

## **Physician Management Companies, Private Equity Investment, and Commercial Healthcare Prices – Evidence from Anesthesiology**

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### Word Count

3000 (excluding headings, key points and abstract)

1 Key Points

2  
3 **Question**

4 What is the association between outpatient facilities that contract with physician management  
5 companies (PMCs) and prices paid to anesthesia practitioners?  
6

7 **Findings**

8 This study of 2,255,933 privately insured patients who received anesthesia services in hospital  
9 outpatient departments and ambulatory surgery centers from 2012 to 2017 found that allowed  
10 amounts increased by 16.5% and unit prices increased by 18.7% when facilities contracted with a  
11 PMC. Larger increases were found if the PMC received private equity investment.  
12

13 **Meaning**

14 PMCs appear to negotiate significantly higher prices for anesthesia services, raising concerns  
15 that upward pressure on prices will lead to higher insurance premiums and higher patient cost-  
16 sharing.  
17

18 Abstract

19 **Importance:** Physician management companies (PMCs), often backed by private equity (PE),  
20 are increasingly providing staffing and management services to health care facilities, yet little is  
21 known of their influence on prices.

22 **Objectives:** To study changes in prices paid to practitioners (anesthesiologists and certified  
23 registered nurse anesthetists) before and after an outpatient facility contracted with a PMC.

24 **Design:** Retrospective study using difference-in-differences methods to compare price changes  
25 before and after a facility contracted with a PMC to facilities that did not, and to compare  
26 differences between PMCs with and without PE investment.

27 **Setting:** Commercial claims data (2012-2017) from three large national insurers in the Health  
28 Care Cost Institute database were combined with a novel dataset of PMC facility contracts to  
29 identify prices paid to anesthesia practitioners in hospital outpatient departments and ambulatory  
30 surgery centers.

31 **Participants:** 2,992 facilities that never contracted with a PMC and 672 facilities that  
32 contracted with a PMC between 2012 and 2017, collectively representing 2,255,933 anesthesia  
33 claims.

34 **Exposure:** Temporal variation in facility-level exposure to PMC contracts for anesthesia  
35 services.

36 **Main outcomes and measures:** (1) Allowed amounts and the unit price (allowed amounts  
37 standardized per unit of service) paid to anesthesia practitioners; (2) the probability that a  
38 practitioner was out-of-network.

39 **Results:** After a facility contracted with a PMC, allowed amounts increased by 16.5%  
40 (+\$116.39; 95% CI, [76.11, 156.67]; P<0.001) and the unit price increased by 18.7% (+\$18.79;  
41 95% CI, [12.73, 24.84]; P<0.001) relative to the pre-PMC contract price. We did not find  
42 evidence that anesthesia practitioners were moved out-of-network. In subsample analyses, PMCs  
43 without PE investment increased allowed amounts by 12.9% (+\$89.88; 95% CI, [42.07,137.69];  
44 P<0.001), while PE-backed PMCs (representing half of the PMCs in the sample) increased  
45 allowed amounts by 26.0% (\$187.06; 95% CI [133.59, 240.52]; P<.001). Similar price increases  
46 were observed for unit prices.

47 **Conclusions and relevance:** Prices paid to anesthesia practitioners increased after hospital  
48 outpatient departments and ambulatory surgery centers contracted with a PMC, and were  
49 substantially higher if the PMC received PE investment. This research provides insights into the  
50 role of corporate ownership in healthcare relevant to policymakers, payers, practitioners, and  
51 patients.

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73 **Introduction**

74 Physician management companies (PMCs) are an example of the increasing  
75 corporatization of American medicine.<sup>1</sup> A PMC is a privately-held or publicly traded for-profit  
76 company that manages the back-end administrative functions of medical practices, such as  
77 insurance contracting and billing. Many PMCs, often referred to as staffing companies, also  
78 contract with hospitals and ambulatory surgery centers to provide professional staffing and  
79 management services. This type of PMC is particularly common in anesthesiology.<sup>2,3</sup> The eight  
80 largest anesthesia-focused PMCs employ nearly 22% of the anesthesia practitioners in the United  
81 States.<sup>4</sup> The growth of these PMCs is partly driven by investments from private equity (PE) firms  
82 attracted by the high-volume and high-margins of anesthesiology<sup>5</sup>: anesthesia is administered  
83 during 100 million surgical procedures annually, and the industry is valued at over \$26.2  
84 billion.<sup>6-11</sup>

85 Healthcare facilities can choose to employ anesthesia practitioners or outsource to an  
86 independent anesthesia group or a PMC. From the facility's perspective, outsourcing relieves the  
87 burden of recruiting practitioners, managing the complexity of anesthesia billing, and scheduling  
88 anesthesia coverage of the operating rooms.<sup>12,13,14</sup> PMCs argue that they have the size,  
89 infrastructure, and managerial expertise needed to increase facility revenue and decrease costs.<sup>15-</sup>  
90 <sup>17</sup>

91 To gain facility contracts, PMCs can either acquire an anesthesia group and take over the  
92 group's existing facility contracts, or submit bids on facility requests for proposals.<sup>18</sup> After  
93 winning a contract bid, PMCs may employ some or all of the existing anesthesia practitioners in  
94 the facility, fill positions using practitioners already employed by the PMC, or a combination of  
95 both.<sup>16,19</sup> A practitioner may choose to join a PMC to reduce administrative responsibilities and  
96 receive the economic benefits of a larger organization, such as greater income stability,  
97 particularly given recent concerns of underpayment from large insurance companies.<sup>20,21</sup>

98 PMCs might influence healthcare delivery in several ways. When a PMC begins  
99 providing services in a facility, the PMC renegotiates payer contracts.<sup>19,22</sup> PMCs might leverage  
100 their market power to negotiate higher payment rates from insurers, benefiting practitioners but  
101 potentially increasing prices for commercially insured patients.<sup>23-26</sup> Additionally, PMCs might  
102 command higher prices by threatening to move their practitioners out-of-network, though recent  
103 legal disputes suggest large insurers might also cancel in-network contracts with PMCs over cost

104 concerns.<sup>27-30</sup> PMCs might also be able to increase quality and lower costs by standardizing care  
105 and improving managerial processes.<sup>31,32</sup>

106 This paper combines commercial claims data with a novel dataset of PMC facility  
107 contracts to study (1) whether prices paid to anesthesiologists and certified registered nurse  
108 anesthetists (CRNAs) changed after a hospital outpatient department or ambulatory surgery  
109 center (ASC) contracted with a PMC; (2) whether practitioners moved out-of-network after a  
110 PMC contract; and (3) whether differences existed between facilities that contracted with PMCs  
111 with and without PE investment.

112

## 113 **Methods**

### 114 STUDY DESIGN

115 We used a difference-in-differences design to compare changes in prices and a  
116 practitioner's out-of-network status before and after a facility contracted with a PMC to facilities  
117 that never contracted with a PMC. Most PMCs seek to negotiate exclusive contracts in which  
118 only one group provides services to a facility.<sup>18,33,34</sup> However, in addition to contracting with a  
119 PMC, facilities may choose to employ some anesthesia practitioners, contract with individual  
120 practitioners at the request of facility surgeons or use locum tenens practitioners (see eMethods 1  
121 for details). Therefore, we defined a facility as starting a PMC contract when a switch from 0%  
122 of practitioners to greater than 60% of practitioners in a facility billed under the Tax  
123 Identification Number (TIN) of a PMC. By potentially including non-PMC practitioners in the  
124 treatment group, our results would be attenuated.

125

### 126 DATA SOURCES

127 We built a longitudinal dataset from 2012 to 2017 that identified the year an ASC or  
128 hospital outpatient department contracted with a PMC. First, we collected the names of PMC  
129 subsidiary companies. To identify these subsidiaries, we used corporate filing data from the  
130 websites "HIPPA Space" and "Open Corporates," Securities and Exchange Commission Filings  
131 for publicly traded companies, and mergers and acquisitions data from Irving Levin and SDC  
132 Platinum. The Irving Levin and SDC Platinum data also provided dates for when PMCs received  
133 private equity investment. We identified 22 PMCs, half of which received private equity funding,  
134 as providers of anesthesia services during our sample period (eTable 1).

135 Second, we used Medicare Data on Practitioner Practice and Specialty (MD-PPAS) to  
136 identify the TIN of the PMC subsidiaries and when a practitioner billed under a PMC TIN. For  
137 all practitioners who billed Medicare, MD-PPAS provided their National Practitioner  
138 Identification (NPI) and the two main TINs they billed under in each month. We created a  
139 dataset of all TINs associated with a PMC by searching for the name of each subsidiary in MD-  
140 PPAS, allowing us to identify when an anesthesia practitioner billed a PMC's TIN (eTable 2)..<sup>35</sup>

141 Third, we merged the PMC dataset with commercial claims for professional (clinician)  
142 services from the Healthcare Cost Institute (HCCI) from 2012 to 2017 using physician NPIs to  
143 identify when a hospital outpatient department or ASC contracted with a PMC (eTable 3). HCCI  
144 data included claims for patients insured by Aetna, Humana, and UnitedHealthcare, three of the  
145 largest U.S. health insurers. We identified new facility contracts when a switch from 0% to 60%  
146 of practitioners billed under the TIN of a PMC.

## 147 STUDY POPULATION

148 The analysis focused on claims for anesthesia provided during same-day procedures in  
149 ASCs and hospital outpatient departments. The database created included 6,710 facilities, of  
150 which 2,992 never had a practitioner bill under a PMC TIN (control), 672 had a switch from 0%  
151 to greater than 60% of practitioners bill a PMC TIN (treatment), 750 had at least one practitioner  
152 bill under a PMC TIN in all years (excluded from analyses), and 2,996 did not fall into either  
153 category (excluded from analyses).

154 As shown in eFigure 1, this database included 7,229,912 claims for professional services  
155 after exclusions (2,255,933 claims were from eligible treatment and control facilities) for  
156 anesthesia services provided by anesthesiologists and CRNAs between January 1, 2012 and  
157 December 31, 2017. Anesthesia services were identified using Current Procedural Terminology  
158 (CPT) codes 00100-01999. To allow for accurate comparisons between facilities before and after  
159 PMC contract, the database was limited to facilities with at least 2 claims a year in the HCCI  
160 data for at least 4 consecutive years. See eMethods 1 for further sample details and exclusions.

161

## 162 STUDY VARIABLES

163 **Outcomes.** The primary outcome of interest, prices for anesthesia services, were  
164 measured using allowed amounts, which represent the actual amount paid by the insurer to the

165 practitioner plus the patient cost share. For each claim, we also converted the allowed amount  
166 into a single “unit price” since in anesthesiology contract negotiations are based on the price paid  
167 per unit of service. The unit price standardizes payment across all procedures according to  
168 procedure complexity (base units) and length of time (time units). Therefore, the unit price  
169 captures the price paid to anesthesia practitioners irrespective of procedure type or duration. Both  
170 allowed amounts and unit prices were winsorized at the top and bottom 0.5% and were  
171 geographically adjusted and inflation adjusted into 2017 dollars.

172 The secondary outcome of interest, the practitioner’s out-of-network status, was  
173 estimated using an indicator variable for whether the anesthesia practitioner was out of a  
174 patient’s network, available in HCCI between 2014-2017. In the primary analyses, we combined  
175 in-network and out-of-network claims to reflect overall changes in prices. For robustness, we  
176 conducted analysis limiting the sample to in-network claims.

177  
178 **Covariates.** Analyses for allowed amounts and unit prices included controls for patient  
179 age, sex, and predicted health risks, using indicators for Elixhauser Comorbidities; analyses of  
180 allowed amounts also included controls for procedure base and time units. In secondary analyses,  
181 the probability of a PMC contract is estimated as a function of the following facility and market  
182 characteristics: the setting (hospital outpatient department or ASC), region (Northwest, Midwest,  
183 West, South or Pacific), the number of anesthesiologists and CRNAs, the number of claims, the  
184 distribution of procedure base and time units, the level of market concentration (defined as a  
185 Hospital Referral Region (HRR)), and the percent of PMC facilities in an HRR.

## 186 187 STATISTICAL ANALYSIS

188 The primary analysis was prespecified to use linear regression and a difference-in-  
189 differences approach to estimate changes in (1) prices and (2) a practitioner’s network status for  
190 anesthesia services provided in facilities before and after a PMC contract compared to facilities  
191 that never contracted with a PMC. Regressions included controls for patient characteristics,  
192 facility fixed effects to adjust for time-invariant facility characteristics, state fixed effects  
193 interacted with year to adjust for state-specific trends, an indicator for the year of contract  
194 (referred to as the transition period) to adjust for the facility’s transition to a PMC staffing  
195 model, and an indicator for the post-PMC contract period, which is the variable of interest (see

196 eMethods 2 for estimating equations). Patient controls were not included in out-of-network  
197 analyses since they would not influence network status.

198 In a prespecified subgroup analysis, we included interactions between the PMC contract  
199 indicators (transition and post-PMC contract period) and an indicator for whether the PMC ever  
200 received investment from a private equity (PE) firm during the sample period to test whether  
201 outcomes differ for PE-backed PMCs. In secondary post-hoc analysis, to explore whether PMCs  
202 target certain types of facilities, we used linear regression to estimate the probability that a  
203 facility contracted with a PMC or with a PE-backed PMC as a function of facility and market  
204 characteristics. All analyses included robust standard errors clustered at the facility-level and  
205 were conducted using Stata version 16.0.

206 A key assumption required for difference-in-differences is that the pre-PMC contract  
207 difference between treatment and control facilities would have remained constant in the absence  
208 of the PMC contract. To test this assumption, we conducted two prespecified secondary analyses.  
209 First, we graphed coefficients from interaction terms between indicators for each year relative to  
210 the time of PMC contract and an indicator for whether a facility contracted with a PMC to test  
211 for pre-existing trends. Given concerns of bias in settings with multiple treatment periods, we  
212 also graphed these interaction terms using the methods of Borusyak, Jaravel, and Spiess (2021).<sup>36</sup>  
213 Second, we tested for differential changes in patient characteristics after a PMC contract and  
214 compared regressions with and without the inclusion of patient risk adjustment.

215 Lastly, we assessed the sensitivity of our results to 1) adding practitioner fixed effects, 2)  
216 using HRR by year fixed effects, 3) using an alternative control group of facilities that contracted  
217 with a PMC after the sample period, 4) using a cut-off of 80% of practitioners billing under a  
218 PMC TIN to identify a PMC contract, 5) limiting the sample to in-network claims, and 6)  
219 estimating hospital outpatient departments and ASCs separately.

220

## 221 **Results**

222

### 223 FACILITY AND PATIENT CHARACTERISTICS

224 Our primary analysis included 672 facilities that contracted with a PMC (treated) and  
225 2,992 facilities that did not (control). Before the PMC contract, treated facilities had more claims  
226 per year (709.61 compared to 355.14), more anesthesiologists (24.43 compared to 13.33) and



227 were more likely to perform procedures with a higher number of base units and time units  
228 compared to control facilities (Tables 1 and 2). These patterns are confirmed in post-hoc  
229 regression analyses of the types of facilities targeted by PMCs (eTable 4). The unadjusted  
230 differential changes in patient characteristics in treatment facilities compared with control  
231 facilities were small (Table 2).

232 Of the 672 PMC facilities, 283 received private equity investment at some point during  
233 the study period (eTables 6-7). Compared to PMCs without PE, facilities that contracted with  
234 PE-backed PMCs were more likely to be in the South, in markets with a greater share of facilities  
235 already under PMC contract, and perform procedures with higher time units (eTable 8). See  
236 eMethods 3 for additional summary statistics.

237 Because the unit price is standardized by base units and time units, it takes into account  
238 any changes or differences in procedure type and duration between and across facilities.

239

#### 240 DIFFERENTIAL CHANGES IN OUTCOMES ASSOCIATED WITH PMC CONTRACTS

241 Contracting with a PMC was associated with an increase in prices for anesthesia services  
242 compared to facilities that did not contract with a PMC (Table 3). In the post-PMC contract  
243 period, allowed amounts increased by \$116.39 (95% CI, [76.11, 156.67];  $P < 0.001$ ) more in PMC  
244 facilities than in non-PMC facilities, representing a 16.5% increase in allowed amounts from the  
245 pre-contract period. Similarly, unit prices increased by \$18.79 (95% CI, [12.73, 24.84];  
246  $P < 0.001$ ), representing an 18.7% increase. Statistically significant price increases were also  
247 observed in the year of the PMC contract (the transition period). We did not find evidence that  
248 practitioners were moved out-of-network.

249 Figure 1 shows adjusted differences in outcomes between facilities that did and did not  
250 contract with PMCs relative to the year of PMC contract (coefficient estimates and 95% CIs are  
251 reported in eTable 8). The coefficients in the pre-contract period did not differ significantly  
252 between PMC and non-PMC facilities. Both allowed amounts and unit prices increased steadily  
253 from the year of contract to 4 years after the contract. The probability a practitioner was out-of-  
254 network increased by 1.95 percentage points (95% CI, [0.09, 3.80];  $P = 0.04$ ) in the year of  
255 contract, but estimates were not statistically significant in subsequent years.

256

#### 257 SUBGROUP, SECONDARY AND SENSITIVITY ANALYSES

258 Figure 2 shows the results of the subgroup analyses between facilities that contract with  
259 PMCs with and without PE investment relative to the regression-adjusted mean of the control  
260 facilities, \$664.40. After PMC contract, allowed amounts were \$754.28 for PMCs without PE  
261 and \$851.46 for PMCs with PE, representing an increase of \$89.88 (95% CI, [42.07,137.69];  
262  $P<0.001$ ) and \$187.06 (95% CI [133.59, 240.52];  $P<0.001$ ) relative to control facilities,  
263 respectively (Figure 2; eTable 9). These are large magnitudes, representing a 12.9% increase for  
264 PMCs without PE and an 26.0% increase for PMCs with PE, relative to the pre-PMC contract  
265 mean (eTable 9). The difference between PMCs is also significantly different: PE-backed PMCs  
266 increased allowed amounts by \$97.18 (95% CI [35.38, 158.97];  $P=0.002$ ) more than PMCs  
267 without PE. The same patterns were observed for unit prices but there were no statistical  
268 differences in a practitioner's out-of-network status.

269 In support of the difference-in-differences design, secondary analyses show that patient  
270 risk factors did not change significantly after a PMC contract (eFigure 2) and that results were  
271 robust to the exclusion of patient controls (eTable 10). Sensitivity analyses (see eMethods 4 for  
272 detailed information) show that results were similar when adding practitioner fixed effects  
273 (eTable 11), using HRR by year fixed effects (eTable 12), using a higher cut-off of 80% of  
274 practitioners billing a PMC TIN (eTables 13-15; eFigures 3-4) and an alternative control group  
275 of facilities that contracted with a PMC after 2017 (eTables 16-18; eFigures 5-6). Our results  
276 were robust to including only in-network claims (eTable 19) and similar between hospital  
277 outpatient departments and ASCs (eTable 20). Lastly, estimates are similar after corrections for  
278 potential bias resulting from multiple treatment periods (eFigure 7).

279

## 280 DISCUSSION

281 The prices paid to anesthesia practitioners in hospital outpatient departments and ASCs  
282 increased after a PMC contract. Relative to the pre-PMC contract, allowed amounts increased by  
283 16.5% and unit prices increased by 18.7%. While both PMCs with and without PE backing  
284 increased prices, this increase was partly driven by PMCs backed by PE: allowed amounts and  
285 unit prices increased by 26.0% and 25.6%, respectively, for facilities that contracted with PE-  
286 backed PMCs. Because unit prices are standardized by procedure type and duration, these results  
287 suggest that price increases were the result of higher prices paid per service.

288           PMCs may have increased prices by negotiating better rates after a facility contract, or by  
289 replacing existing anesthesia practitioners with practitioners already employed by the PMC. To  
290 account for compositional changes among practitioners, we added practitioner fixed effects to  
291 our primary specification and found similar price increases (eTable 11). These results suggest  
292 that PMCs negotiated higher rates after a new facility contract.

293           One way PMCs may command higher prices is by amassing market share and by developing  
294 better negotiating expertise. For example, PMCs may acquire anesthesia groups and target  
295 facilities in a certain geographic area to increase their size and gain regional experience with  
296 practitioners and insurers.<sup>4,37</sup> While we did not conduct a formal market competition analysis, we  
297 found evidence that PMCs, particularly PE-backed PMCs, were more likely to enter markets  
298 with greater shares of facilities already under PMC contract (eTables 4 and 7). PE-backed PMCs  
299 may also have had stronger incentives to create short-term returns for investors relative to those  
300 without PE investment.<sup>35,38,39</sup>

301           PMCs may also gain negotiating leverage over insurers by threatening to move practitioners  
302 out-of-network.<sup>28-30</sup> We did not find evidence that practitioners moved out-of-network except for  
303 a modest increase in the year the contract started. However, the mere threat may be sufficient to  
304 influence negotiating dynamics between PMCs and insurance companies.

305           This research has important implications for payers, practitioners, patients, and policymakers.  
306 In recent legal disputes, insurance companies have argued that the prices they pay to PMC  
307 practitioners are too high, while PMCs have argued that large insurers do not adequately  
308 compensate practitioners.<sup>21,29,30</sup> Either way, the proliferation of PMCs and private equity firms in  
309 healthcare has raised concerns about increasing upward pressure on prices for in-network care,  
310 which can contribute to higher insurance premiums and higher patient cost-sharing.<sup>40</sup>

311

## 312 LIMITATIONS

313           This study had several limitations. First, while HCCI includes claims from three of the  
314 largest U.S. insurers, it does not include all commercial claims, so our results may not generalize  
315 to other insurers. Second, we do not have the dates of PMC contracts; instead, we identified  
316 contracts when a switch from 0% of practitioners to greater than 60% of practitioners in a facility  
317 billed under a PMC TIN, which was robust to a more conservative 80% cut-off. Third, analyses  
318 of practitioner network status should be interpreted as short-term results since we only had

319 access to a network indicator between 2014-2017. Fourth, given the lack of claims-based  
320 methods for measuring anesthesia quality, we were unable to determine whether higher quality  
321 justified higher prices. To minimize potential variation in quality, our analysis focused on  
322 anesthesia provided during same-day procedures among commercially-insured patients. Fifth,  
323 the results may not generalize to inpatient settings.

324

## 325 CONCLUSION

326 In hospital outpatient departments and ASCs that contracted with PMCs, there were large  
327 and significant increases in the prices paid to anesthesia practitioners. These price increases were  
328 substantially larger if the PMC received private equity investment.

329

330

331 **Acknowledgements:** This research was supported by the Physicians Foundation Center for the  
332 Study of Physician Practice and Leadership at Weill Cornell Medical College, Arnold Ventures  
333 and the Commonwealth Fund. The views presented here are those of the authors and not  
334 necessarily those of the Physicians Foundation Center, Arnold Ventures or the Commonwealth  
335 Fund. Neither organization had a role in the design or interpretation of the study. The author(s)  
336 acknowledge the assistance of the Health Care Cost Institute (HCCI) and its data contributors,  
337 Aetna, Humana, and UnitedHealthcare, in providing the claims data analyzed in this study.

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TABLES

Table 1. Unadjusted Facility and Market Characteristics, Before PMC Contract

	PMC Facility (Treatment) <sup>a</sup>	Never PMC Facility (Control) <sup>a</sup>	Difference [95% CI]
<b>Facility Characteristics<sup>b</sup></b>			
<b>Number of Facilities</b>	672	2,992	
Hospital Outpatient Department (%)	56.10	53.18	2.93 [-1.25,7.10]
Ambulatory Surgery Center (%)	43.90	46.82	-2.93 [-7.10,1.25]
<b>Facility Region (%)</b>			
Northeast	18.01	13.14	4.87 [1.97,7.77]
Midwest	21.13	28.61	-7.48 [-11.20,-3.76]
West	17.56	25.23	-7.67 [-11.23,-4.12]
South	43.15	32.15	11.00 [7.05,14.96]
<b>Total Claims</b>	297,147	1,457,060	
Claims per Facility	709.61	355.14	354.46 [352.26,356.67]
Anesthesiologists per Facility	24.43	13.33	11.1 [11.03,11.17]
CRNAs per Facility	6.91	7.68	-0.76 [-0.82,-0.71]
<b>Market Characteristics<sup>c</sup></b>			
Concentration (HHI)	1061.09	1225.14	-164.06 [-168.55,-159.58]
PMC Facilities (%)	11.58	9.93	1.65 [1.60,1.70]

Abbreviations: PMC, Physician Management Company. CI, confidence interval. CRNA, Certified Registered Nurse Anesthetist. HHI, Hirschman Herfindahl Index.

<sup>a</sup> Facilities that contracted with PMCs (treatment) were compared to PMCs that did not contract with PMCs (control), before the PMC contracts were implemented. The pre-PMC facility mean includes all years prior to the start of contract, and the never PMC facility mean represents the mean of all years of data.

<sup>b</sup> The facility setting (hospital outpatient department or ASC) and region values are presented as a proportion of the number of facilities. The remainder of facilities are located in the Pacific census region.

<sup>c</sup> The market represents the Hospital Referral Region (HRR) of the facility as defined by the Dartmouth Atlas. The HHI is measure of the market concentration of the HRR calculated using the share of anesthesia claims per facility. A market with an HHI of less than 1,500 is generally considered a competitive market. “PMC Facilities” represents the percent of facilities in an HRR under PMC contract using our full sample of 6,710 facilities.

376 Table 2. Unadjusted Outcomes, Procedure Time and Base Units, and Patient Characteristics, Before and After PMC Contract  
 377

	PMC Facility (Treatment) <sup>a</sup>		Never PMC Facility (Control) <sup>a</sup>	Difference from Pre- to Post- PMC Contract Period <sup>b</sup>	Unadjusted Differential Change from Pre- to Post- PMC Contract Period <sup>c</sup>
	Pre-PMC Contract Mean	Post-PMC Contract Mean	Mean of All Years	Difference [95% CI]	Difference [95% CI]
<b>Outcome Variables</b>					
Allowed Amounts (\$)	704.40	805.62	651.00	101.21 [98.89,103.54]	145.57 [144.06,147.09]
Unit Price (\$) <sup>e</sup>	100.39	118.07	100.64	17.69 [17.33,18.05]	17.48 [17.23,17.73]
OON Practitioner (%) <sup>d</sup>	15.08	15.44	13.27	0.35 [0.06,0.65]	2.01 [1.80,2.19]
<b>Control Variables <sup>e</sup></b>					
<b>Time Units (%)</b>					
Quintile = 1	37.79	33.35	45.15	-4.45 [-4.66,-4.23]	-10.55 [-10.71,-10.40]
Quintile = 2	13.58	16.27	12.33	2.69 [2.53,2.85]	3.73 [3.62,3.83]
Quintile = 3	15.27	18.21	14.57	2.94 [2.77,3.11]	3.53 [3.41,3.64]
Quintile = 4	15.12	16.62	14.54	1.51 [1.34,1.67]	1.99 [1.88,2.10]
Quintile = 5	18.23	15.54	13.42	-2.69 [-2.86,-2.52]	1.31 [1.20,1.42]
<b>Base Units (%)</b>					
Base=2-4	34.84	31.56	38.92	-3.28 [-3.49,-3.07]	-6.66 [-6.82,-6.51]
Base=5	52.04	54.66	48.25	2.63 [2.40,2.85]	5.78 [5.62,5.93]
Base=6-8	12.47	13.01	12.24	0.53 [0.38,0.68]	0.73 [0.62,0.83]
Base=9+	0.64	0.77	0.60	0.12 [0.08,0.16]	0.16 [0.14,0.19]
<b>Patient Characteristics (%)</b>					
Male	40.91	41.3	41.72	0.39 [0.16,0.61]	-0.29 [-0.44,-0.13]
Age (18 to 24)	6.07	5.19	6.48	-0.88 [-0.99,-0.78]	-1.23 [-1.30,-1.15]
Age (25 to 34)	10.81	10.08	10.71	-0.73 [-0.87,-0.59]	-0.65 [-0.74,-0.55]
Age (35 to 44)	17.83	16.89	16.76	-0.94 [-1.11,-0.77]	-0.05 [-0.17,0.07]
Age (45 to 54)	31.22	31.15	29.43	-0.07 [-0.28,0.14]	1.42 [1.28,1.56]
Age (55 to 64)	34.07	36.69	36.62	2.62 [2.40,2.84]	0.51 [0.35,0.66]

378 Abbreviations: PMC, Physician Management Company. OON, Out-of-Network. CI, confidence interval.

379 <sup>a</sup> The pre-PMC contract period includes all years prior to the start of contract. The post-PMC contract period includes the year the contract started and all  
380 subsequent years. There were 0 facility contracts in 2012 (by construction), 125 facility contracts in 2013, 131 in 2014, 144 in 2015, 163 in 2016 and 109 in  
381 2017.

382 <sup>b</sup> The difference estimate indicates the absolute change in mean values from the pre-PMC contract period to the post-PMC contract period.

383 <sup>c</sup> The unadjusted differential change represents the difference between the PMC facility from pre- to post-PMC contract relative to facilities that never contracted  
384 with a PMC.

385 <sup>d</sup> OON status is only available from 2014-2017. During this period, 416 facilities contracted with a PMC (total claims=235,832) and 2,992 facilities never  
386 contracted with a PMC (total claims=1,005,082).

387 <sup>e</sup> The unit price represents allowed amounts standardized by the duration of the anesthesia procedure measured by time units (a single unit represents 15 minutes),  
388 and the complexity of the procedure, measured by base units (See eMethods 1 for details). In regression analysis using allowed amounts as the outcome, we  
389 include controls for time units and base units as follows: 1) Time units are binned into quintiles of the distribution, where the 1st quintile represents procedures of  
390 shorter duration and the 5th quintile represents procedures of longer duration, and 2) Base units are binned into categories of similar complexity, where base units  
391 of 2-4 represent lower complexity procedures and base units greater than 9 represent more complex procedures. Additional controls include 30 patient risk  
392 factors based on Elixhauser comorbidities, which are not shown for table clarity. See eMethods 3 for additional output.

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415 Table 3. Adjusted Differential Changes in Outcomes Associated with PMC Contract

Outcomes <sup>b</sup>	Total Claims	Pre-PMC Contract Mean <sup>c</sup>	Adjusted Difference-in-Differences Estimates <sup>a</sup>				Relative Change <sup>f</sup>
			Transition Difference <sup>d</sup> [95% CI]	P-Value	Post-PMC Contract Difference <sup>e</sup> [95% CI]	P-Value	
Allowed Amount (\$)	2,255,933	704.40	51.19 [29.10,73.28]	<0.001	116.39 [76.11,156.67]	<0.001	16.52%
Unit Price (\$)	2,255,933	100.39	7.15 [3.37,10.92]	<0.001	18.79 [12.73,24.84]	<0.001	18.72%
Probability OON Practitioner (%)	1,240,914	15.08	1.80 [-0.06,3.67]	0.06	2.25 [-2.56,7.06]	0.36	15.23%

416 Abbreviations: PMC, Physician Management Company. OON, Out-of-Network. CI, confidence interval.

417 <sup>a</sup> Facilities that contracted with PMCs (treatment) were compared to PMCs that did not contract with PMCs (control), before and after PMC contracts were  
 418 implemented using a difference-in-differences specification with controls for patient characteristics and risk factors, facility and state by year fixed effects, and  
 419 robust standard errors clustered at the facility level.

420 <sup>b</sup> Allowed amounts and units prices are based on HCCI data from 2012-2017, while the indicator for practitioner network status was only available from 2014-  
 421 2017. The unit price represents allowed amounts standardized by the duration of the anesthesia procedure measured by time units and the complexity of the  
 422 procedure, measured by base units. The regression for allowed amount includes controls for base and time units as shown in Table 2.

423 <sup>c</sup>The pre-PMC contract mean includes all years prior to the start of contract. There were 0 facility contracts in 2012 (by construction), 125 facility contracts in  
 424 2013, 131 in 2014, 144 in 2015, 163 in 2016 and 109 in 2017.

425 <sup>d</sup>The transition difference represents the differential change between treatment and control facilities from the pre-PMC contract period to the year of PMC  
 426 contract.

427 <sup>e</sup>The post-PMC contract difference represents the differential change between treatment and control facilities from the pre-PMC contract period to the years after  
 428 the facility contracted with the PMC.

429 <sup>f</sup>Relative change is the adjusted post-PMC contract estimate as a percent of the pre-PMC contract mean.

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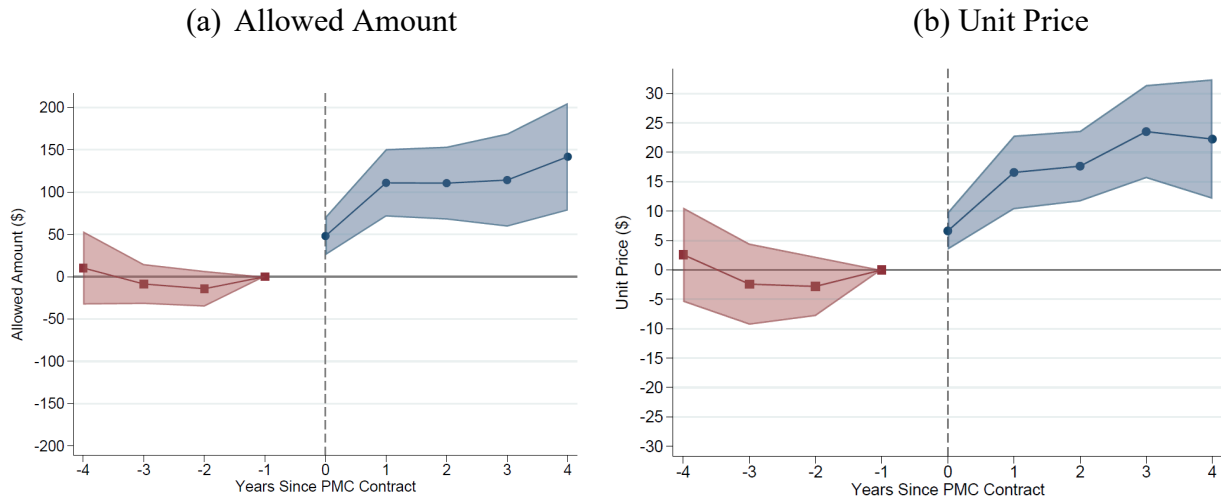


439 FIGURES

440 Figure 1. Adjusted Differences in Outcomes Between Treatment and Control Facilities Relative  
 441 to the Year of PMC Contract

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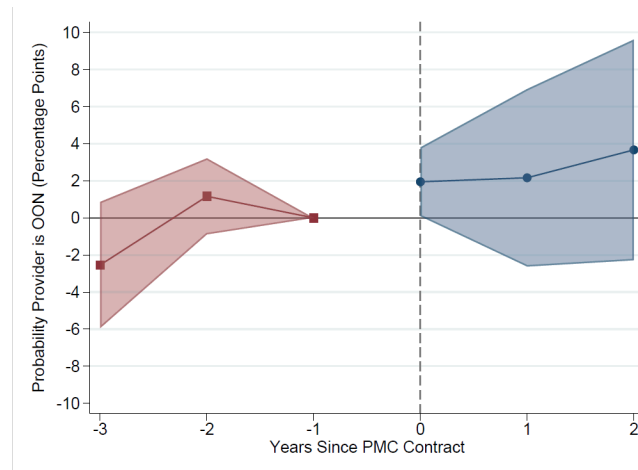
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(c) Probability Practitioner is Out-of-Network (OON)



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448 **Caption:** This figure shows adjusted difference-in-differences estimates between treatment and control facilities  
 449 relative to the year of PMC contract. The year-to-contract coefficient estimates on the x-axis represent changes in  
 450 the outcome and 95% confidence interval (error bars); coefficients were estimated relative to the reference period,  
 451 year prior to contract (See eTable 8 for regression output). There were 125 facility contracts in 2013, 131 in 2014,  
 452 144 in 2015, 163 in 2016 and 109 in 2017. To correct for potential bias from negative weighting in settings with  
 453 multiple treatment periods, eFigure 7 replicates Figure 1 using the methods in Borusyak, Jaravel, and Spiess (2021).  
 454 Allowed amounts and units prices are based on HCCI data from 2012-2017, while the probability a practitioner was  
 455 out-of-network used data from 2014-2017, resulting in shorter treatment window.

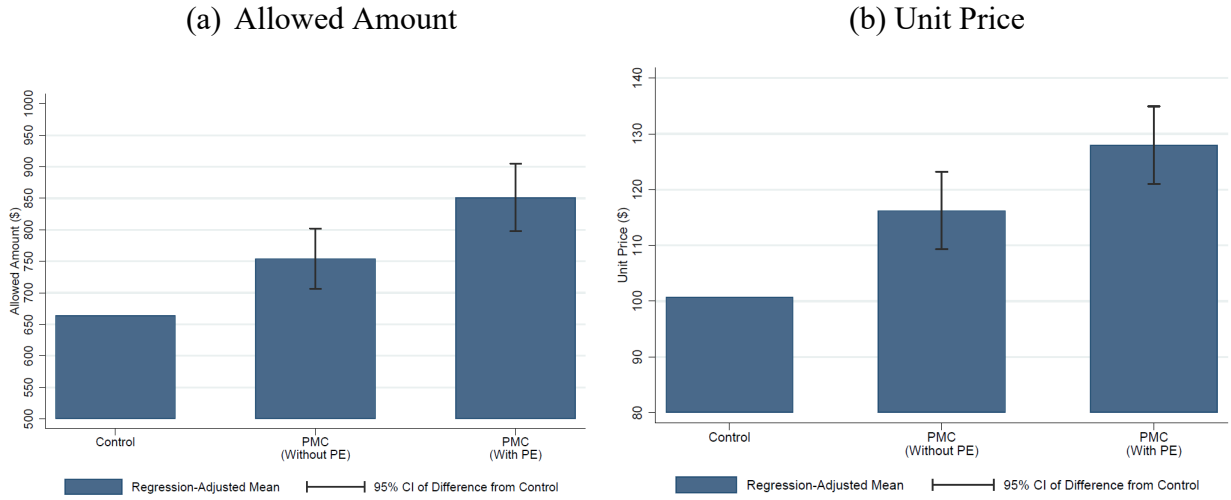
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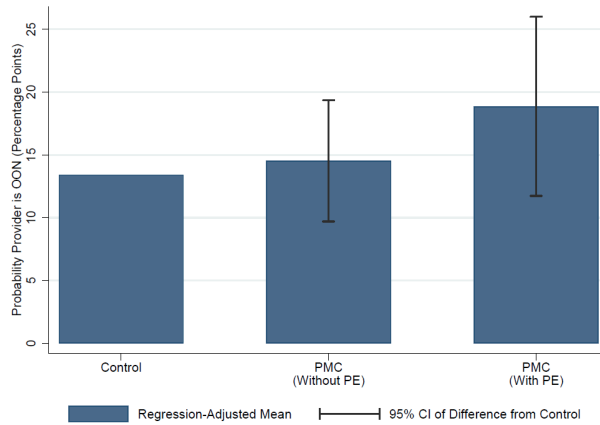
459 Figure 2. Adjusted Differential Changes in Outcomes Associated with PMC Contract with and  
 460 without Private Equity Investment

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(c) Probability Practitioner is Out-of-Network (OON)



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466 **Caption:** This figure shows the adjusted difference-in-differences estimates from the specification interacting the  
 467 post-PMC contract indicator with an indicator for whether the PMC received private equity (PE) investment, relative  
 468 to the regression-adjusted mean value of the control facilities. Therefore, the difference between the height of the  
 469 PMC bars and the control bar represents the differential change in each outcome relative to control facilities, with  
 470 the corresponding 95% confidence interval. The regression-adjusted difference between PMCs with PE relative to  
 471 without PE is as follows: +\$97.18 [35.38, 158.97] for allowed amounts, +11.71 [4.46, 18.95] for unit prices and  
 472 +4.34 [-2.11, 10.79] for the probability a practitioner is out-of-network. See eTable 9 for the regression output.

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