ANESTHESIOLOGY

Trends in Direct Hospital Payments to Anesthesia Groups

A Retrospective Cohort Study of Nonacademic Hospitals in California

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ABSTRACT

Background: In addition to payments for services, anesthesia groups in the United States often receive revenue from direct hospital payments. Understanding the magnitude of these payments and their association with the hospitals' payer mixes has important policy implications.

Methods: Using a dataset of financial reports from 240 nonacademic California hospitals between 2002 and 2014, the authors characterized the prevalence and magnitude of direct hospital payments to anesthesia groups, and analyzed the association between these payments and the fraction of anesthesia revenue derived from public payers (*e.g.*, Medicaid).

Results: Of hospitals analyzed, 69% (124 of 180) made direct payments to an anesthesia group in 2014, compared to 52% (76 of 147) in 2002; the median payment increased from $242,351 (mean, $578,322; interquartile range, $72,753 to $523,861; all dollar values in 2018 U.S. dollars) to $765,128 (mean, $1,295,369; interquartile range, $267,006 to $1,503,163) during this time period. After adjusting for relevant covariates, hospitals where public insurers accounted for a larger fraction of anesthesia revenues were more likely to make direct payments to anesthesia groups ($\beta = 0.45$; 95% CI, 0.10 to 0.81; $P = 0.013$), so that a 10–percentage point increase in the fraction of anesthesia revenue derived from public payers would be associated with a 4.5–percentage point increase in the probability of receiving any payment. Among hospitals making payments, our results ($\beta = 2.10$; 95% CI, 0.74 to 3.45; $P = 0.003$) suggest that a 1–percentage point increase in the fraction of anesthesia revenue derived from public payers would be associated with a 2% relative increase in the amount paid.

Conclusions: Direct payments from hospitals are becoming a larger financial consideration for anesthesia groups in California serving nonacademic hospitals, and are larger for groups working at hospitals serving publicly insured patients.

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EDITOR'S PERSPECTIVE

What We Already Know about This Topic

- In the United States, anesthesia groups derive revenue from insurers and "direct payments" or "institutional support" from hospitals
- Direct payments can represent a significant portion of group revenue and may enable the provision of services to patients covered by public insurers, which disproportionately represent low-resource and underserved populations
- The magnitude or characteristics of direct hospital payments to nonacademic private practice anesthesia groups is not well understood

What This Article Tells Us That Is New

- Among 240 nonacademic California hospitals analyzed between 2002 and 2014, more hospitals made direct payments to an anesthesia group in 2014 than in 2002 and the median payment increased
- Hospitals where public insurers accounted for a larger fraction of anesthesia revenues were increasingly more likely to make direct payments to private anesthesia groups
- Direct payments to private anesthesia groups are becoming increasingly important, particularly for hospitals providing care to underserved populations

In the United States, anesthesia groups primarily derive revenue from payments (typically from insurers) for the services they provide. However, another potentially large source of revenue consists of additional payments, also known as "direct payments" or "institutional support," from the hospitals where anesthesia groups provide services. These payments serve a variety of functions, including compensating anesthesia groups for activities not billable to insurance providers (*e.g.,* in-house call) and for the incremental hours of underutilized operating room time caused by management decisions such as opening extra operating rooms or unnecessarily scheduling the cases into overutilized operating room time.[1–3] In addition, as hospital-based physicians, anesthesiologists typically provide care for all patients treated at a hospital, irrespective of insurance

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status. Hospitals with less economically favorable payer mixes—specifically, a higher proportion of anesthesia income from public payers—may pay larger amounts to anesthesia groups to provide an added financial incentive for anesthesiologist recruitment or retention, particularly since the amounts paid by public payers may not be sufficient to cover the anesthesia group's staffing costs.[1]

These direct payments have important implications. First, from an economic perspective, they can represent a significant portion of some anesthesia groups' revenue. Second, as previously noted, these payments may maintain anesthesia services at hospitals serving patients covered under insurance plans that reimburse at lower rates.[1] These patients are often covered under public plans like Medicare and Medicaid, the latter of which disproportionately represents low-resource and underserved populations. Understanding the extent to which direct anesthesia payments are associated with less economically favorable payer mixes has implications when it comes to reducing disparities in anesthesia care. This is important in light of several recent studies showing disparities in anesthesia care across factors including socioeconomic status and geography.[4–7]

Despite these implications, there has been little work examining the magnitude or characteristics of direct hospital payments to private practice anesthesia groups, largely because these payments are generated by negotiations between private practice groups and hospitals and are often not reported publicly. A series of surveys among academic hospitals found that direct payments to anesthesia groups at academic centers increased steadily from 2000 to 2010, reaching a mean of $8.56 million in 2010.[8–10] However, these data did not assess payments among groups working at nonacademic hospitals, which comprise the vast majority of anesthesia practice in the United States.

In this study, we use a unique dataset consisting of publicly available financial reports for nonacademic hospitals in the state of California between 2002 and 2014 to expand upon existing knowledge of direct payments to anesthesia groups in two ways. First, by looking at many nonacademic hospitals, both public and private, over a 13-yr period, we sought to provide a descriptive analysis on the magnitude of these payments and their changes over time. Second, we tested the hypothesis that hospitals where anesthesia groups derive greater percentage revenues from less generous payers (*i.e.*, public insurers) would make larger direct payments to anesthesia groups.

Materials and Methods

Data Source

The California Office of Statewide Health Planning and Development (Sacramento, California) regulates hospitals in the State of California. Hospital financial reports were obtained from the System for Integrated Electronic Reporting and Auditing website published by the California Office of Statewide Health Planning and Development. All reports are publicly available (https://siera.oshpd.ca.gov/FinancialDisclosure.aspx; accessed January 29, 2019). These reports consist of financial statements that all hospitals must provide on an annual basis to the California Office of Statewide Health Planning and Development, including sources of revenues, costs, and crucially, direct payments to anesthesia groups. Specifically, hospitals are required to report professional fees, salaries, wages, and employee benefits paid to anesthesia groups providing services at the hospital. A full list of variables used for this study and their corresponding line and columns in the reports can be found in Supplemental Digital Content, table 1 http://links.lww.com/ALN/B974.

Sample

The present study examined hospital financial reports filed in the state of California between (and inclusive of) 2002 and 2014 (Supplemental Digital Content, fig.1, http://links.lww.com/ALN/B974, for a flow diagram outlining sample construction). When a hospital filed multiple reports in one financial year due to a change in ownership, we combined these reports. From the initial sample of 521 hospitals, we applied the following exclusion criteria. First, we excluded hospitals that typically do not provide anesthesia services, such as mental health hospitals (n = 70), rehabilitation hospitals (n = 17), and long-term care facilities (n = 18). Second, we excluded hospitals that directly employed anesthesiologists (n = 94), including Kaiser hospitals (n = 40), academic institutions (n = 17), and hospitals owned by Sutter Health (n = 23), a large integrated healthcare system in the state of California. Note that while for some of these hospitals (*e.g.*, Kaiser and many academic institutions), the physician practice and the hospital were technically distinct entities, given the fairly close-knit connections between the two, we treated these as akin to situations where the hospitals directly employed the physicians, in part because typically the hospital was bound to use the affiliated physician practice. Finally, we excluded hospitals that did not report any minutes of anesthesia care on their financial disclosure reports (n = 65), reported zero anesthesia staff (n = 13), or reported no anesthesia revenue (n = 4). The resulting final sample consisted of 240 hospitals and 2,204 hospital-year pairs, with the median hospital having 13 observations (*i.e.*, financial reports were present in the dataset for all 13 yr). There was no missing data for any of the final 2,204 hospital-year pairs.

While the data are audited and legally are required to be accurate, we performed several checks to assess validity, primarily by verifying the correlation between some reported variables (*e.g.*, total anesthesia minutes and total operating room minutes). A description of these checks and the results can be found in the Supplemental Digital Content, table 2, http://links.lww.com/ALN/B974.

Outcomes

The primary outcome of interest was the direct payment to the anesthesia group made by each hospital, defined as the "professional fees" paid to the anesthesia group(s) working at the hospital in any given financial year (page 15, line 245, column 3; for complete list of variables see Supplemental Digital Content, table 1, http://links.lww.com/ALN/B974). In order to normalize this amount to the anesthesia workload at the hospital, we divided the annual payment amount by the annual number of total anesthesia minutes reported by the hospital to obtain the direct payment per anesthesia minute. This direct payment amount is distinct from salaries, wages, and employee benefits paid by the hospital to an affiliated anesthesia group. In the case of 61 hospital-year pairs, a hospital changed ownership during the year and filed multiple reports (one for each owner); in this case, we calculated the direct payment as the total for the year across all owners. We converted all dollar values to 2018 dollars using the Consumer Price Index (https://www.bls.gov/cpi/tables/supplemental-files/home.htm; accessed July 26, 2018).

Exposure

Our primary independent variable of interest was the percentage of anesthesia revenues derived from public payers and programs for indigent payers. Specifically, in our dataset, hospitals report anesthesia revenues (*i.e.*, billing revenues for anesthesia professional services provided at the hospital) by type of payer (*e.g.*, private insurer, Medicare, Medicaid) on page 12, line 245, columns 1 to 20. We defined public payers as Medicare, MediCal, county programs, or the category "other indigent programs," and divided the sum of anesthesia revenues from these sources by total anesthesia revenues to identify the percentage of billing revenue derived from public payers.

Additional Variables

Our analyses adjusted for several additional variables. First, using data from the California Office of Statewide Health Planning and Development reports, we directly obtained the following variables: fraction of anesthesia revenue generated from inpatient sources, the presence of a 24-h in-house anesthesia provider, and the number of licensed beds in the hospital. Second, we obtained variables based on the county where the hospital was located, including total county population, the percent of each county's population older than 65 yr of age, the percent of residents identifying as white, and the median income for each county. Population data were obtained from yearly U.S. Census estimates (http://www.nber.org/data/census-intercensal-county-population-age-sex-race-hispanic.html; accessed July 13, 2018), while yearly income data were obtained from the Small Area Income and Poverty Estimates program (https://www.census.gov/programs-surveys/saipe.html; accessed July 13, 2018).

Statistical Analyses

As a first step, we calculated descriptive statistics, including mean, median, and interquartile range. We then used a multivariable regression in order to estimate the association between the percentage of patients insured by public payers and the magnitude of these direct hospital payments. To minimize confounding, we adopted two approaches. First, we incorporated the use of hospital fixed effects. Thus, rather than making comparisons across hospitals, our approach was based on changes within a hospital over time. In other words, our approach did not compare direct payments from hospital A, a hospital with a high percentage of publicly insured patients, to hospital B, a hospital with a lower percentage of publicly insured patients. Rather, our approach examined whether changes in the percentages of publicly insured patients at hospital A over time were associated with changes in payments made to the anesthesia group(s).

Second, a large minority (34.4%) of hospitals did not report making any payments at all (*i.e.*, a payment of $0) to anesthesia groups. When there are many observations for which the dependent variable is zero, a simple regression analysis will tend to be downward-biased; in other words, the estimated association will be lower in magnitude than the true association.[11] To address this issue, we performed a two-step analysis. In the first step, we used a multivariable linear regression in which the outcome was whether the hospital made any payment at all. In this analysis, the dependent variable was indicator for whether the hospital made any payment to its affiliated anesthesia group(s) in the given year, and the independent variable of interest was the percentage of anesthesia revenues derived from public payers in that year. Additional variables in the linear regression included hospital fixed effects, year fixed effects (*i.e.*, as categories), and the reported values for the covariates listed under "additional variables" (*e.g.*, number of licensed beds) for the given year. We chose a linear regression rather than logistic regression, because the high prevalence of these direct payments (66%) in our data, so the odds ratio would not approximate the risk ratio.[12–14] In contrast, the results of the linear probability model we used can easily be interpreted as adjusted risk differences.[15,16]

In the second step, we estimated a multivariable linear regression in which the dependent variable was the direct payment amount for the given year, while the independent variables remained the same as in our baseline analysis. These analyses were restricted to observations with a nonzero anesthesia payment. This two-step approach has been used in other studies to obtain non-biased estimates when a large proportion of observations assume a value of zero.[17,18] It obtains unbiased estimates (*i.e.*, estimates that are likely to be close to the true value) because the first step estimates the effect of the given exposure (*e.g.*, percentage of patients insured by public insurers) on the probability that the outcome (*e.g.*, direct payment) is nonzero, while the second step estimates the effect of a given exposure of the level of the outcome itself, conditional on the outcome being greater than zero. For this second set of analyses, we converted our dependent variable (*i.e.*, the direct payment amount) to natural logs both because the distribution of the underlying data was fairly skewed and also in order to easily report the estimated association in percentage terms.

To aid in the interpretation of our results, we used our regression coefficients to estimate the predicted probability of receiving a direct hospital payment and the average payment amount (among groups receiving a nonzero payment) for three hypothetical groups, earning 40%, 50%, and 60% of revenue from public payers. In the case of the probability of receiving a direct payment, we simply calculated the predicted probability based on the regression coefficients from the linear probability model described above. In the case of payment amounts, we used Duan Smearing[19] estimator to calculate the predicted payment magnitude. In calculating both of these predicted values, we used the sample mean for the all the remaining variables (*e.g.*, hospital fixed effects, year fixed effects, number of beds) in order to obtain the predicted value for a hypothetical "average" group receiving 40%, 50%, and 60% of its revenue from public payers.

Since we had one primary outcome and one independent variable of interest, we considered a two-tailed *P* value of 0.05 or less to be sufficient for statistical significance. We did not conduct an *a priori* power analysis as the sample size was based on the available data. All analyses were performed using STATA MP 14.0 (USA). All standard errors in our analyses were adjusted for clustering at the hospital level. Summary statistics were calculated using R Statistical Computing Software (https://www.R-project.org/; accessed March 3, 2019).

Secondary and Sensitivity Analyses

In one secondary analysis, we tested the hypothesis that larger direct hospital payments were associated with decreased work hours per anesthesiologist, either because these payments compensate anesthesia groups for inefficient use of operating room time or, potentially, due to increased recruitment incentive leading to greater numbers of anesthesia staff.[1,3] For this analysis, our outcome of interest was the overall weekly minutes of anesthesia care provided per anesthesiologist. This was calculated by dividing the total number of billable anesthesia minutes reported by the hospital each year by the total number of anesthesia staff reported by the hospital for that year. Our independent variable of interest was the direct payment amount. We also included the same set of independent variables used for our primary analysis (*e.g.,* hospital fixed effects, hospital characteristics, and other covariates).

In another secondary analysis, we explored the robustness of our results to alternative definitions of direct payments to anesthesia groups. Specifically, in our primary analysis, we defined direct hospital payments as consisting only of the professional fee paid to the anesthesia group. In order to ensure that changes to the definition of a direct payment did not alter our findings, we conducted a separate sensitivity analysis in which direct payments were defined as the sum of all wages, salaries, benefits, and professional fees paid to affiliated anesthesia groups ("Total anesthesia compensation," page 15, line 245, column 4). For this analysis, we used an approach parallel to that of our primary analysis, except that it used the alternative definition of "direct payments" (*i.e.*, the total sum of professional fees, wages, salaries, and benefits paid to the anesthesia group).

Finally, we performed a *post hoc* sensitivity analysis in which we examined the sensitivity of our results to outliers by excluding the top 1% of reported payment amounts and comparing these results to those produced using the full dataset.

Table 1. Sample Characteristics

	Mean ± SD	Median (Interquartile Range)
Hospital characteristics (first reporting year)		
Anesthesia revenue from public payers, %	51.5% ± 17.5%	52.0% (40.5–62.3%)
Licensed beds, N	209 ± 140	177 (106–274)
24-hr anesthesiologist on call in-house, N (%)	109 (45.4%)	---
Anesthesia revenue from inpatient services, %	56.7% ± 17.0%	56.3% (46.8–65.1%)
County characteristics (first reporting year)		
Total county population, thousands	3,743 ± 4,005	1,687 (561–9,706)
County population over 65 years old, %	11.0% ± 2.0%	10.1% (9.8–11.6%)
County population white, %	78.0% ± 8.9%	77.8% (73.6–85.1%)
County median income, $	$63,506 ± $12,179	$58,998 ($56,582–$73,865)
Anesthesia group characteristics (all reporting years)		
Direct payments to anesthesia groups, $*	$983,555 ± $1,283,748	$547,506 ($234,432–$1,165,778)
Anesthesia revenue, $	$13,437,643 ± $16,868,853	$8,365,035 ($3,047,257–$18,517,944)
Time per anesthesiologist, min/yr	46,502 ± 44,030	35,788 (21,857–57,826)

Table 1 presents descriptive characteristics for our sample, based on the characteristics corresponding to the first year each hospital filed a financial disclosure report. All dollar amounts are in 2018 U.S. dollars. Since "24-hr anesthesiologist on call in-house" is a binary categorical (yes/no) variable, the table shows the number (%) of hospitals with a 24-hr in-house anesthesiologist on call instead of the mean and SD. Hospital and county characteristics are summarized for the first reporting year, while anesthesia characteristics reported for all years included in the dataset.

*Among only hospitals making a non-zero payment to an anesthesia group.

Results

Table 1 reports summary statistics for our sample (n = 240 hospitals). These hospitals derived roughly half of their anesthesia revenue from public payers (mean ± SD: 52% ± 17.5%) and reported an average of 209 licensed beds ± 140. Across hospitals, inpatient revenue accounted for an average of 57% of all anesthesia revenue ± 17%. There were 109 of 244 hospitals (45%) reporting an anesthesiologist being on call 24 h/day. Overall, 66% of the hospitals reported direct payments to one or more anesthesia groups in any given year, and these payments averaged $983,555 (median, $547,506; interquartile range, $234,432 to $1,165,778) in 2018-adjusted dollars. The mean reported anesthesia revenue was $13,436,908 (median, $8,365,035; interquartile range, $3,047,257 to $18,517,944).

Between 2002 and 2014, direct payments to anesthesia groups increased in both prevalence and magnitude (fig. 1). In 2002, 52% (76 of 147) of private hospitals in California reported making a direct payment in their financial disclosure reports; by 2014, this value had risen to 69% (124 of 180). Similarly, the median payment increased over the study period from $242,352 (interquartile range, $72,753 to $523,861) to $765,128 (interquartile range, $267,006 to $1,503,163), while the mean increased from $578,322 to $1,295,369. Across all years, the median payment was less than the median payment, suggesting that groups covering a small number of hospitals received larger payments, while groups covering the remaining hospitals received smaller payments. Indeed, in 2002, groups at the top 10 hospitals (in terms of direct payments received) accounted for 59% of the total direct payments made to all hospitals, although by 2014, the top 10 hospitals accounted for 38% of all payments. Overall, hospitals making direct payments to anesthesia groups treated a higher percentage of patients identifying as white (β = 3.61; 95% CI, 0.03 to 7.20; $P = 0.048$), but we observed no other associations between these payments

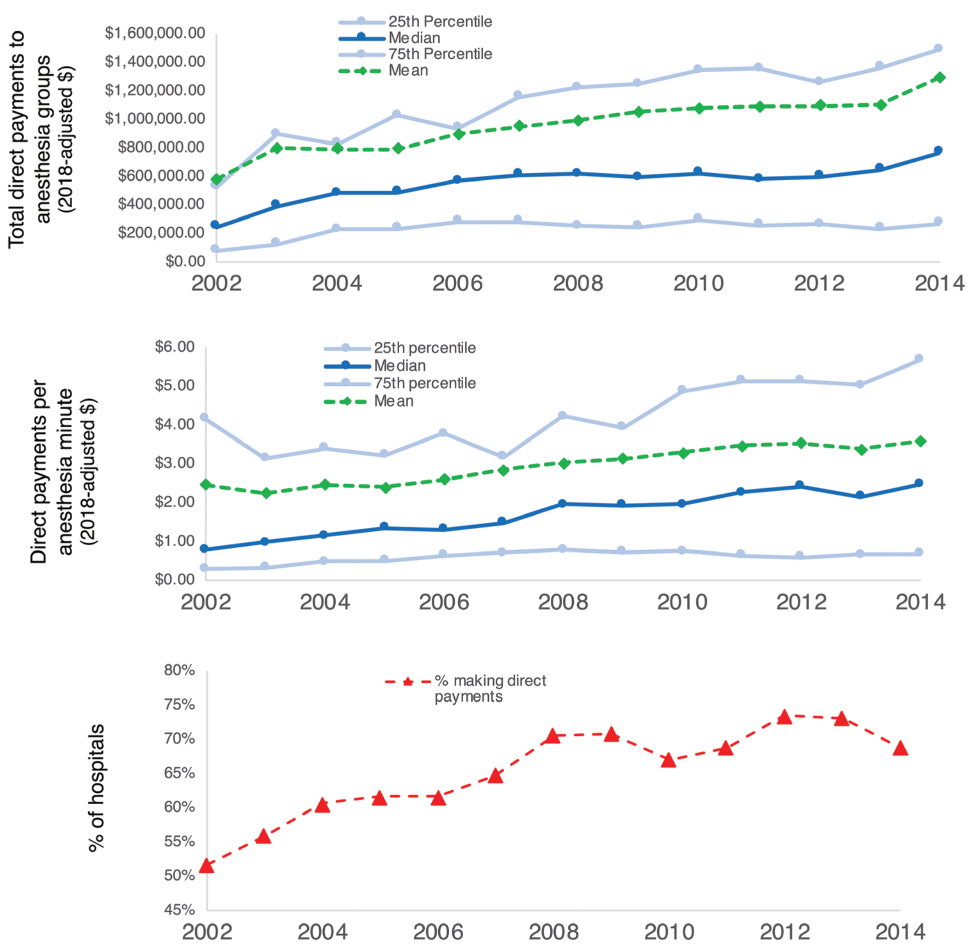

Fig. 1. The incidence and magnitude of direct hospital payments to anesthesia groups between 2002 and 2014. The *top* panel shows the total payment amount, while the *middle* panel shows the amount paid per anesthesia minute, in order to adjust for caseload. The *bottom* panel shows the percentage of hospitals that made any payments at all. All dollar amounts are in 2018 U.S. dollars.

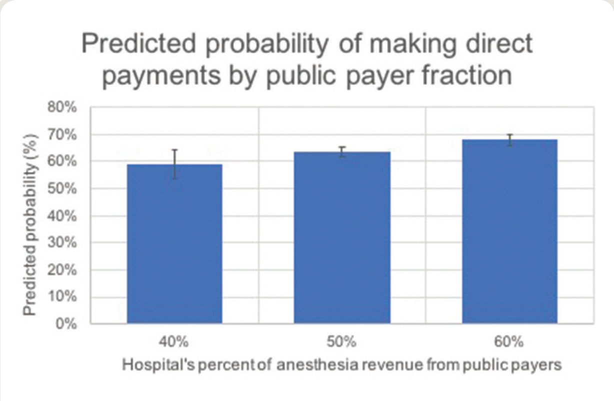

Fig. 2. Association between anesthesia revenue from public payers and the predicted probability of making direct payments to anesthesia groups. Predicted probability of making a direct payment to an anesthesia group for three hypothetical hospitals groups receiving 40%, 50%, and 60% of anesthesia revenue from public payers. These predicted probabilities are based on the multivariable linear regression used in our primary analysis; full regression results can be found in the Supplemental Digital Content (http://links.lww.com/ALN/B974). The error bars show the 95% CI around the predicted probability, and are adjusted for clustering at the hospital level.

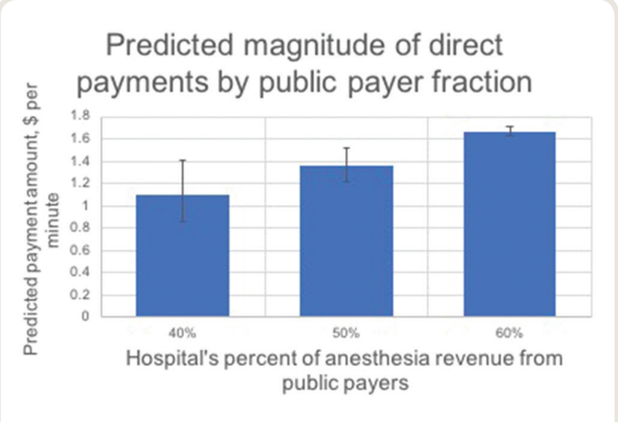

Fig. 3. Association between anesthesia revenue from public payers and predicted direct payment magnitude. Predicted direct payment (in 2018 U.S. dollars) to an anesthesia group for three hypothetical hospitals receiving 40%, 50%, and 60% of anesthesia revenue from public payers. These predicted payments are based on the multivariable linear regression used in our primary analysis; full regression results can be found in the Supplemental Digital Content (http://links.lww.com/ALN/B974). The error bars show the 95% CI around the predicted payment amount and are adjusted for clustering at the hospital level.

and demographic or hospital-level variables (Supplemental Digital Content, table 3, http://links.lww.com/ALN/B974).

The percent of anesthesia revenue coming from public payers (*e.g.*, Medicare and Medicaid) was significantly associated with both the probability of receiving a direct hospital payment (β = 0.45; 95% CI, 0.10 to 0.81; $P = 0.013$) and the magnitude of that payment (β = 2.10; 95% CI, 0.74 to 3.45, $P = 0.003$). With regards to the probability of receiving a payment, our estimated regression coefficient implies that a 10–percentage point increase in the fraction of anesthesia revenue derived from public payers would be associated with a 4.5–percentage point increase in the probability of receiving a payment. In terms of payment magnitude, the estimated regression coefficient implies that a 1–percentage point increase in the fraction of anesthesia revenue derived from public payers would be associated with a 2% relative increase in the amount paid.

To put these regression results in broader context, these results suggest that a transition from 40 to 50% of anesthesia revenue from public payers would be associated with an increase in the predicted probability of receiving a direct payment from 59% (95% CI, 54 to 64%) to 63% (95% CI, 62 to 65%; fig. 2). A further increase to 60% of anesthesia revenue from public payers would be expected to increase this predicted probability to 68% (95% CI, 66 to 70%). Among hospitals making direct payments to anesthesia groups, a similar increase in revenue from public payers (from 40 to 50% of revenue) would also be expected to increase predicted payment magnitude from $1.10 per min of anesthesia care provided (95% CI, $0.86 to $1.40) to $1.35 per anesthesia min (95% CI, $1.21 to $1.51; fig. 3). If public payers were to make up a full 60% of anesthesia revenue, the predicted direct anesthesia payment would rise to $1.67 (95% CI, $1.63 to $1.71). For the full table of regression coefficients with all covariates, see Supplemental Digital Content, table 3, http://links.lww.com/ALN/B974.

In a secondary analysis, larger direct payments to anesthesia groups were associated with decreased minutes of anesthesia care provided per anesthesia staff (β = −0.42; 95% CI, −0.71 to −0.12, $P = 0.007$; table 2). Here, our results suggest that a $10 increase in the direct payment per minute was associated with a 4.2-h decrease in the weekly hours per anesthesia staff member.

In our sensitivity analysis, where the definition of direct hospital payments was broadened to include all wages and benefits along with professional fees, the relationship between these payments and public payer fraction was unchanged (see Supplemental Digital Content, table 4, http://links.lww.com/ALN/B974). In addition, an analysis in which we excluded the top 1% of reported payments also showed no significant differences from our baseline analysis (see Supplemental Digital Content, table 5, http://links.lww.com/ALN/B974).

Discussion

In this study, we found that direct hospital payments to anesthesia groups at nonacademic hospitals in California increased both in magnitude and in prevalence between 2002 and 2014. Between 2002 and 2014, the percent of

Table 2. Factors Associated with Anesthesiologist Workload

	Anesthesiologist Workload (hr/week)	
	Estimated Change (95% CI)	*P* Value
Direct hospital payment amount ($ per anesthesiologist per min)	−0.42 (−0.71 to −0.12)	0.007*
Economic factors		
Percent of anesthesia revenue from public payers	−3.89 (−13.4 to 5.6)	0.420
Demographic factors		
Median income (per $100,000)	−21.0 (−64.1 to 22.2)	0.339
County population (per 100,000)	11.2 (−4.8 to 27.2)	0.171
County population, % white	−96.4 (−266.1 to 73.4)	0.264
County population, % > 65 yr	60.5 (−245.1 to 366.2)	0.697
Hospital factors		
Number of beds (per 100 beds)	−0.08 (−1.40 to 1.23)	0.905
24-hr anesthesiologist on call	0.42 (−1.40 to 2.23)	0.649
Fraction of anesthesia services provided as inpatient	−12.7 (−23.5 to -1.9)	0.021*

*Denotes statistical significance $P < 0.05$.

private hospitals making direct payments to anesthesia groups increased from 52 to 69%, the median inflation–adjusted payment underwent an approximately three-fold increase, and the mean payment increased by 120%. In line with literature suggesting similar increases among academic groups, these results suggest that these payments are becoming an increasingly important part of the economic landscape of anesthesia practice.[8–10] We also found that the distribution of payments was fairly concentrated, with the top 10 hospitals accounting for 59% of all direct payments in 2002 and 38% of all payments in 2014. In addition, we found that increased revenue from publicly insured patients was associated with larger direct hospital payments.

Our results have important policy implications. The presence of larger and more frequent direct hospital payments to anesthesia groups among hospitals treating publicly insured patients raises a larger economic/policy question regarding the best way to finance the health care of low-income patients, particularly as in some cases the amounts paid by public insurers have lagged compared to the amounts paid by private payers. For example, between 2005 and 2014, the amount paid by Medicaid in California remained constant at around $14 per anesthesia unit,[20] while the median amount paid by commercial insurers nationally increased from $50[21] to $66[22] (32% increase), so it may be possible that the observed temporal increase in direct payments to anesthesia groups reflects efforts by hospitals to ameliorate the growing difference between public and private insurer payments. However, hospitals must find a way to finance these direct payments to anesthesia groups, for example by negotiating higher prices from private insurers, which may raise costs for privately insured patients. On the other hand, while increasing the amounts paid by public insurers could reduce the need for direct payments to anesthesia groups, it would also need to be financed by higher taxes or cuts in government spending. Evaluating the tradeoffs among alternative policies for financing the care of low-income patients is an area for further research.

In a secondary analysis, we found that larger hospital payments to anesthesia groups were associated with fewer minutes of anesthesia care provided per anesthesiologist. There are two potential explanations for this finding. First, larger direct payments may be an effect of decreased workload (*i.e.*, they may compensate for inefficient operating room scheduling).[1,2] For example, there are several managerial epidemiologic studies showing few hours of cases per operating room per workday.[2,23–25] Alternatively, it is possible that that decreased anesthesia workload is an effect of increased direct hospital payments, suggesting that these payments play a role in maintaining or even attracting anesthesia groups to hospitals serving publicly insured patients. However, this finding should be viewed with caution, because our data did not allow us to calculate the workload per full-time equivalent (*i.e.*, number of anesthesia minutes per full-time equivalent), so we cannot rule out the possibility that association between hospital payments and minutes per anesthesiologists were due to changes in the hiring of more or having fewer full-time equivalents.

Our study should be viewed in light of its limitations. First, we only considered the presence of direct hospital payments to anesthesia groups in one state in the United States, albeit a large state comprising approximately 12% of the U.S. population.[26] Second, as with any retrospective study, we cannot exclude the possibility that our results were driven by confounding from unobservable factors, although we did utilize a robust empirical approach to reduce the possibility of confounding. Third, our approach did not consider all the potential ways in which anesthesia groups may receive direct hospital payments, such as support for equipment or personnel including nurse anesthetists. Third, as noted above, the dataset lacked many elements (*e.g.*, data on full-time equivalents, Certified Registered Nurse Anesthetist employment, number of anesthetizing locations, and overall operating room utilization) that would be needed for a fully accurate assessment of anesthesia staffing and workload. Fourth, while we did normalize the total payment by the number of anesthesia minutes in order to adjust for the volume of anesthesia care provided, this approach might not fully adjust for other dimensions of anesthesia care. For example, while we did adjust for the provision of in-house call, we were not able to adjust for medical directorships and other non-billable activities, nor were we able to adjust for the provision of in-house obstetric anesthesia services.

In summary, our results suggest that direct payments to anesthesia groups are becoming an increasingly important component of the financial landscape of anesthesia care, particular for hospitals serving underserved populations. Future research could consider the association of the presence of these payments in other specialties and states, as well the association of these payments with policies (*e.g.*, "opt-out") and economic trends (*e.g.*, consolidation among anesthesia groups over time). Finally, it may also be helpful to estimate the extent to which these payments improve outcomes among underserved populations.

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Competing Interests

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