

Appendix

EC1. Measuring Outcomes

Polypectomy rate: We measured the indication of polypectomy during colonoscopy as a proxy for quality. Adenoma detection is a well-established predictor of interval cancer and is one of the most important colonoscopy quality measures, but measuring adenoma detection requires pathology data that is not available at the national level. We instead used a polypectomy, i.e., whether any polyp was removed during a screening colonoscopy, which correlates well with adenoma detection and interval cancer. Polypectomy was identified from claims using HCPCS codes and the existence of pathology bills consistent with previous studies (see Table EC1).

Incomplete colonoscopy: Incomplete colonoscopies can result in missed lesions, which is considered a key contributor to the interval cancer. We identified incomplete colonoscopies using the CPT modifier code 53, 73, or 74 based on previous studies. CPT modifier 53 indicates the surgical codes or medical diagnostic codes when the procedure is discontinued because of extenuating circumstances. CPT modifier 73 indicates discontinued outpatient/hospital ambulatory surgical center (ASC) procedure prior to the administration of anesthesia. CPT modifier 74 indicates a surgical or diagnostic procedure requiring anesthesia was terminated after the induction of anesthesia or after the procedure was started (e.g., the incision made, intubation started, scope inserted) due to extenuating circumstances or circumstances that threatened the well-being of the patient.

Deep sedation use: Because the FDA limits that propofol can be administered by individuals trained in the administration of general anesthesia, another provider (i.e., an anesthesiologist or nurse anesthetist) is usually present during the endoscopic procedure if propofol sedation is used during a colonoscopy. We used an approach by an existing study Khiani et al. (2012) and Liu et al. (2012) to identify anesthesiology involvement with colonoscopy. All of the studies relied on the presence of the CPT-4 code 00810, anesthesia assistance with endoscopic procedure distal to the duodenum, occurring on the same date as the colonoscopy of interest. Although this approach does not specifically identify the use of propofol, it is presumed that most anesthesia-assisted procedures would include this agent. Khiani et al. (2012) additionally counted the presence of the specialty code for an anesthesiologist or certified registered nurse anesthetist (CRNA) on the date of colonoscopy, and Liu et al. (2012) included another HCPCS code (“00740” for anesthesia service associated with upper gastrointestinal endoscopies). The agreements in identifying anesthesia accompanied colonoscopies were high across the three studies.

Major complication: We examined the three most common and important complications after colonoscopy: perforation, bleeding, and infection. Perforation of the colon after colonoscopy is a significant adverse outcome, detected during or soon after colonoscopy and can ultimately result

in death. Currently, perforation occurs about 1 out of 1,000 to 1,400 colonoscopies. Bleeding and infection are also common complications after colonoscopy. Evidence shows that the complication rate varies by the endoscopist's characteristics and can be an indicator of the quality of care, including the skills of the endoscopist and the bowel preparation. We identified perforation and infection events using ICD-9 codes that are present either on or within 7 days after colonoscopy, and bleeding events as the presence of ICD-9 codes that are up to 7 days after colonoscopy date since the presence of bleeding can also be a reason for a visit rather than the outcome (see Table EC1). We tested the sensitivity of including or excluding the date of colonoscopy.

Other complications: Other complications were measured using the previously validated algorithm to measure clinical complication rates after colonoscopy (Robinson et al. 2015). These complications include the presence of cardiovascular, serious gastrointestinal, and/or nonserious gastrointestinal diagnoses, based on medical literature (Warren et al. 2009). Cardiac complications include arrhythmia, congestive heart failure, cardiac or respiratory arrest, syncope, hypotension, and shock. Serious gastrointestinal complications include perforation, lower gastrointestinal bleeding, and infection. nonserious gastrointestinal complications include paralytic ileus, nausea, vomiting, dehydration, abdominal pain, diverticulitis, and enterocolitis. The lists of corresponding codes are provided in EC1.

Severity of bleeding: We further examined the severity of bleeding to distinguish between major and minor bleeding based on other studies. We identified major bleeding as either 1) indication of hemoperitoneum or 2) indication of inpatient or emergency department stays with diagnosis codes for gastrointestinal or nonspecific hemorrhage or 3) indication of transfusion within seven days after the test date.

Interval cancer: An interval CRC is a CRC that appears after a negative colonoscopy. An interval CRC may occur due to genetic and clinical factors of the patient, as well as inadequate polypectomy or missed lesions. Thus, a higher interval cancer rate may signal poor provider quality, to an extent the patient risk is adjusted (Kaminski et al. 2010). We identified colonoscopies attributable to the interval cancer as the test that precedes 6 to 36 months before the first diagnosis of CRC, consistent with previous definitions. To measure the incidence of interval cancer, we first identified the overall CRC incidence. We used the algorithm by (Quantin et al. 2012) to find the first presence of diagnosis codes for CRC in inpatient, outpatient, and office visits, and the first date of presentation of diagnosis codes for CRC. Next, we calculated the time interval between the first date of diagnosis and all colonoscopy dates and identified the colonoscopies that precede first cancer diagnosis by 6 to 36 months. For patients who had more than one colonoscopy within this period, the assignment of cancer was based on the date of the first complete colonoscopy performed. To check the sensitivity, we removed the cases where the patient does not have any confirmation colonoscopy within six

months before the first date of CRC diagnosis to account for the long interval to confirmatory colonoscopy.

EC2. Robustness Checks

Inverse Probability Weighting (IPW). We adjusted for the baseline differences in physicians, especially the pre-integration characteristics, using IPW. In IPW, each observation is weighted to balance the representation of subgroups within the full data set. The weight is the reciprocal of the predicted probability of the observation being in the group that was observed for each observation. We used a logistic model with pre-integration characteristics of patient, physician, and area to estimate the propensity score that each physician will integrate. Using the propensity score, we weighed the entire study sample by inverse probability of treatment weights defined as $z/e + (1 - z)/(1 - e)$, where z denotes treatment status and e denotes the estimated propensity score. The weight ranged from minimum 1.05 and maximum 17.70. We truncated the propensity at the 99th percentile to address the unstable weights or for providers with a very low probability of receiving the treatment. Using the weighted sample, we estimated the average treatment effect from our main model. We also examined the parallel trend of the IPW weighted sample.

Patient Experience. In addition to the outcome variables discussed earlier, we examined the effect of integration on patient experience to test whether integration affects other dimensions of care. To measure patient experience, we used the Outpatient Consumer Assessment of Healthcare Providers and Systems (OAS CAHPS) survey data for HOPDs. The OAS CAHPS survey asks patients who made outpatient visits about various aspects of their experience, including cleanliness, communication, and overall recommendation. Because these surveys were initiated in 2018, we were not able to perform a DID analysis similar to what we have done for our main analyses. Instead, we conducted a matched regression of physicians who did and did not integrate and compared their outcomes. Among the HOPD-affiliated physicians, we performed matching based on their patients' age, demographics, and clinical risk, and physician's own characteristics such as geographic regions. We ran a linear regression on the matched sample for the four patient experience outcomes: facilities and staff, communication, overall rating, and recommendation. Overall, we find that integration is associated with better patient experience measures (see Table EC16). The results could suggest that despite a reduction in the actual care processes, there can be a potential positive impact of vertical integration. Yet, the results need to be interpreted with caution, as we were not able to adjust for unobserved differences among physicians.

Event Study Specification. We have added the event study specification, presented below and also included in Table EC18 of the manuscript. We examined the effect for the years two years pre and post integration, to ensure that the majority of our sample have the same observation

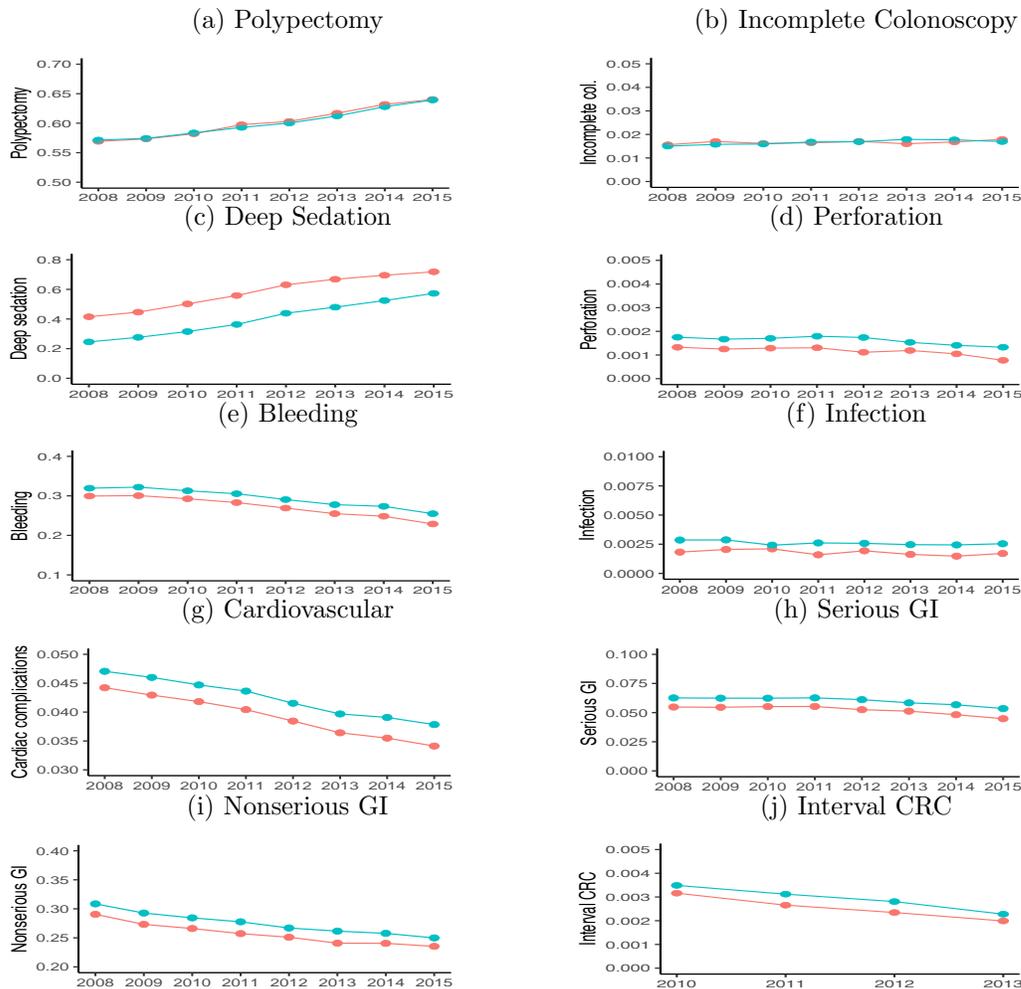
years. We also added this specification and methods in our Appendix. Our results show that the integration effects appear after the first year of integration and are generally consistent across the two years.

$$Y_{ijt} = \alpha_{-2}POST_{j,t-2} + \alpha_{-1}POST_{j,t-1} + \alpha_1POST_{j,t+1} + \alpha_2POST_{j,t+2} + \beta\mathbf{X}_{ijt} + \gamma\mathbf{Z}_{it} + PHYSICIAN_j + MARKET_i + YEAR_t + \epsilon_{ijt} \quad (7)$$

Controlling for Cardiac-Related Comorbidities. If the underlying patient cardiac risk was higher after physicians integrated, our results might be biased. Therefore, we conducted an additional robustness test that uses models that include cardiac-related comorbidities as an additional covariate. Results can be seen in Table EC19. While the effect size decreases, we still observe that there is a consistent increase in both bleeding and cardiac symptoms post integration.

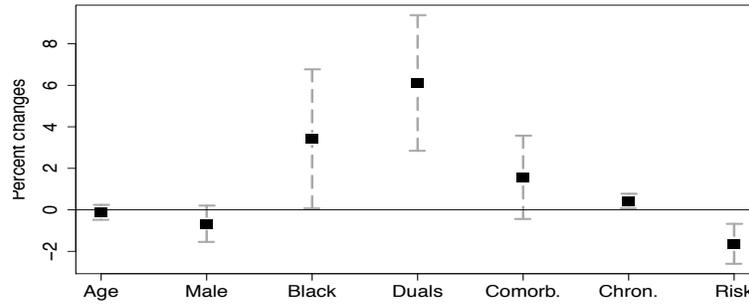
EC3. Figures and Tables

Figure EC1: Trends of Process Measures and Post-Procedure Complications



Note. Red line indicates the trend of independent physicians, and the green line indicates the trend of integrated physicians.

Figure EC2: Average Effect of Integration on Patient Composition, Scaled into Percent Changes



Note. All effects are scaled as changes in percentages. Each dot indicates the size of the DID coefficient. Grey lines depict the 95% confidence intervals around the coefficient of the DID variable. Standard errors are robust and clustered at the physician and the year levels.

Table EC1: List of Codes Used

	Code type	Codes
Colonoscopy	HCPCS	44388, 44389, 44391, 44392, 44393, 44394, 44397, 45378, 45379, 45380, 45381, 45382, 45383, 45384, 45385, 45386, 45391, 45392, G0105, G0121
Polypectomy	HCPCS	44389, 45380, 44392, 45384, 44393, 44394, 45383, 45385, 45379
Incomplete colonoscopy	CPT modifier	53, 73, 74
Deep sedation	HCPCS	00810
Cardiac complications	ICD-9	arrhythmia (ICD-9 codes 427.0-427.4, 427.6-427.9), congestive heart failure (ICD-9 codes 428.0-428.9), cardiac or respiratory arrest (ICD-9 codes 427.5, 799.1, 997.1), syncope, hypotension, or shock (ICD-9 codes 453.29, 458.8-458.9, 639.5, 780.2, 785.50-785.51, 998.0, 995.4) perforation (ICD-9 codes 569.83, 998.2), lower gastrointestinal bleeding (ICD-9 codes 558.9, 578.1, 995.2, 995.89, 998.1-998.13, 286.5, 459, 562.02-562.03, 562.12, 562.13, 569.3, 569.84-569.86, 578.9, 792.1), infection (CPT code 78066 or ICD-9 codes 790.7, 424.9-424.99) paralytic ileus (ICD-9 codes 560.1), nausea, vomiting, dehydration (ICD-9 codes 276.5, 536.2, 787.0-02), abdominal pain (ICD-9 codes 789.0), diverticulitis (ICD-9 codes 562.01, 562.03, 562.11, and 562.13), enterocolitis (ICD-9 codes 555-556)
Serious GI complications	ICD-9	V16.0, V16.8, V16.9, V18.5
Family history of CRC or polyps	ICD-9	153.0, 153.1, 153.2, 153.3, 153.4, 153.6, 153.7, 153.8, 153.9, 154.0, 154.1, V10.00, V10.05, V10.06
History of CRC or polyps	ICD-9	555.0, 555.1 555.2, 555.9, 556.0, 556.2, 556.3, 556.4, 556.5, 556.6, 556.8, 556.9
IBD	ICD-9	

Note. CRC indicates colorectal cancer. GI indicates gastrointestinal. IBD indicates inflammatory bowel disease.

Table EC2: Examination of Pre-Treatment Trends

	<i>Dependent variable:</i>			
	Dec sed (1)	Bleed (2)	Cardio (3)	Non GI (4)
integ:year2009	-0.001 (0.009)	-0.001 (0.004)	-0.009 (0.004)	0.007 (0.003)
integ:year2010	-0.005 (0.009)	-0.005 (0.005)	0.003 (0.004)	0.005 (0.003)
integ:year2011	-0.004 (0.008)	0.001 (0.005)	-0.004 (0.004)	0.003 (0.003)
Observations	1,380,007	1,380,007	1,380,007	1,380,007
R ²	0.495	0.112	0.124	0.054
Adjusted R ²	0.492	0.108	0.120	0.050
Residual Std. Error (df = 1373997)	0.353	0.341	0.422	0.231

Note:

*p<0.05; **p<0.01; ***p<0.001

Note. We examined the pre-treatment trends for year 2009-2011 of the providers who have integrated in 2012. The pre-treatment trends of the providers who have integrated in later years (i.e., 2013 or beyond) are similar with the results from the providers who integrated in 2012.

Table EC3: Regression Results: Process Measures

	<i>Dependent variable:</i>		
	Pol (1)	Incomp (2)	Deep Sed (3)
age	-0.0004* (0.0001)	0.001*** (0.00003)	-0.001*** (0.0001)
sex_female	-0.066*** (0.001)	0.004*** (0.0003)	0.001 (0.001)
race_black	-0.037*** (0.002)	0.002* (0.001)	-0.011*** (0.002)
race_other	-0.023*** (0.003)	-0.004*** (0.001)	-0.015*** (0.002)
race_asian	-0.019*** (0.002)	-0.008*** (0.001)	-0.019*** (0.003)
race_hispanic	-0.036*** (0.004)	-0.004** (0.001)	-0.008 (0.004)
race_native	-0.007 (0.007)	0.0002 (0.002)	-0.007 (0.006)
esrd	-0.009 (0.005)	0.0003 (0.002)	-0.040*** (0.006)
dual	0.002 (0.002)	0.008*** (0.001)	-0.017*** (0.002)
chronic	0.006 (0.003)	-0.0001 (0.0004)	0.005 (0.009)
comorbid	0.006*** (0.0003)	0.002*** (0.0001)	-0.007*** (0.001)
rural	0.005* (0.002)	0.0004 (0.001)	-0.006 (0.003)
unemp	0.001 (0.001)	-0.0001 (0.0001)	0.001 (0.0005)
poverty	-0.0001 (0.0001)	0.0001 (0.00004)	-0.001*** (0.0002)
under_65	-0.0002 (0.0001)	0.00004 (0.00005)	-0.001** (0.0002)
gi_supply	-57.883* (17.347)	5.656 (3.641)	-6.990 (14.479)
hmo_pen	-0.00002 (0.0001)	-0.00000 (0.00003)	0.001* (0.0002)
hhi	0.00000 (0.00000)	0.00000 (0.00000)	-0.00000* (0.00000)
plcsrvc_out	0.030*** (0.004)	-0.0002 (0.001)	-0.036* (0.012)
plcsrvc_asc	0.032*** (0.004)	-0.0001 (0.001)	0.041** (0.012)
post	-0.001 (0.002)	0.0003 (0.0004)	-0.037*** (0.005)
Observations	2,442,582	2,442,582	2,442,582
R ²	0.097	0.032	0.529
Adjusted R ²	0.092	0.026	0.527
Residual Std. Error (df = 2429138)	0.467	0.125	0.344

Note: *p<0.05; **p<0.01; ***p<0.001

Table EC4: Regression Results: Post-Procedure Complications

	<i>Dependent variable:</i>						
	Perf (1)	Bleed (2)	Infect (3)	Non GI (4)	Seri GI (5)	Cardiac (6)	Int CRC (7)
age	0.0001*** (0.00001)	0.011*** (0.0001)	0.0001*** (0.00001)	0.004*** (0.0001)	0.009*** (0.0005)	0.003*** (0.00004)	0.0001** (0.00002)
sex_female	0.0005*** (0.0001)	0.030*** (0.001)	-0.0003* (0.0001)	0.032*** (0.001)	0.018*** (0.001)	-0.002 (0.001)	-0.0004 (0.0002)
race_black	-0.0004* (0.0002)	0.007*** (0.001)	-0.00002 (0.0002)	-0.017*** (0.002)	-0.010* (0.003)	0.001 (0.001)	0.0005 (0.0004)
race_other	0.0002 (0.0003)	-0.004 (0.002)	0.0002 (0.001)	-0.017*** (0.002)	-0.005 (0.002)	-0.008*** (0.001)	0.001 (0.001)
race_asian	-0.0004 (0.0002)	-0.014*** (0.002)	-0.001 (0.0005)	-0.031*** (0.003)	-0.017** (0.003)	-0.017*** (0.001)	-0.001 (0.0003)
race_hispanic	-0.001 (0.0004)	-0.030*** (0.003)	-0.001** (0.0003)	-0.011** (0.003)	-0.036*** (0.006)	-0.018*** (0.002)	-0.0003 (0.001)
race_native	-0.001 (0.001)	0.040*** (0.006)	0.001 (0.002)	0.006 (0.005)	0.034** (0.007)	0.012 (0.009)	-0.001 (0.001)
esrd	-0.0004 (0.001)	0.158*** (0.003)	0.016*** (0.001)	0.091*** (0.006)	0.168*** (0.006)	0.094*** (0.006)	-0.003 (0.001)
dual	0.0005 (0.0002)	0.077*** (0.001)	0.001** (0.0003)	0.048*** (0.002)	0.052*** (0.001)	0.021*** (0.001)	0.0002 (0.0005)
chronic	0.00001 (0.0001)	0.006*** (0.002)	-0.0003** (0.0001)	0.0001 (0.001)	0.002 (0.003)	-0.003 (0.003)	-0.0002 (0.0001)
comorb	0.0003*** (0.00003)	0.036*** (0.0001)	0.001*** (0.0001)	0.024*** (0.001)	0.027*** (0.001)	0.019*** (0.0004)	0.001*** (0.0001)
rural	0.001* (0.0002)	0.013*** (0.001)	0.001* (0.0002)	0.008** (0.002)	0.013*** (0.002)	0.001 (0.001)	0.0001 (0.0001)
unemp	0.0001 (0.00003)	-0.001 (0.0003)	-0.00002 (0.00004)	0.0001 (0.0004)	-0.001 (0.001)	-0.0001 (0.0001)	0.0001 (0.0001)
poverty	-0.00003 (0.00002)	0.0004*** (0.0001)	-0.00001 (0.00003)	0.0001 (0.0001)	0.0003 (0.0001)	-0.0001* (0.00005)	-0.0001* (0.00001)
under_65	-0.00000 (0.00001)	0.0005*** (0.0001)	0.00000 (0.00002)	-0.00003 (0.0002)	0.0003 (0.0001)	0.0003*** (0.00004)	-0.00002 (0.00002)
gi_supply	2.786 (1.965)	-73.752*** (10.936)	-1.894 (1.134)	-53.238*** (9.523)	-73.546** (17.610)	-32.382** (6.989)	-2.729 (1.856)
hmo_pen	-0.00000 (0.00001)	-0.0003*** (0.0001)	-0.00000 (0.00001)	-0.0004** (0.0001)	-0.0004* (0.0001)	0.0001** (0.00001)	-0.00001 (0.00001)
hhi	-0.00000 (0.00000)	-0.00000 (0.00000)	-0.00000 (0.00000)	-0.00000 (0.00000)	-0.00000 (0.00000)	-0.00000 (0.00000)	0.00000 (0.00000)
plcsrvc_out	0.0002 (0.0002)	0.034*** (0.002)	0.0002 (0.0002)	0.015** (0.003)	0.021** (0.006)	0.007*** (0.001)	0.001 (0.001)
plcsrvc_asc	-0.00004 (0.0002)	-0.005* (0.002)	-0.0003 (0.0002)	-0.007 (0.004)	0.004 (0.007)	0.001 (0.001)	0.001 (0.001)
post	0.00002 (0.0001)	0.004** (0.001)	-0.0001 (0.0001)	0.003* (0.001)	-0.0001 (0.002)	0.005*** (0.001)	-0.0001 (0.0003)
Observations	2,442,582	2,442,582	2,442,582	2,442,582	2,633,499	2,635,352	1,551,886
R ²	0.013	0.127	0.022	0.102	0.120	0.068	0.019
Adjusted R ²	0.007	0.122	0.016	0.098	0.116	0.068	0.012
Residual	0.037	0.424	0.047	0.316	0.420	0.187	0.056
Std. Error	(df = 2429138)	(df = 2429138)	(df = 2429138)	(df = 2429138)	(df = 2620055)	(df = 2635325)	(df = 1539893)

Note:

* p<0.05; ** p<0.01; *** p<0.001

Table EC5: Regression Results: Operational Efficiency (Throughput)

	<i>Dependent variable:</i>			
	Total Serv (1)	Total Col (2)	Total Proc (3)	Total Pat (4)
age	-1.208 (1.580)	-0.574** (0.106)	-0.005 (0.016)	0.113 (0.187)
sex_prop_male	24.791 (37.851)	1.567 (2.205)	0.280 (0.586)	2.016 (5.444)
race_prop_white	38.645 (33.966)	9.530* (3.165)	1.833 (0.741)	18.884 (8.158)
prop_dual	-16.123 (27.567)	-8.245* (3.386)	-0.011 (0.539)	13.370 (7.572)
comorb	1.206 (4.632)	-3.020*** (0.461)	0.071 (0.047)	-0.370 (0.720)
chronic	-226.046 (107.807)	8.653 (9.534)	-1.232 (2.024)	-1.088 (24.242)
prop_rural	39.091 (46.995)	-7.950 (5.448)	-1.275 (1.007)	-29.106 (11.779)
gi_supply	-1,166,130.000 (530,952.800)	-33,316.770 (20,676.980)	-20,937.880 (13,712.540)	-141,328.400 (58,161.450)
unemp	-16.618 (13.405)	3.378** (0.845)	-0.471 (0.361)	3.694 (2.864)
poverty	3.681 (8.780)	0.074 (0.315)	0.087 (0.093)	1.201 (0.773)
hmo_pen	-3.565 (2.044)	-2.147*** (0.169)	-0.068 (0.025)	-3.302** (0.453)
hhi	0.018 (0.019)	0.003 (0.001)	0.0004 (0.0002)	0.010 (0.004)
post	5.146 (20.460)	3.241** (0.852)	1.059** (0.142)	7.596* (2.260)
Observations	24,025	66,908	34,398	33,337
R ²	0.924	0.871	0.922	0.947
Adjusted R ²	0.871	0.845	0.889	0.924
Residual Std. Error	721.685 (df = 14118)	52.363 (df = 55637)	5.739 (df = 24293)	78.940 (df = 23243)

Note:

* p<0.05; ** p<0.01; *** p<0.001

Table EC6: Regression Results: Waiting Time

	<i>Dependent variable:</i>	
	Log Incomp Time	Log Follow Time
	(1)	(2)
age	-0.0002 (0.007)	-0.012 (0.006)
sex_female	0.184* (0.060)	0.174* (0.050)
race_black	0.067 (0.104)	0.151 (0.070)
race_other	-0.083 (0.152)	-0.057 (0.154)
race_asian	0.441 (0.264)	0.414 (0.214)
race_hispanic	-0.003 (0.188)	-0.059 (0.175)
race_native	-0.080 (0.407)	-0.174 (0.356)
esrd	0.208 (0.303)	-0.110 (0.222)
dual	0.061 (0.082)	-0.021 (0.060)
chronic	0.003 (0.145)	0.143 (0.130)
comorb	-0.003 (0.009)	-0.037** (0.008)
rural	0.018 (0.084)	0.129 (0.083)
unemp	-0.031 (0.019)	-0.016 (0.019)
poverty	0.002 (0.010)	-0.0005 (0.010)
under_65	-0.010 (0.009)	0.001 (0.008)
gi_supply	-1,184.367 (1,123.960)	-1,298.640 (1,050.033)
hmo_pen	-0.001 (0.005)	-0.001 (0.004)
hhi	-0.00002 (0.00003)	-0.00004 (0.00004)
plcsrvc_out	0.497 (0.237)	0.483 (0.247)
plcsrvc_asc	0.363 (0.215)	0.360 (0.226)
post	0.152 (0.135)	0.078 (0.087)
Observations	12,968	16,124
R ²	0.682	0.641
Adjusted R ²	0.548	0.504
Residual Std. Error	1.114 (df = 9106)	1.186 (df = 11660)
<i>Note:</i>	* p<0.05; ** p<0.01; *** p<0.001	

Table EC7: Regression Results: Spending

	<i>Dependent variable:</i>		
	Total Spend (1)	Phy Spend (2)	Fac Spend (3)
age	0.488** (0.112)	-0.085 (0.060)	2.170*** (0.165)
sex_female	-4.919*** (0.746)	-3.766*** (0.120)	2.338* (0.832)
race_black	-7.013** (1.461)	-3.250*** (0.158)	-13.223** (2.703)
race_other	-2.606 (1.434)	-1.259 (0.581)	-5.312* (2.186)
race_asian	4.188 (2.666)	0.561 (0.569)	3.475 (4.473)
race_hispanic	3.570 (2.385)	-1.738* (0.694)	-5.340 (4.824)
race_native	-14.740* (4.681)	-4.446** (0.912)	4.032 (5.615)
esrd	-34.695*** (5.089)	-1.872* (0.704)	53.221*** (7.040)
dual	17.901*** (1.789)	-0.442 (0.413)	32.179*** (1.858)
chronic	19.343 (16.926)	7.774 (6.275)	5.508 (5.560)
comorb	-1.449 (0.623)	-0.436* (0.148)	12.012*** (0.736)
rural	14.636*** (2.034)	-0.619* (0.257)	7.042* (2.767)
unemp	0.470 (0.427)	0.111* (0.042)	1.772* (0.651)
poverty	-0.050 (0.170)	-0.070** (0.017)	-0.253 (0.224)
under_65	-0.476* (0.145)	-0.066** (0.016)	-0.432 (0.270)
gi_supply	-83,881.790*** (14,080.990)	2,318.263 (3,046.107)	-83,433.070*** (13,961.910)
hmo_pen	-0.371** (0.103)	-0.006 (0.014)	-0.850** (0.166)
hhi	0.0004 (0.001)	-0.0002 (0.0001)	-0.0001 (0.001)
post	126.956*** (11.105)	-3.542*** (0.536)	77.477*** (10.043)
Observations	2,442,582	2,442,582	976,456
R ²	0.359	0.263	0.365
Adjusted R ²	0.355	0.259	0.357
Residual Std. Error	287.040 (df = 2429138)	60.216 (df = 2429138)	292.382 (df = 963875)

Note:

*p<0.05; **p<0.01; ***p<0.001

Table EC8: Changes in Procedure Mix

	<i>Dependent variable:</i>	
	Prop Biopsy (1)	Prop Pol (2)
post	0.003 (0.001)	0.006 (0.003)
Observations	34,464	63,502
R ²	0.743	0.526
Adjusted R ²	0.636	0.426
Residual Std. Error	0.045 (df = 24321)	0.183 (df = 52454)
<i>Note:</i>	*p<0.05; **p<0.01; ***p<0.001	

Table EC9: Mediation Analysis Results

Mediator	Throughput		Deep sedation	
	Bleed	Cardiac	Bleed	Cardiac
Average causal mediation effect	-0.00003 (-0.0002-0.00002)	-0.0003*** (-0.0004-0.00001)	0.001*** (0.00089-0.00004)	0.0013*** (0.0012-0.00001)
Average direct effect	0.017*** (0.016-0.02)	0.013*** (0.012-0.01)	0.016*** (0.015-0.02)	0.0090*** (0.0087-0.01)
Total effect	0.017*** (0.016-0.02)	0.012*** (0.011-0.01)	0.017*** (0.016-0.02)	0.010*** (0.009-0.01)
Prop. mediated	-0.0014 (-0.010-0.0000)	-0.023*** (-0.036- -0.01)	0.060*** (0.05-0.07)	0.12*** (0.12-0.13)

Note. *p<0.05; **p<0.01; ***p<0.001. Comp. indicates complications. Prop. indicates proportion.

Table EC10: Regression Results: Interactions with Places of Service

<i>Dependent variable:</i>	
	Deep Sed
post	-0.011 (0.018)
plcsrv_out	-0.046* (0.017)
plcsrv_asc	0.044* (0.013)
post:plcsrv_out	0.011 (0.016)
post:plcsrv_asc	-0.007 (0.018)
Observations	2,222,322
R ²	0.567
Adjusted R ²	0.565
Residual Std. Error	0.330 (df = 2209024)
<i>Note:</i>	* p<0.05; ** p<0.01; *** p<0.001

Table EC11: Regression Results: (a) Changes in Affiliated Anesthesiologists: External Margin (Left) and (b) Changes in Anesthesiology Volume: Internal Margin (Right)

<i>Dependent variable:</i>		
Num. Affiliated Anesthesiologists		
	(1)	(2)
post	0.805*** (0.121)	-0.672** (0.149)
Observations	67,362	45,867
R ²	0.775	0.802
Adjusted R ²	0.729	0.750
Residual Std. Error	3.736 (df = 55993)	3.834 (df = 36439)
<i>Note:</i>	*p<0.05; **p<0.01; ***p<0.001	

<i>Dependent variable:</i>		
Total Anesthesiologists		
	(1)	(2)
post	-2.788*** (0.218)	-1.880*** (0.295)
Observations	586,368	384,988
R ²	0.235	0.209
Adjusted R ²	0.219	0.188
Residual Std. Error	21.851 (df = 574205)	16.460 (df = 374975)
<i>Note:</i>	*p<0.05; **p<0.01; ***p<0.001	

Table EC12: Mechanisms for Changes in Operational Efficiency

<i>Dependent variable:</i>				
	Total Serv	Total Col	Total Proc	Total Pat
	(1)	(2)	(3)	(4)
post	-27.644 (44.850)	3.014* (1.227)	0.616 (0.284)	3.749 (5.201)
sed	51.872 (58.743)	12.071*** (1.837)	-0.501 (0.348)	5.185 (6.319)
post:sed	60.297 (52.619)	1.274 (1.834)	0.775 (0.418)	6.939 (5.380)
Observations	24,025	66,908	34,398	33,337
R ²	0.924	0.871	0.922	0.947
Adjusted R ²	0.871	0.845	0.889	0.924
Residual Std. Error	721.597 (df = 14116)	52.310 (df = 55635)	5.739 (df = 24291)	78.929 (df = 23241)
<i>Note:</i>	*p<0.05; **p<0.01; ***p<0.001			

Table EC13: Regression Results: (a) IPW Adjusted (Left) and (b) Coarsened Exact Matching (Right)

	Estimate	Cluster s.e.	Pr(> t)		Estimate	Cluster s.e.	Pr(> t)
Pol	-0.001	0.002	0.633	Pol	-0.009	0.006	0.154
Incomp	0.0003	0.0004	0.550	Incomp	0.002	0.001	0.254
Deep Sed	-0.037***	0.005	0.0003	Deep Sed	-0.036**	0.006	0.001
Perf	0.00002	0.0001	0.897	Perf	0.00001	0.0002	0.966
Bleed	0.004**	0.001	0.001	Bleed	0.008*	0.004	0.044
Infect	-0.0001	0.0001	0.413	Infect	-0.0001	0.0004	0.728
Cardiac	0.010***	0.001	0.00000	Cardiac	0.011***	0.001	0.0001
Serious GI	-0.0001	0.002	0.973	Serious GI	0.002	0.004	0.651
Nonserious GI	0.003*	0.001	0.014	Nonserious GI	0.004**	0.001	0.001
Int CRC	-0.0001	0.0003	0.618	Int CRC	0.001	0.001	0.394

Table EC14: Regression Results: Full Integration

<i>Dependent variable: process measures and post-procedure complications</i>										
	Pol.	Incomp.	Deep Sed.	Perf.	Bleed.	Infect.	Cardiac.	Seri. GI	Non. GI	Int. CRC
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
POST	-0.0087 (0.0041)	0.0011 (0.0013)	-0.021 (0.011)	-0.00016 (0.00031)	0.0061 (0.0056)	0.00044 (0.00075)	0.003 (0.004)	-0.0001 (0.002)	0.010 (0.001)	0.00004 (0.001)
Obs.	1,487,344	1,487,344	1,487,344	1,487,344	1,487,344	1,487,344	1,487,344	1,487,344	1,487,344	940,845
R ²	0.096	0.037	0.510	0.019	0.140	0.025	0.108	0.068	0.120	0.025
Adj. R ²	0.089	0.030	0.507	0.011	0.134	0.017	0.101	0.068	0.116	0.015
Res. Std. Err.	0.468	0.126	0.344	0.040	0.425	0.051	0.323	0.187	0.420	0.057

<i>Dependent variable: operational efficiency and spending</i>										
	Total Serv.	Total Col.	Total Proc.	Total Pat.	Incomp. Time	Follow. Time	Total Spend.	Phy. Spend.	Fac. Spend.	Ann. Spend.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
POST	-111.304** (16.128)	-9.619** (1.952)	-4.043** (0.429)	-28.564* (4.922)	0.366 (0.315)	0.012 (0.083)	75.354*** (9.519)	-4.367** (0.912)	24.130** (4.816)	265.054 (291.982)
Obs.	18,152	45,502	23,951	23,397	10,009	26,387	1,487,344	1,487,344	939,345	45,867
R ²	0.921	0.877	0.913	0.930	0.682	0.337	0.291	0.147	0.324	0.822
Adj. R ²	0.863	0.845	0.868	0.894	0.543	0.092	0.286	0.140	0.316	0.776
Res. Std. Err.	436.827	51.617	5.857	82.626	1.136	1.133	332.085	58.687	274.980	6,617.175

Note. Pol. indicates polypectomy. Incomp. indicates incomplete colonoscopy. Sed. indicates deep sedation. Perf. indicates perforation. Bleed. indicates bleeding. Infect. indicates infection. Cardiac. indicates cardiovascular symptoms. Ser. GI indicates serious GI symptoms. Non. GI indicates nonserious GI symptoms. Col. indicates colonoscopy. Serv. indicates services. Proc. indicates procedures. Each dot indicates the size of the DID coefficient. Each dot indicates the size of the DID coefficient. Grey lines depict the 95% confidence intervals around the coefficient of the DID variable. Standard errors are robust and clustered at the physician and the year levels.

Table EC15: Bonferroni Correction

	Pol	Incomp	Deep Sed	Perf	Bleed	Infect	Non GI	Seri GI	Cardiac	Int CRC
Adj p-val	1.00	1.00	0.003	1.00	0.011	1.00	0.158	1.00	0.00003	1.00

Table EC16: Regression Results: Patient Experience

	<i>Dependent variable:</i>			
	facilities and staff (1)	communication (2)	overall rating (3)	recommendation (4)
age	-0.025*** (0.004)	-0.059*** (0.007)	-0.037*** (0.007)	-0.035** (0.011)
sex_prop_male	-0.134 (0.070)	0.017 (0.117)	-0.205 (0.125)	-0.199 (0.195)
race_prop_white	0.400*** (0.067)	0.158 (0.111)	0.092 (0.118)	0.451* (0.185)
prop_dual	-0.376*** (0.084)	-0.382** (0.141)	-1.131*** (0.150)	-1.303*** (0.235)
comorb	0.012 (0.011)	-0.008 (0.018)	-0.005 (0.019)	-0.065* (0.030)
chronic	0.474 (0.273)	1.010* (0.456)	0.600 (0.486)	0.430 (0.760)
prop_rural	0.015 (0.045)	0.039 (0.075)	-0.408*** (0.080)	-0.563*** (0.126)
gi_supply	-501.287* (234.549)	-859.999* (391.142)	787.086 (416.591)	3,034.942*** (652.256)
unemp	-0.028*** (0.007)	-0.101*** (0.011)	0.020 (0.012)	0.009 (0.018)
poverty	-0.012*** (0.002)	0.013** (0.004)	-0.005 (0.004)	-0.020** (0.007)
hmo_pen	0.001 (0.001)	-0.006*** (0.001)	-0.007*** (0.002)	-0.002 (0.002)
hhi	0.00002 (0.00001)	0.00002 (0.00001)	-0.00001 (0.00001)	-0.00001 (0.00002)
post	0.105*** (0.022)	0.029 (0.036)	0.160*** (0.039)	0.150* (0.061)
Constant	99.576*** (0.381)	98.538*** (0.635)	96.068*** (0.677)	95.364*** (1.059)
Observations	5,508	5,508	5,506	5,506
R ²	0.049	0.036	0.026	0.026
Adjusted R ²	0.046	0.034	0.024	0.023
Residual Std. Error	0.746 (df = 5494)	1.244 (df = 5494)	1.325 (df = 5492)	2.075 (df = 5492)
F Statistic	21.573*** (df = 13; 5494)	15.792*** (df = 13; 5494)	11.370*** (df = 13; 5492)	11.160*** (df = 13; 5492)

Note:

*p<0.05; **p<0.01; ***p<0.001

Table EC17: Follow-Up Rates for Incomplete and Positive Colonoscopies

% followed up	Independent	Partially integrated	Fully integrated
Incomplete colonoscopy	40.5	39.9	40.8
Positive colonoscopy	23.8	23.1	23.9

Note: Follow-up rates for incomplete colonoscopies are defined as the proportion of incomplete colonoscopies for which there exists at least one other complete colonoscopy within the six month by the same provider, among all incomplete colonoscopies. Follow-up rates for positive colonoscopies are defined as the proportion of positive colonoscopies (e.g., the ones with biopsy for which there exists at least one other colonoscopy within six month by the same provider, among all positive colonoscopies).

Table EC18: Regression Results: Event Study Specification

	<i>Dependent variable:</i>			
	Dee sed	Bleed	Cardiac	Non GI
	(1)	(2)	(3)	(4)
integ:pre2	-0.001 (0.009)	-0.001 (0.004)	-0.009 (0.004)	0.007 (0.003)
integ:pre1	-0.005 (0.009)	-0.005 (0.005)	0.003 (0.004)	0.005 (0.003)
integ:post1	-0.041*** (0.008)	0.001* (0.0005)	0.0004*** (0.0001)	0.003 (0.003)
integ:post2	-0.032*** (0.001)	0.001*** (0.0001)	0.0005*** (0.0001)	0.003* (0.001)
Observations	1,380,007	1,380,007	1,380,007	1,380,007
R ²	0.495	0.112	0.124	0.054
Adjusted R ²	0.492	0.108	0.120	0.050
Residual Std. Error (df = 1373997)	0.353	0.341	0.422	0.231

Note:

*p<0.05; **p<0.01; ***p<0.001

Table EC19: Regression Results: Controlling for Cardiac-Related Comorbidities

	<i>Dependent variable:</i>			
	Dec sed (1)	Bleed (2)	Cardiac (3)	Non GI (4)
Cardiac	0.002 (0.009)	0.001 (0.004)	0.005 (0.011)	0.007 (0.005)
integ	-0.041*** (0.008)	0.001* (0.0005)	0.0004*** (0.0001)	0.003* (0.002)
Observations	1,380,007	1,380,007	1,380,007	1,380,007
R ²	0.475	0.114	0.134	0.051
Adjusted R ²	0.472	0.110	0.130	0.047
Residual Std. Error (df = 1373997)	0.352	0.341	0.421	0.233

Note:

*p<0.05; **p<0.01; ***p<0.001