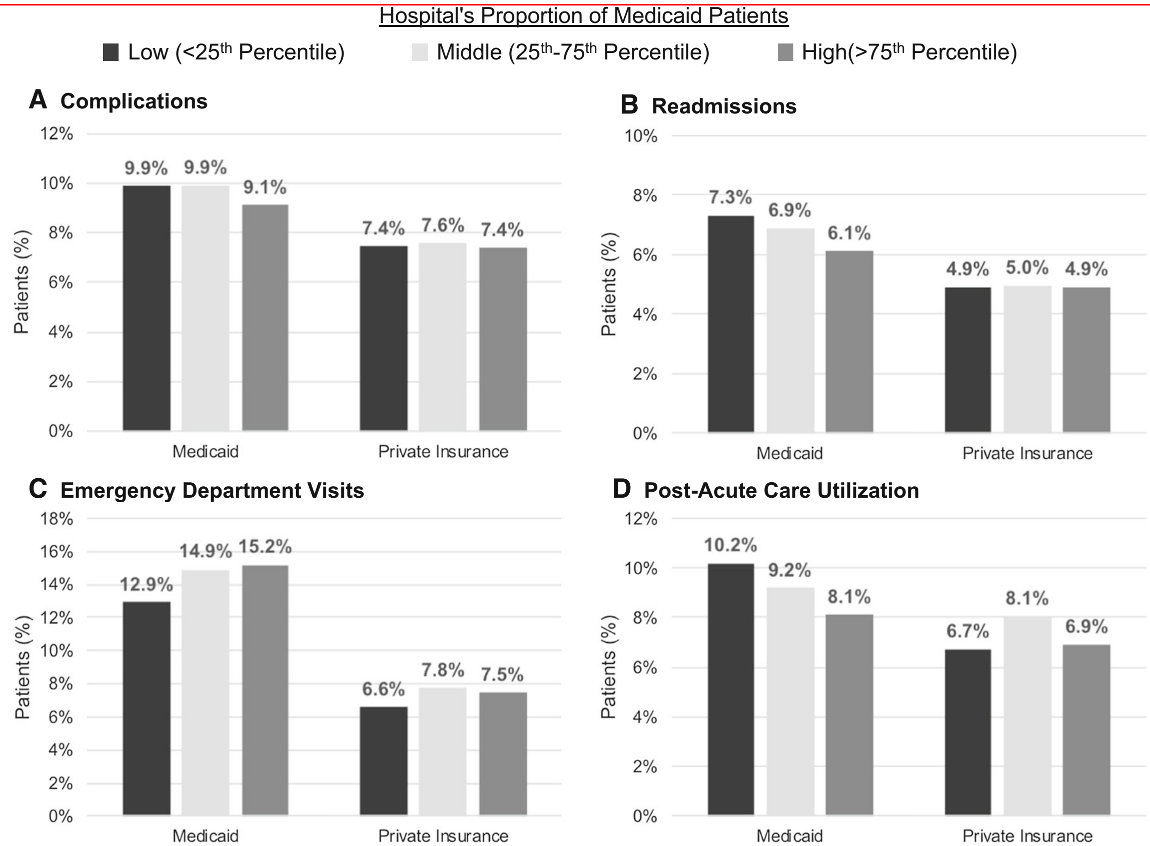

Fig. 2 Differences in outcome rates between Medicaid and privately insured patients stratified by proportion of Medicaid patients treated. Figure shows risk-adjusted outcome rates for Medicaid and privately insured patients stratified by hospitals grouped by the proportion of Medicaid patients. Complication rates were higher for Medicaid patients when compared to privately insured patients. However, results were not significantly different between hospital quartiles. In contrast, rates of post-discharge resource utilization differed significantly across hospital quartiles. This relationship was stronger for the Medicaid population

these factors are remediable. No prior work examines factors related to the access or delivery of surgical services (e.g., the choice of hospital) and how these factors contribute to persistent disparities [11, 19].

This study expands upon prior work to characterize the extent to which hospital factors explain outcomes and resource utilization. In this context, few studies have addressed surgeons' questions about how Medicaid expansion will impact surgical outcomes. There have been attempts to address the impact of the Affordable Care Act on cardiac surgery outcome in expansion versus non-expansion states [19]. This study found that risk-adjusted rates of major complications decreased in Michigan Medicaid beneficiaries after expansion, but no differences were observed over the same time period in a non-expansion State (Virginia). This study addresses a fundamentally different question. The long-term implications of sustained healthcare coverage may serve to improve surgical outcomes. In the near term, however, expanding a high-risk surgical population known to concentrate in certain hospitals may have a more direct influence on outcomes. Understanding this impact could inform more immediate clinical and policy-driven actions to reduce disparities for Medicaid beneficiaries.

This study has several limitations. First, because this is an observational study that uses clinical data from a statewide quality collaborative, risk-adjustment is limited to patient characteristics captured by the registry. However, there is no reason to suspect that measured or unmeasured characteristics would be different between Medicaid and privately insured patients (they are collected by nurse abstractors in an identical manner), and procedure codes and surgical priority were included in the analysis as an attempt to minimize these effects. Second, these data represent surgical practices from the state of Michigan and it is possible our results are not generalizable to other states. However, collaborative member hospitals perform more than 90% of surgical procedures in the state and include a heterogeneous group of hospitals (large vs. small, community vs. academic). This study is not meant to address

Table 2 Effects of patient factors and hospital choice on disparities between Medicaid patients and privately insured patients

All procedures	Risk-adjusted odds ratio (95% CI)	Proportion of difference explained (%)	*P* Value
Any complication, 30 day or in hospital			
Unadjusted	1.26 (1.17 to 1.36)	–	<0.01
Patient and procedural factors	1.25 (1.15 to 1.35)	3.8	<0.01
Choice of hospital	1.24 (1.16 to 1.33)	3.9	<0.01
Readmission			
Unadjusted	1.36 (1.28 to 1.46)	–	<0.01
Patient and procedural factors	1.32 (1.23 to 1.41)	11.1	<0.01
Choice of hospital	1.21 (1.12 to 1.30)	30.6	<0.01
Emergency department visit			
Unadjusted	2.12 (2.03 to 2.21)	–	<0.01
Patient and procedural factors	1.99 (1.90 to 2.09)	11.6	<0.01
Choice of hospital	1.62 (1.55 to 1.71)	33.0	<0.01
Post-acute care			
Unadjusted	1.31 (1.15 to 1.49)	–	<0.01
Patient and procedural factors	1.31 (1.18 to 1.45)	0.0	0.04
Choice of hospital	1.26 (1.13 to 1.42)	16.1	<0.01
Elective procedures			
Any complication, 30 day or in hospital			
Unadjusted	1.21 (1.10 to 1.33)	–	<0.01
Patient and procedural factors	1.19 (1.08 to 1.31)	9.5	<0.01
Choice of hospital	1.18 (1.07 to 1.30)	4.8	<0.01
Readmission			
Unadjusted	1.29 (1.19 to 1.41)	–	<0.01
Patient and procedural factors	1.27 (1.16 to 1.39)	6.9	<0.01
Choice of hospital	1.15 (1.02 to 1.28)	41.4	<0.01
Emergency department visit			
Unadjusted	1.89 (1.75 to 2.04)	–	<0.01
Patient and procedural factors	1.77 (1.65 to 1.90)	13.4	<0.01
Choice of hospital	1.44 (1.33 to 1.57)	37.2	<0.01
Post-acute care			
Unadjusted	1.35 (1.18 to 1.54)	–	0.26
Patient and procedural factors	1.33 (1.16 to 1.52)	5.7	0.01
Choice of hospital	1.22 (1.10 to 1.35)	31.4	0.04

questions of hospital quality. While ED visits and post-acute care utilization increased across hospital quartiles, readmissions decreased from the low to high quartile. Whether lower readmission rates at the high quartile represent a good or bad outcome is beyond the scope of this analysis and should be pursued in expanding upon this study. Some may be concerned by the complexity of factors that determine the hospital at which patients receive care. While it is plausible that Medicaid patients may have less choice of hospital than privately insured patients, this study would only strengthen the policy imperative to understand the implications of the hospital on outcomes for Medicaid patients. Emergency surgery could confound the findings, but the results did not change when restricting to only elective or specific procedures.

Hospitals that care for large proportions of poor, underserved, or marginalized patients and their surgeons face unique challenges, irremediable risk factors, and often deliver care with constrained resources. Their care delivery model is different from large referral centers or regions with numerous hospitals that may be able to distribute these patients more evenly. With these findings, our collaborative will facilitate a working group to engage surgeons from varying disciplines—as this problem crosses specialty lines. It will be important to determine which hospital factors most influence disparities in outcomes, such as post-discharge care, communication with providers, or availability of outpatient clinic resources. For example, this study suggests that implementation of best practices for post-acute care would directly benefit the

Medicaid population. As collaboratives like MSQC now exist in many States, this model is exportable and also leads to evidence-based practices with immediate policy implications. International endeavors to drive quality improvement for poor or marginalized patient populations can also use this study to focus on strategies that may be most effective for the local healthcare environment [20].

This study is also relevant to healthcare policymakers and insurance companies, who can use these findings to design better policies. It may be beneficial to provide greater financial incentives to hospitals caring for large proportions of Medicaid beneficiaries, or various marginalized patient populations from other countries, to ensure appropriate continuity of care [21]. Policies aiming to improve the quality and equity of surgical care for Medicaid beneficiaries should focus on the post-acute care period, where the greatest disparities exist and where the relationship to the hospital is strongest. The observation that Medicaid beneficiaries utilize more post-discharge resources than privately insured patients also underscores the importance of including this period when evaluating episode costs, alternative payment models, and programs targeting disparities for this patient population.

Conclusions

This study showed that Medicaid's surgical beneficiaries concentrate in certain hospitals and that the hospital at which they received care was a significant driver of disparities in post-discharge resource utilization compared to other non-elderly, private insurance beneficiaries.

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Compliance with ethical standards

Conflict of interest The authors do not have any conflicts of interest to report.

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