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Medical Device Firm Payments To Physicians Exceed What Drug Companies Pay Physicians, Target Surgical Specialists

DOI: 10.1377/hlthaff.2020.01785
HEALTH AFFAIRS 40,
NO. 4 (2021): 603–612

ABSTRACT **Many physicians receive payments from medical device companies that make products physicians can use or recommend. Such payments are controversial because of concerns that they might influence physicians to treat patients with devices made by the firms that make those payments, even if those devices are not optimal for patients. This issue has been studied extensively in the drug industry. Medical devices entail a greater degree of physician-industry interaction regarding treatment, training, and innovation than pharmaceuticals, and they have been less studied because of data limitations. We summarize and compare device and drug firm payment rates and magnitudes reported in Open Payments data by payment type, physician specialty, and Medicare billing amount. Relative to drug firm payments, device firm payments as a percentage of industry revenue were seven times as large; device firm payments were also more often related to product development and training and were more strongly correlated with physicians' Medicare billing amounts. Using Food and Drug Administration product approval data, we further document that top-paying firms dominate high-revenue device categories. Our results suggest that optimal policy regarding physician-industry relationships for medical devices may be very different from that for pharmaceuticals. Estimating the causal relationships between payments and device use, pricing, and innovation to inform policy makers will be possible only with greater data transparency, such as including device identifiers in medical claims.**

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Medical devices and supplies play an important role in the delivery of modern health care. They can account for significant increases in life expectancy, as well as growth in health expenditures.[1,2] In this article we provide what is, to the best of our knowledge, the first comprehensive examination of medical device industry payments to physicians across payment types and specialties. For context, we present a similarly comprehensive examination of pharmaceutical industry payments.

Many physicians receive payments and other in-kind compensation, such as meals, from companies that produce products the physicians can prescribe, implant, inject, or recommend. There are several possible justifications for the close relationships between industry and physicians represented by these payments. For example, industry may provide valuable information and training on innovative new products, and physicians may provide expertise regarding the use of existing products and ideas for future products.

In contrast, industry observers and policy makers have raised concerns that physicians' treatment decisions may be biased by financial relationships. For example, a 2008 report from the Medicare Payment Advisory Commission concluded that "Medicare should be concerned about the potential for bias" driven by physician-industry interactions, and it advocated for a federally mandated public reporting system for financial ties.[3] In 2009 an Institute of Medicine report cited potential tensions between such financial relationships and the goals of medical research, education, and practice, highlighting "the risk of undue industry influence on physician prescribing behavior with little or no benefit to patient care."[4] It went further to recommend the elimination of in-kind gifts such as meals and other aspects of physician-industry relationships it deemed problematic. Subsequently, several states[5] and many academic medical centers[6] have imposed policies banning or severely limiting payments and associated interactions between physicians and industry; the Physician Payments Sunshine Act of 2010 also went into effect, requiring broad disclosure of such payments. Despite such policies and scrutiny, payments to physicians by pharmaceutical and device manufacturers have remained high.

Device and drug firms are often grouped together under the umbrella term "medical product manufacturers" and share some important similarities.[7] Their products are regulated by the Food and Drug Administration (FDA), they make large investments in research and development over long time horizons to create new products, and the use of their products generally requires the recommendation of a physician. However, device and drug firms differ greatly in their interactions with physicians as a result of several diverging features of their products. First, drugs are usually taken orally by patients, whereas many medical devices must be implanted by physicians in surgical specialties. Second, almost all drugs are therapeutic or preventive, whereas devices may be therapeutic, diagnostic, supportive, surgical, or used to monitor a patient's condition, and therefore physicians may encounter devices at more stages of the health care value chain. Finally, although drugs are typically metabolized by the body quickly, implanted medical devices may reside in patients' bodies for many years.

One way of looking at these differences is that devices may require physicians to learn from firms and firms to learn from physicians in a way that most drugs do not. For example, physicians play a key role in medical device innovation[8] and often rely on device industry representatives for training on how to use new devices; as a consequence, representatives are often present in the surgical suite.[9] Another way of viewing these differences is that device firms have more opportunities to influence physicians—but this influence might not be good for patients if it comes from the firms with the deepest pockets instead of the firms with the best therapies. Under either view, if payments represent a substantial operating cost for a successful device manufacturer, more payments could raise entry costs and thus contribute to increased industry concentration.[10] Indeed, many important device categories are dominated by a few manufacturers and vendors, a fact that has received renewed attention in light of recent shortages during the COVID-19 pandemic.[11]

Recent studies of payments from pharmaceutical firms to physicians have documented positive associations between payments and physicians' prescribing of drugs made by the firms that pay them.[12–22] One meta-analysis of thirty-six such studies counted positive associations in 89 of 101 analyses conducted.[23] However, far less attention has been paid to interactions between physicians and the medical device industry. A handful of studies have focused on individual specialties, summarizing payments from industry[24–29] or correlating payments with the use of specific procedures.[30,31] One study summarized industry payments (including both drug and device payments) across multiple specialties.[32] To our knowledge, no prior studies have explicitly separated device firm payments from drug firm payments.

This article presents new evidence on payments from medical device firms. We compare the rate, magnitude, nature, and targeting of payments from the device and drug industries to a comprehensive sample of physicians, across and within specialties. We also explore the potential relationship between payments and device market concentration.

Study Data And Methods

DATA AND SAMPLE This study used 2014–17 data from the Centers for Medicare and Medicaid Services (CMS) Open Payments website. The Open Payments database contains information on all industry payments made to US physicians, whether related to research, nonresearch interactions, or physician-ownership. Each entry in the database identifies the recipient of the payment; the firm making the payment; and the date, amount, and category of the payment. We followed the literature by focusing on nonresearch payments.

We estimated market size using several sources. Total spending in the US prescription drug

market in 2014–17 was $1,378 billion.[33,34] The size of the 2014–17 implantable medical device market was $211.3 billion.[35,36]

Our analysis included all physicians, identified by National Provider Identifiers (NPIs) in Medicare Part B utilization data for 2014–17.[37] We matched Open Payments recipients to NPIs in the National Plan and Provider Enumeration System by physician name, address, specialty, and credentials, recovering NPIs for 98 percent of all payment recipients in 2014–17. Complete details are in the online appendix.[38] We then matched Open Payments data with Medicare Part B utilization data by physician NPI. The purpose of this match was to recover recipients' Medicare-defined specialties, to focus our analysis on physicians actively treating patients during the period of study, and to examine the correlation between industry payments to physicians and Medicare billing. We defined Medicare billing as the total allowed amount a physician receives for Medicare Part B services.

CLASSIFICATION We classified each payment by the type of product involved. First, where appropriate, we classified firms in the database as being drug or device vendors if at least 95 percent of their product-linked payments were associated with drugs or devices, respectively. For the small subset of firms not classified using that approach, we performed the same exercise within each physician specialty (for example, cardiology), classifying vendors as drug or device vendors within that specialty. Using this procedure, we were able to classify 99 percent of payments in our sample, encompassing 97 percent of the total dollar value of nonresearch industry payments made during 2014–17.

Finally, we ranked the device firms (including subsidiaries) by the total dollar value of their payments during our sample period. For the ten top-paying firms in this ranking, we linked them to their associated approved medical devices in the FDA's public Global Unique Device Identification Database.[39]

OUTCOMES The primary outcomes in our analysis were the share of physicians receiving drug- and device-related payments (the payment "rate") and the total dollar value of payments (the payment "magnitude"), separated by the "nature" of physician-industry interaction reported with the payment (for example, payments could be consulting fees, speaking fees, in-kind or cash food and beverage payments, and so on). We considered these variables both in aggregate and broken down by specialty and by Medicare billing (payment "targeting"). We concluded by using FDA medical device data to correlate payments with the share of approved devices marketed by each firm.

LIMITATIONS Our study had several limitations. First, our analysis was limited to physicians participating in Medicare.[40] Second, our data did not include physician-level medical device or pharmaceutical utilization data, so we could not estimate the causal effects of payments on product use, let alone important follow-on outcomes such as prices and quality. Third, our analysis did not provide insights into long-run causal effects of payments on firm entry, exit, and innovation.

Study Results

Exhibit 1 summarizes the rate and magnitude of general nonresearch payments made to physicians by payment category and vendor type.[41] During 2014–17 vendors promoting medical devices paid $904 million to 196,624 physicians (30 percent of active physicians) each year, on average. During the same period, vendors promoting drugs paid $821 million to 331,187 physicians (50 percent). Although the dollar amounts are similar in magnitude, they start to look different once one considers that the pharmaceutical industry is much larger than the device industry. During this period device-related payments to physicians represented about 1.7 percent of device industry revenue—more than seven times the 0.24 percent of drug industry revenue spent by pharmaceutical firms on physician payments (calculation based on the size of the respective industry markets stated above). Device firms also paid larger amounts to fewer physicians.

In some ways, the types of drug and device industry payments look similar in nature. Both drug and device firms made a large number of small-value food and beverage payments to physicians. Drug vendors made (in-kind or cash) food and beverage payments to 48 percent of physicians each year (19 percent of payment dollars), whereas device vendors made such payments to 29 percent of physicians per year (7 percent of payment dollars). Drug and device vendors also paid a nearly equivalent total dollar amount in consulting fees, although consulting fee payments by drug vendors were distributed to more than double the number of physicians.

The composition of payments differed considerably across vendor types in other dimensions. For example, over the course of 2014–17, royalty, licensing, and investment payments made by device vendors amounted to nearly $440 million per year, making up 49 percent of the total value of payments made by device vendors,[42] but this category amounted to only 1 percent of drug vendors' total value of payments. Device vendors also spent more on education.[43] Total education payments from device firms were four times

EXHIBIT 1

Device and drug manufacturers' payments to physicians, by type of payment and vendor category, 2014–17

	Device vendors				Drug vendors			
	Payments		Physicians		Payments		Physicians	
Payment types	Amount ($1,000s)	Physicians	Share of all physicians	Avg. payment amount ($)	Amount ($1,000s)	Physicians	Share of all physicians	Avg. payment amount ($)
Royalty, licensing, and investment	439,506	1,976	0.30	222,450	7,745	70	0.01	110,248
Consulting fee	144,591	9,546	1.44	15,146	142,868	20,212	3.04	7,068
Speaking fee	136,744	9,324	1.40	14,666	418,412	20,894	3.15	20,026
Travel and lodging	79,974	37,473	5.64	2,134	86,302	20,608	3.10	4,188
Food and beverage	58,909	191,472	28.84	308	153,141	321,251	48.38	477
Education	29,036	13,361	2.01	2,173	7,642	84,837	12.78	90
Other[a]	15,463	5,166	0.78	2,993	5,331	3,337	0.50	1,597
Total per year	904,222	196,624	29.61	4,599	821,441	331,187	49.88	2,480
Total 2014–17	3,616,886	332,658	50.00	10,873	3,285,763	475,793	71.52	6,906

SOURCE Authors' analysis of Open Payments data for 2014–17, Centers for Medicare and Medicaid Services Part B utilization data for 2014–17, and sources cited in the text. **NOTE** All dollar amounts are in inflation-adjusted 2020 dollars. [a]Includes gifts, entertainment, and charitable contributions.

those from drug firms, and education payments per physician from device firms were twenty-four times those from drug firms.

Exhibits 2 and 3 summarize total payments from drug and device firms to physicians in each of the top twenty specialties, as well as to physicians in all other specialties combined. Exhibit 2 plots the average rate of active physicians in each specialty receiving drug and device payments per year. Exhibit 3 shows the magnitude of payments in each specialty, as captured by the distribution of payments per physician-year (among physicians receiving any payment in that year) as a box-whisker plot in log scale.

Some specialists, such as cardiologists, urologists, obstetrician-gynecologists, and ophthalmologists, received significant payments from both vendor types. However, the figures highlight several differences in the patterns of drug and device payments. As shown in exhibit 2, physicians in surgical specialties had the highest payment rates from device vendors.[44] For example, approximately 75 percent of neurosurgeons and orthopedic surgeons received payments from device vendors, whereas payment rates varied from 4 percent to 41 percent for the twelve nonsurgical specialties at the bottom of the figure, beginning with pulmonology. Among physicians receiving device payments, the magnitude of payments was also largest among surgical specialties. As shown in exhibit 3, median annual payments from device vendors to neurosurgeons and orthopedic surgeons were $454 and $410, respectively, whereas median annual payment magnitudes ranged from $14 to $44 for the nonsurgical specialties at the bottom of the figure, beginning with medical oncology.

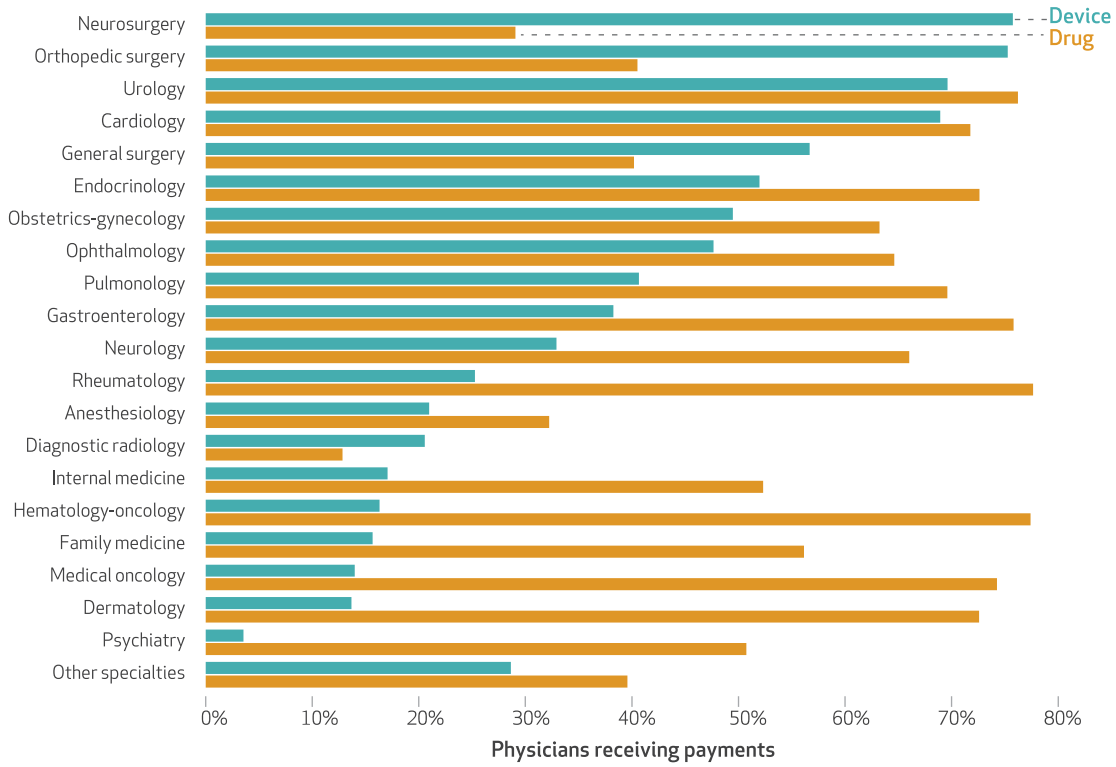
In contrast, the specialties receiving the highest payment rates from drug firms (exhibit 2) were the nonsurgical specialties of rheumatology (78 percent), hematology-oncology (77 percent), and gastroenterology (76 percent), whereas only 29 percent of neurosurgeons and 41 percent of orthopedic surgeons received payments from drug vendors. Among physicians receiving payments, the highest median drug payments were also concentrated among nonsurgical specialties, including medical oncology ($846), endocrinology ($624), and rheumatology ($707), whereas the median annual drug payments to neurosurgeons and orthopedic surgeons were only $31 and $35, respectively.

Exhibit 4, which plots payments versus physicians' annual Medicare Part B billing, makes the pattern of device firms targeting surgical specialists and drug firms targeting nonsurgical specialists even clearer. Within surgical specialists, the average payments from device firms were higher than those from drug firms for every decile of physician billing. Conversely, within nonsurgical specialists, the average payments from drug firms were higher than those from device firms for every decile of physician billing. Wilcoxon signed-rank tests, pairing device and drug payments at the physician-year level within each decile of the Medicare billing distribution, confirmed that the differences between the distributions of annual drug and device payments were statistically significant within both surgical and nonsurgical specialties, with p values for each of the twenty tests below 0.01.

Exhibit 4 illustrates that even within special-

EXHIBIT 2

Average share of active physicians receiving payments from device and drug manufacturers, by specialty and vendor type, 2014–17



SOURCE Authors' analysis of Open Payments data and Centers for Medicare and Medicaid Services Part B utilization data for 2014–17.
NOTES Average share of active physicians who received payment from a vendor in a year, by physician specialty and vendor type, averaged over 2014–17. The top twenty specialties in terms of total value of industry payments to physicians in 2014–17 are shown in descending order of device payment rate, followed by all other specialties combined.

ties, drug and device vendors exhibited different patterns in how they targeted physicians for payment. Within both surgical and nonsurgical specialties, physicians with higher Medicare billing received more payments from drug firms than did physicians with lower Medicare billing. For example, moving from the third decile (20–30 percentile range) of the overall Medicare billing distribution to the eighth decile (70–80 percentile range) was associated with an increase in drug vendor payments of $78 per year for surgical specialties and $596 per year for nonsurgical specialties. We document a very different pattern for device vendors: The relationship between billing and payments was fairly flat for physicians in nonsurgical specialties, but it was quite steep in surgical specialties. Among surgeons, moving from the third decile of the overall Medicare billing distribution to the eighth decile was associated with an increase in device vendor payments of $5,497 per year.

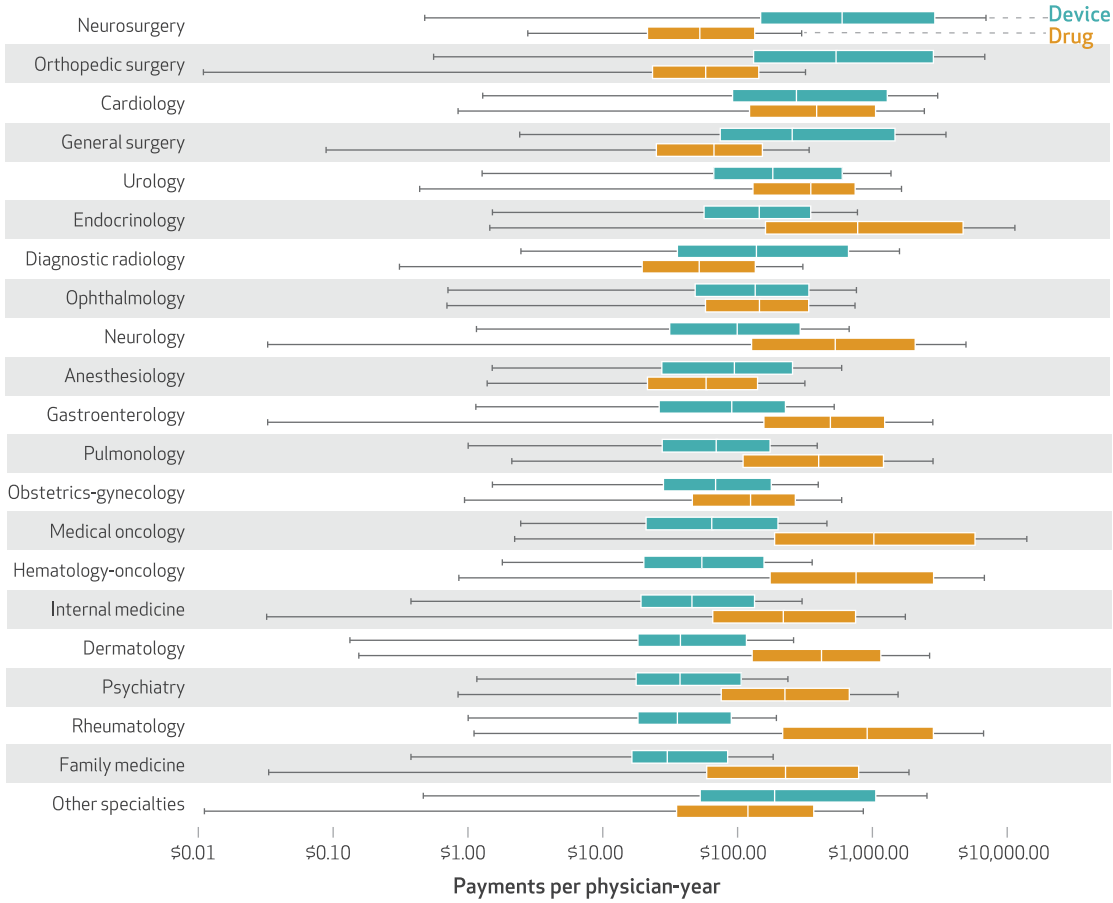
Finally, having characterized how physicians were targeted for payments from device firms, we discuss which firms were making those payments. Exhibit 5 lists the top ten firms making device-related payments. These ten firms (and their subsidiaries) accounted for 65 percent of device-related general payments to physicians over the course of 2014–17.

These top-paying firms held dominant positions in medical device markets. The middle panel of exhibit 5 displays the percentage of FDA-approved medical devices accounted for by each of the top ten firms for the set of medical device specialty panels that dominated medical device spending: cardiovascular, neurology, orthopedics, and general and plastic surgery ("surgery").[45,46] Across all specialties, the ten top-paying firms in exhibit 5 accounted for 17.6 percent of FDA-approved devices.[47] However, within the specialties that drive hospital spending on medical devices, these firms were even more dominant, accounting for 20 percent of cardiovascular devices, 19 percent of neurology devices, 34 percent of orthopedics devices, and 13 percent of surgery devices.

The above averages pool many high- and low-cost products together. The right-hand panel of

EXHIBIT 3

Yearly value of device and drug manufacturers' payments to physicians, by specialty and vendor type, 2014–17



SOURCE Authors' analysis of Open Payments data and Centers for Medicare and Medicaid Services Part B utilization data for 2014–17.
NOTES Box plot of total dollar amount (inflation adjusted to 2020) of annual payments received by active physicians (logarithmic scale), by physician specialty and vendor type, among physicians who received payments in a year. The end points of the bars are twenty-fifth and seventy-fifth percentiles, and the white lines are the medians. The whiskers are the lower and upper "inner fences" of the distribution: the twenty-fifth percentile minus 1.5 times the interquartile range, and the seventy-fifth percentile plus 1.5 times the interquartile range. The top twenty specialties in terms of total value of industry payments to physicians in 2014–17 are shown in descending order of median annual device payment value, followed by all other specialties combined.

exhibit 5 focuses on the highest-spending product categories in each specialty, and the dominance of these top-paying firms becomes even more striking. These firms accounted for 92 percent of drug-eluting coronary stents (cardiovascular), 87 percent of implantable spinal cord stimulators (neurology), 44 percent of implantable spinal fixation devices (orthopedics), and 70 percent of surgical staplers (surgery). Moreover, the top firms had differing portfolios across specialties, with the vast majority of stent, spinal stimulator, and stapler sales each being concentrated among only three firms.

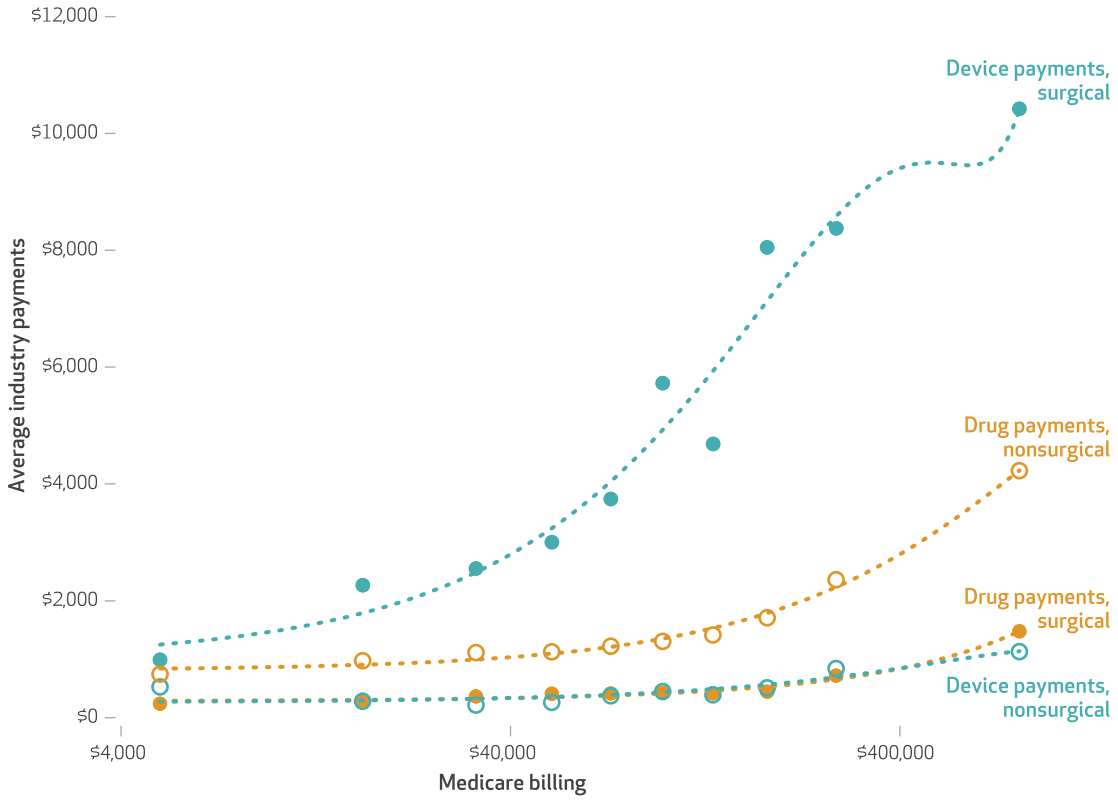
Discussion

Device vendors paid physicians $3.62 billion over the course of 2014–17. This amounted to 1.7 percent of device industry revenue—more than seven times the percentage of drug industry revenue spent on payments to physicians. This difference was driven in part by large differences in payments related to training (for example, education) and innovation (for example, royalties). Device firms also paid larger amounts to fewer physicians. Even though magnitudes of payments tend to be small relative to physician salaries, larger payments may indicate a higher frequency or intensity of interactions with industry. In spite of the potential financial and health consequences of these relationships, we still know relatively little about them.

Research on these relationships will have to grapple with the challenge of obtaining causal estimates of the effects of payments on device use and with the complex question of how such ef-

EXHIBIT 4

Device and drug manufacturers' payments to physicians and physicians' Medicare billing amounts, 2014–17



SOURCE Authors' analysis of Open Payments data and Centers for Medicare and Medicaid Services Part B utilization data for 2014–17.
NOTES Binned scatterplot of the average total annual value of payments physicians received from industry, by physician surgical versus nonsurgical specialty and vendor type, and physicians' annual Medicare billing (logarithmic scale). Physician-years are binned into deciles of annual Medicare billing. Physician-years without payments from industry are included in the averages. A physician's annual Medicare billing is defined as the annual sum of the total allowed amount the physician received for Medicare Part B services. All amounts are inflation adjusted to 2020. Cubic trendline shown for each data series.

fects affect patient welfare. The latter question is challenging in the pharmaceutical market as well,[13] but the device market presents additional difficulties because of the role of device representatives in training, the role of physicians in innovation, and the scarcity of data on product safety and efficacy[48] and provider-level prices and utilization.

Innovation seems particularly important to explore, as unlike the case with drug development, device vendors may solicit input from practitioners on development, and physicians may approach vendors with ideas for devices.[49,50] Also, although all novel drugs undergo several phases of animal and human trials before FDA approval, the vast majority of new medical devices either are exempt from review or undergo a review process without clinical trials.[51] Taken together, these factors may explain why physicians are often involved in the development of medical devices and why royalty, licensing, and investment fees are significantly higher for medical devices than for drugs. Both new product development and product recalls in the device industry have increased in recent years, underscoring the need to understand these mechanisms.[52]

Publicly available data yield only indirect insights into the correlation between payments and utilization. Payments from device vendors were concentrated in surgical specialties, while payments from drug vendors were concentrated in nonsurgical specialties. This is not entirely surprising, as firms likely target both training and promotion to specialists with appropriate patient populations for their products.

Moreover, there is a stronger pattern of device firms paying physicians with high Medicare billing. Surgical specialists in the top decile of the Medicare billing distribution received, on average, $10,420 in payments from device vendors annually—7 times what surgical specialists in the top decile received from drug vendors and 2.5 times what nonsurgical specialists in the top decile received from drug vendors. The relatively

EXHIBIT 5

Top-paying device vendors' share of Food and Drug Administration (FDA)-approved products, by physician specialty panel, 2014–17

Vendor	Device payments ($ millions)[a]	Share of all FDA products[b] (%)				Share of top FDA product code[c] (%)			
		Cardio.	Neurol.	Ortho.	Surg.	Cardio.	Neurol.	Ortho.	Surg.
Medtronic	577.02	12.84	8.72	3.40	2.47	23.94	32.75	12.37	42.75
Johnson & Johnson	383.89	0.71	3.70	5.54	4.64	0.00	0.00	5.33	23.21
Zimmer Biomet	285.21	0.22	1.27	9.99	2.79	0.00	0.00	9.07	0.00
Stryker	263.09	0.92	3.14	6.19	0.85	0.00	0.00	6.68	0.00
Abbott Laboratories	217.47	2.07	0.47	0.00	0.01	28.62	18.45	0.00	0.00
Arthrex	182.99	0.00	0.06	1.07	0.68	0.00	0.00	0.00	0.00
Smith & Nephew	128.12	0.00	0.10	4.30	0.93	0.00	0.00	0.00	0.00
Boston Scientific	117.88	3.65	0.90	0.00	0.08	39.15	36.27	0.00	0.00
Intuitive Surgical Operations	108.18	0.00	0.00	0.00	0.11	0.00	0.00	0.00	4.12
Nuvasive	103.66	0.00	0.24	3.95	0.01	0.00	0.00	10.55	0.00
Total	2,367.51	20.40	18.61	34.45	12.57	91.72	87.46	44.01	70.08

SOURCE Authors' analysis of the FDA's AccessGUDID, Open Payments data for 2014–17, and Centers for Medicare and Medicaid Services Part B utilization data for 2014–17. **NOTES** Cardio. is cardiovascular. Neurol. is neurology. Ortho. is orthopedics. Surg. is general and plastic surgery. [a]Total device-related physician payments in 2014–17, in millions of dollars. [b]Share of approved devices (identified by product device identifier) of all products by FDA device classification specialty panel. [c]Share of approved devices (identified by product device identifier) of the top-selling product code by FDA device classification specialty panel.

steep relationship between device payments and billing suggests that device firms have greater potential scope than drug firms to influence spending on relevant patient populations.

Our results suggest that the relationships between device firms and physicians are quite different from—and, if anything, more intensive than—the relationships between drug firms and physicians. Policy makers tempted to extrapolate from the more developed literature on drug payments to the device industry should exercise caution. For example, the service and expertise functions of many surgical device sales representatives could be difficult to restrict in ways that pharmaceutical representative meetings are not.

In addition to their potential impacts on device usage and spending, payments also represent a substantial cost of doing business for device firms. Economists have documented how such costs can create endogenous barriers to entry and thus diminish competition—and all that implies for prices, quality, and innovation.[11] Indeed, we document that both payments and device sales were dominated by a small number of firms in 2014–17. Ten device vendors accounted for approximately two-thirds of device-related payments, and those same vendors held large shares of the approved devices in the markets for cardiovascular, neurological, orthopedic, and surgical medical devices. Those firms were particularly dominant in the highest-spending product categories. If, in addition, the ten top-paying firms' shares of total sales exceeded their shares of approved product counts, then those firms' market dominance would be even greater than our results imply.

The market dominance of the top-paying firms may reflect fundamental realities of the industry, such as a genuine need for collaboration between physicians and industry or scale economies in device development, production, and distribution. It may also reflect a pattern in which device market concentration is reinforced by payments to physicians. Future research that distinguishes these potential underlying mechanisms would have important implications for health and antitrust policy.

The primary obstacle holding back research on all of these issues is the fact that data on physicians' use of medical devices are scarcer and less detailed than data on pharmaceutical prescribing. A promising policy remedy would be to include the FDA's unique medical device identifiers in health care claims data.[53] This policy would allow researchers to link physician-level usage of specific firms' branded devices to the same firms' physician-level payments promoting those devices, just as the inclusion of unique National Drug Codes in prescription drug claims data has allowed this linkage in the pharmaceutical market. Such a linkage is a critical input needed to answer the many questions about the relationship between the medical device industry and physicians that are laid out in this article.[54]

Conclusion

Device firms provide higher payments to physicians than drug firms in both absolute and relative terms. These payments are more likely to relate to product development and training than

payments from drug firms, and they are highly targeted to high-billing physicians in surgical specialties. Payments are also concentrated among a set of large firms that dominate high-spending medical device categories. Our results present new evidence that device firms' relationships with physicians differ from drug firms' relationships in important ways, suggesting the need for research into the implications of those relationships for consumer welfare. ■

Alon Bergman received support from Agency for Healthcare Research and Quality T32 Grant No. 5T32HS26116, and is a National Research Service Award Postdoctoral Fellow. Matthew Grennan and Ashley Swanson received grants from the National Institute for Health Care Management and the Leonard Davis Institute at the University of Pennsylvania. Matthew Grennan has worked with Analysis Group on consulting cases unrelated to the current topic. All mistakes are the responsibility of the authors. The contents are solely the responsibility of the authors and do not necessarily represent the views of the Agency for Healthcare Research and Quality.

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42 For example, these payments include royalty payments for products using a physician's intellectual property, as well as transfers related to the purchase of companies with physician ownership.

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45 The FDA organizes medical devices into sixteen medical specialty "panels" such as Cardiovascular devices or Ear, Nose, and Throat devices.

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