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The Sun Is Still Shining: Nature of Industry Payments to Transplant Surgeons From 2014 to 2019

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Background. Established in 2013, the Open Payments Program (OPP) mandated that medical device and pharmaceutical manufacturers submit record of any financial incentive given to physicians to the Centers for Medicare and Medicaid Services, which is in turn made publicly available. This study aims to characterize these payments to transplant surgeons over the first 6 y of OPP data. **Methods.** The study sample included all physicians who received at least one nonresearch payment as transplant surgeons to the OPP. To capture transplant surgeons who may be listed under their pipeline specialty, the American Society of Transplant Surgeons member directory as of January 2021 was queried. Payments were analyzed temporally, geographically, and by payment type, physician, and industry payer. **Results.** In total, payments totaling $15 661 536 were made to 1335 transplant surgeons over the study period. The mean payment was $436.90 (SD, $1760), and the median payment was $52.94 (interquartile range, $18.29–$159.80). The top contributing companies were Intuitive Surgical, Inc.; Gilead Sciences, Inc.; and Novartis Pharmaceuticals. Only 5.3% ($827 236) was paid toward faculty or as a speaker for a nonaccredited and noncertified continuing education program and honorarium. Educational payments came in at $1 233 141 (7.9%) over the study period. $13 750 828.60 (87.8%) of the payments were for other categories (consulting fees, food and beverages, etc). Organ transplant and procurement region 7 and 8 transplant surgeons received the highest median payments during the study period. **Conclusions.** This study is the first to characterize the payments made to transplant surgeons since the passage of the Sunshine Act. Further studies are needed to understand and interpret the relationship between industry and transplant surgeons, as the payments may or may not translate to influence in medical decisions or use of medical devices.

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INTRODUCTION

Industry payments to physicians are of broad and current interest in the US healthcare community. They include monetary payments (eg, paid guest speakers) or items of value (eg, physician lunches) that medical device and pharmaceutical manufacturers give to physicians, physician groups, and hospitals.[1] Because of the nature of these payments, there is ethical concern regarding their influence, especially their potential to incentivize practices such as physician kickbacks and overprescribing.[2] Despite these concerns, industry-physician relationships are commonplace in today's US healthcare system, with 94% of physicians reporting some form of financial incentive from an industry counterpart.[3]

To bring transparency to physician-industry relationships, the Centers for Medicare and Medicaid Services (CMS) implemented the Open Payments Program (OPP) in 2014. As a part of this program, which was spearheaded under the Physician Payments Sunshine Act (Section 2006 of the Affordable Care Act), medical device and pharmaceutical manufacturers are now required to submit record of any financial incentive given to physicians, physician groups, and hospitals to CMS.[4] These data are in turn made available to the public by CMS.

Since the inception of the program, studies in many medical specialties and subspecialties have been conducted to quantify and qualify physician-industry relationships.[5-8] Because of the substantial pharmaceutical demands of transplant patients and evolving nature of medical devices and drug utilization by surgeons preoperatively, intraoperatively, and postoperatively,

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industry involvement in transplantation is apparent. As of 2017, the US transplantation market size was estimated at $3.6 billion US Dollar and is expected to continually increase over the next decade.[9] Relationships between transplant surgeons and industry have been briefly examined in a previous study, which characterized the first 5 mo of data after the establishment of OPP in 2014.[10] Ahmed et al found that physicians receiving consulting fees had higher h indices, a measure of research impact, that liver transplant centers receiving >$1000 annually had higher patient volumes, and that kidney transplant centers receiving >$1000 annually treated more patients who utilized private insurance or self-pay and clearly stated that supplementary longitudinal investigation of OPP was necessary to further understand the link between industry and transplant surgeons. This study aims to expand upon these findings by characterizing trends in industry payments made to transplant surgeons over the past 6 y of OPP data.

MATERIALS AND METHODS

The study sample included all physicians who received at least one nonresearch payment as transplant surgeons to the OPP. Additionally, in order to capture transplant surgeons who may be listed under their pipeline specialty, the American Society of Transplant Surgeons member directory as of January 2021 was queried. All members were searched in the OPP database, and payments from member physicians categorized under Urology, Surgery, Pediatric Urology, and Pediatric Surgery were included. Physicians identified as residents in the American Society of Transplant Surgeons member directory were excluded from analysis. This study was exempt from institutional review board approval because it is an analysis of publicly available data. All analyses were conducted using Tableau Software and Stata Statistical Software, version 14.2.

Data Sources

Data from 2014 to 2019 were obtained from the publicly available OPP database available on the CMS website (http://www.cms.gov/openpayments). Physician payment data were aggregated within and across study years using the unique CMS physician identifier. Data on transplant volume by the Organ Procurement and Transplant Network (OPTN) region for intestine, kidney, liver, pancreas, and dual kidney and pancreas transplantation were also extracted from the OPTN website.

Summary statistics were used to characterize and compare payments made to all transplant surgeons across and within study years, and study years were compared using analysis of variance testing. As some payment entries in the CMS database included multiple number of payments, summary statistics for in total and for each study year were calculated using the number of entries in the CMS database as the number of payments rather than the number of payments included in total amount variable, as this encompassed consulting fees and other recurring payments in one unique entry. Summary statistics detailing the number of entries for each payment category is reported in the Nature of Payments section. To account for inflation, all dollar amounts were adjusted to 2019 US Dollar using yearly consumer price indices.

Nature of Payments

The OPP variable Nature of Payment or Transfer of Value was used in order to characterize and compare the distribution of payments within and across study years. Payment types included compensation for services other than consulting, including serving as faculty or as a speaker at a venue other than a continuing education program; compensation for serving as faculty or as a speaker for an accredited or certified continuing education program; compensation for serving as faculty or as a speaker for a nonaccredited and noncertified continuing education program; consulting; current or prospective ownership or investment interest; education; entertainment; food and beverage; gift; grant; honoraria; royalty or license; and travel and lodging. The total amount of payments in each category across each study year and in total was quantified.

Geographic Distribution

To analyze the geographic distribution of payments, individual payments were aggregated at the state level using the Recipient State variable from the OPP and the results visualized using a heat map. Payments were further sorted into 11 OPTN regions, visualized via heat map, and compared across regions. Payments were analyzed across all study years and within each study year. Payments by OPTN regions were further analyzed by transplant volume. Transplant volume caseloads including intestine, kidney, liver, pancreas, and dual kidney and pancreas transplantation for each of the 11 OPTN regions were obtained, and total payment per transplant was calculated. Number of transplant surgeons receiving payment per region and average payment per transplant surgeon for each region were also calculated.

Top Payers and Earners

To identify and characterize the major contributors in nonresearch payments to transplant surgeons, the top 30 industry payers to transplant surgeons by total amount were also identified. The total amount in payments for each of the top 30 industry payers was then summarized and visualized by payment category.

To characterize the potential earnings of transplant surgeons from industry payments, the top 50 transplant surgeons by total payment amount across the study period were identified by their unique CMS identifier and their earnings summarized. The identifiers associated with these transplant surgeons were then removed for privacy reasons. Total amount of payments for each of the top 50 surgeons were then further broken down into payment category and visualized.

RESULTS

In total, payments totaling $15 661 536 were made to 1335 transplant surgeons over the study period. The mean payment was $436.90 (SD, $1760), and the median payment was $52.94 (interquartile range [IQR], $18.29–$159.80). The highest payment made to a transplant surgeon over the study period was $101 846.00. Total amount of payments did not demonstrate a discernible trend over the study period. The highest total amount of payments was made in 2015, at $3 137 981, whereas the lowest payment year was 2017 at $2 306 299. Mean payments ranged from $401.33 (SD, $1576.70) in 2016 to $496.05 (SD, $1970.10) in 2015. Analysis of variance between years demonstrated a significant difference in mean total amount of payments across study years ($P < 0.001$).

Nature of Payments

Of the $15 661 536 in total payments, compensation for services other than consulting, including serving as faculty or

as a speaker at a venue other than a continuing education program, comprised the largest amount in total payment over the study period, at $4 907 236 (31.3%), followed by consulting fees at $4 102 693 (26.2%), travel and lodging at $3 181 480 (20.3%), food and beverage at $1 317 375 (8.4%), education at $1 233 141 (7.9%), compensation for serving as faculty or as a speaker for a nonaccredited and noncertified continuing education program at $425 432 (2.7%), and honoraria at $401 804 (2.6%), with all other categories comprising the remaining $85 712 (0.6%). When analyzed over the study period, payments from the top 3 categories comprised the top 3 total amounts for all study years (Figure 1).

Current or prospective ownership or investment interest had the largest median payment at $3038 (IQR, $2661–$3038; n = 24) paid to 1 transplant surgeon, followed by compensation for services other than consulting, including serving as faculty or as a speaker at a venue other than a continuing education program, with a median of $2700 (IQR, $2106–$3728; n = 1653) paid to 145 transplant surgeons, compensation for serving as faculty or as a speaker for a nonaccredited and noncertified continuing education program with a median of $2697 (IQR, $2697–$2800; n = 141) to 28 transplant surgeons, compensation for serving as faculty or as a speaker for an accredited or certified continuing education program with a median of $2429 (n = 1) to 1 transplant surgeon, and consulting fee with a median of $2268 (IQR, $675–$4172; n = 1115) to 240 transplant surgeons. Notably, food and beverage comprised the highest number of payments (n = 24 193) with a median of $25 (IQR, $15–$90) made to 1257 transplant surgeons. Further details of payment breakdown can be found in Table 1.

Geographic Distribution

Geographic distribution of median payments by state across study years is presented in Figure 2.

Transplant surgeons from Maryland received the highest median payment at $175.70, followed by Minnesota, Missouri, Arizona, and Illinois in the top 5 highest. Payments by OPTN region are shown in Figure 3 and Table 2. When analyzed by OPTN region, transplant surgeons in region 7 followed by region 8 received the highest median payments. Notably, region 5 had the highest transplant volume over the study period, followed by regions 3, 2, 4, and 11 (Table 2). When payments were analyzed by transplant volume, region 9 demonstrated the highest total payment amount per transplant at $183, followed by region 8 at $130 and region 5 at $111. Region 1 had the lowest total payment amount per transplant at $33 (Table 2).

Top Payers and Earners

The total amount of payments categorized by nature of payments made by the top 30 industry payers is shown in Figure 4. The industry payer with the largest total amount paid over the study period was Intuitive Surgical, Inc., at

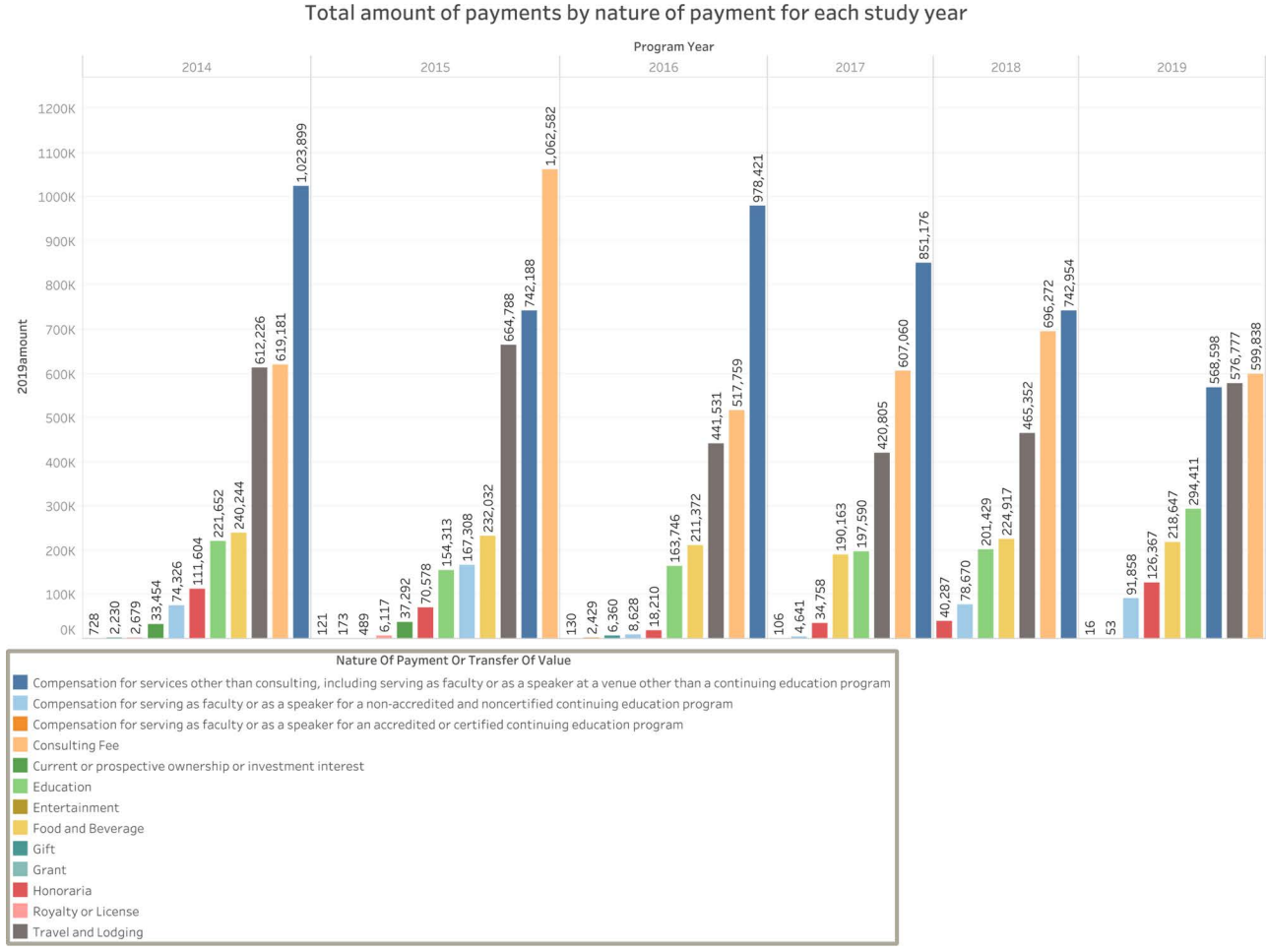

FIGURE 1. Breakdown of total payments by nature of payment for each year of the study period in 2019 USD. USD, United States Dollar.

TABLE 1.

Breakdown of payment categories by number of payments, median payment, number of transplant surgeons receiving payment, and mean payment per surgeon in 2019 USD

Nature of payment	Total amount, $	No. of Payments	Median Payment, $ (IQR)	No. of transplant surgeons receiving payment, %	Mean payment per surgeon, $
Current or prospective ownership or investment interest	70 747	24	3038 (2661–3038)	1	70 747.00
Compensation for services other than consulting, including serving as faculty or as a speaker at a venue other than a continuing education program	4 907 236	1653	2700 (2106–3728)	145	33 843.01
Compensation for serving as faculty or as a speaker for a nonaccredited and noncertified continuing education program	425 432	141	2697 (2697–2800)	28	15 194.00
Compensation for serving as faculty or as a speaker for an accredited or certified continuing education program	2429	1	2429 (2429–2429)	1	2429.00
Consulting fee	4 102 693	1115	2268 (675–4172)	240	17 094.55
Honoraria	401 804	162	2159 (972–3510)	69	5823.25
Royalty or license	8796	9	765 (661–1393)	2	4398.00
Grant	489	2	244 (232–257)	2	244.50
Travel and lodging	3 181 480	7493	228 (66–489)	538	5913.53
Education	1 233 141	1225	97 (18–1080)	426	2894.70
Entertainment	1100	17	52 (13–102)	12	91.67
Gift	8817	21	46 (11–336)	14	629.79
Food and beverage	1 317 375	23 983	25 (15–90)	1257	1048.03

IQR, interquartile range; USD, United States Dollar.

$1 901 546, followed by Gilead Sciences, Inc., at $1 188 143 and Novartis Pharmaceuticals at $1 091 238. The top 30 payers contributed approximately 80% of the total payments received over the study period.

The top 50 highest earning transplant surgeons in total amount of industry payments over the study period are shown in Figure 5. The highest earning transplant surgeon earned $861 647 over the study period, with the largest share received for education, at $462 811. The second through sixth highest earners all received over $500 000 in industry payments during the study period.

DISCUSSION

Since 2014, the Sunshine Act has brought greater transparency to physician-industry relationships across all medical specialties. Ahmed et al provided a brief introduction to transplant physician-industry relationships based on the first 5 mo of data

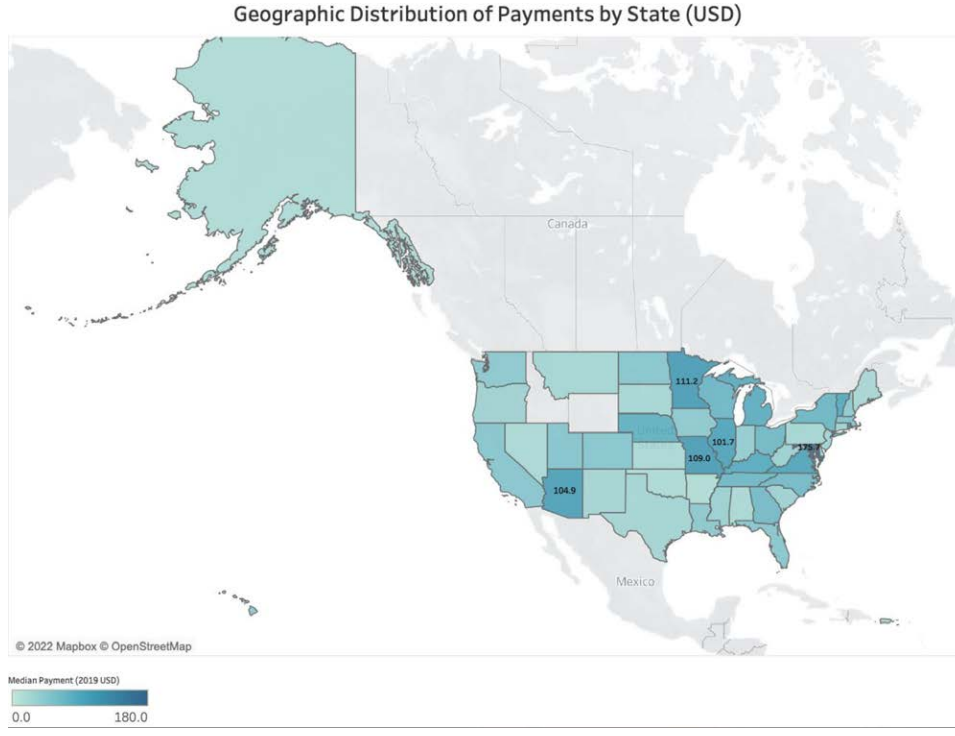

FIGURE 2. Geographic distribution of median payments by state. Map scale ranges from $0 to $180.00 in 2019 USD. USD, United States Dollar.

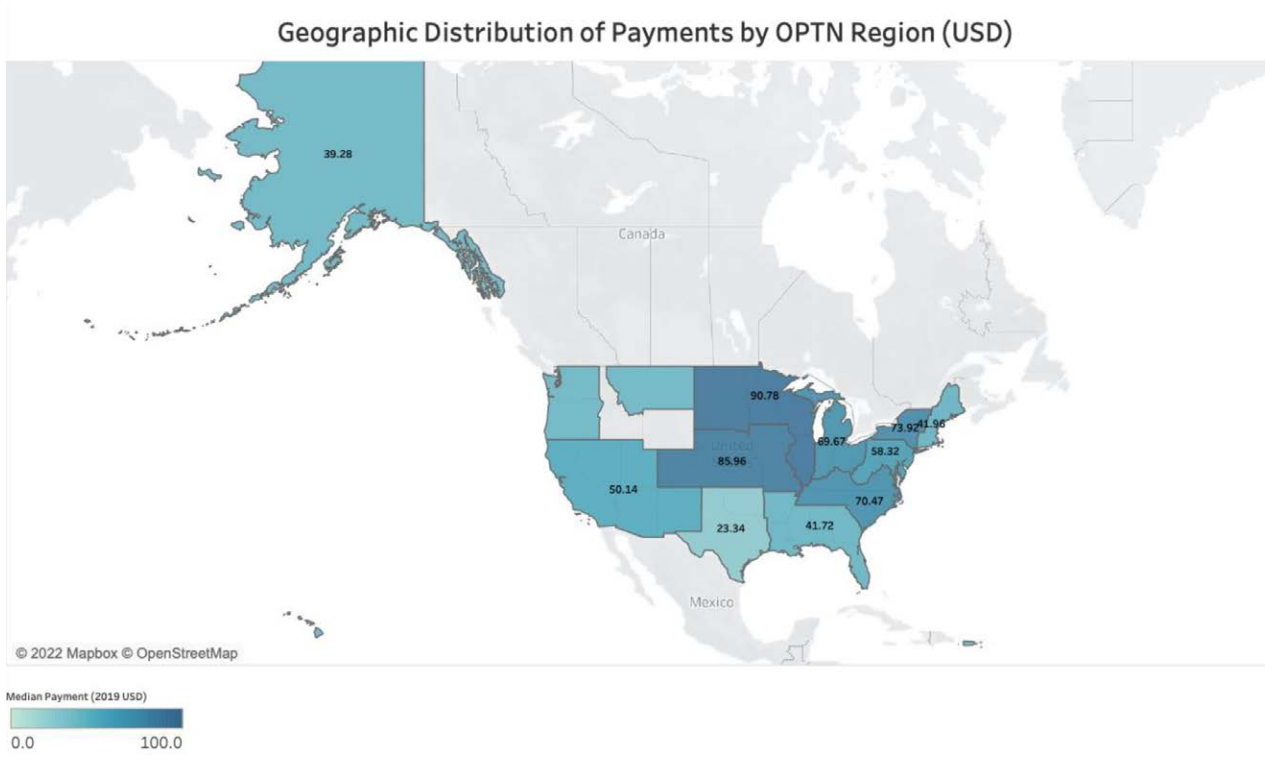

FIGURE 3. Geographic distribution of median payments to transplant surgeons by the Organ Procurement and Transplant Network (OPTN) region. For the purposes of this study, Vermont was included in region 9, and Virginia was included in region 11, as it was not feasible to separate these groups into 2 regions. Map scale is from $0 to $100 and is in 2019 USD. USD, United States Dollar.

after the establishment of the Sunshine Act. This study builds on these findings by being the first to characterize payments made to transplant surgeons longitudinally from 2014 to 2019.

These findings should be considered in the context of some existing literature suggesting that any form of manufacturer compensation, from the largest sum of compensation for services other than consulting, including serving as faculty or as a speaker at a venue other than a continuing education to food and beverage, may be related in some manner to the utilization of said manufacturer's products.[11-13] The challenge behind the physician-industry relationship is elucidating which forms and manners of physician compensation drive positive innovation and discussion and which may be indirectly complicating patient care. Although the Sunshine Act and respective OPP were formed to shed light on these relationships and make compensation publicly available, the causal link between physicians and industry is far from understood. The Sunshine Act allows the public to quantify payments made to physicians since 2013, but without much more information than the payment type and exact dollar amount

TABLE 2.

Total payment by Organ Procurement and Transplant Network region with median payment, transplant volume, payment per transplant, number of transplant surgeons receiving payment per region, and payment per transplant surgeon

Recipient state (group)	States in Region	Total amount of payment, $ (%total)	No. of payments	Median payment, $ (IQR)	Total number of transplants	Average payment per transplant performed, $	No. of transplant surgeons receiving payment	Average payment per transplant surgeon, $
Region 1	CT, ME, MA, NH, RI, Eastern VT	229 779 (1.47%)	916	42 (19–125)	6911	33.25	83	2768.42
Region 2	DE, DC, MD, NJ, PA, WV, Northern VA	2 108 229 (13.46%)	4135	58 (18–196)	21 296	99.00	227	9287.35
Region 3	AL, AK, FL, GA, LA, MS, PR	2 189 540 (13.98%)	5691	42 (17–136)	24 451	89.55	207	10 577.49
Region 4	OK, TX	981 906 (6.27%)	3959	23 (16–113)	16 848	58.28	141	6963.87
Region 5	AZ, CA, NV, NM, UT	3 058 327 (19.53%)	6479	50 (19–157)	27 563	110.96	228	13 413.71
Region 6	AK, HI, ID, MT, OR, WA	206 188 (1.32%)	978	39 (19–118)	5659	36.44	53	3890.34
Region 7	IL, MN, ND, SD, WI	1 234 498 (7.88%)	2394	91 (25–284)	14 818	83.31	154	8016.22
Region 8	CO, IA, KS, MO, NE, WY	1 425 607 (9.1%)	2522	86 (21–264)	11 001	129.59	107	13 323.43
Region 9	NY, Western VT	2 152 415 (13.74%)	3582	74 (20–227)	11 766	182.94	138	15 597.21
Region 10	IN, MI, OH	1 113 508 (7.11%)	2690	70 (19–174)	15 010	74.18	167	6667.71
Region 11	KY, NC, SC, TN, VA	960 204 (6.13%)	2494	70 (18–155)	16 745	57.34	150	6401.36
Other	USVI	1334 (0.01%)	6	75 (69–102)	NA	NA	3	444.67

IQR, interquartile range; NA, not available.

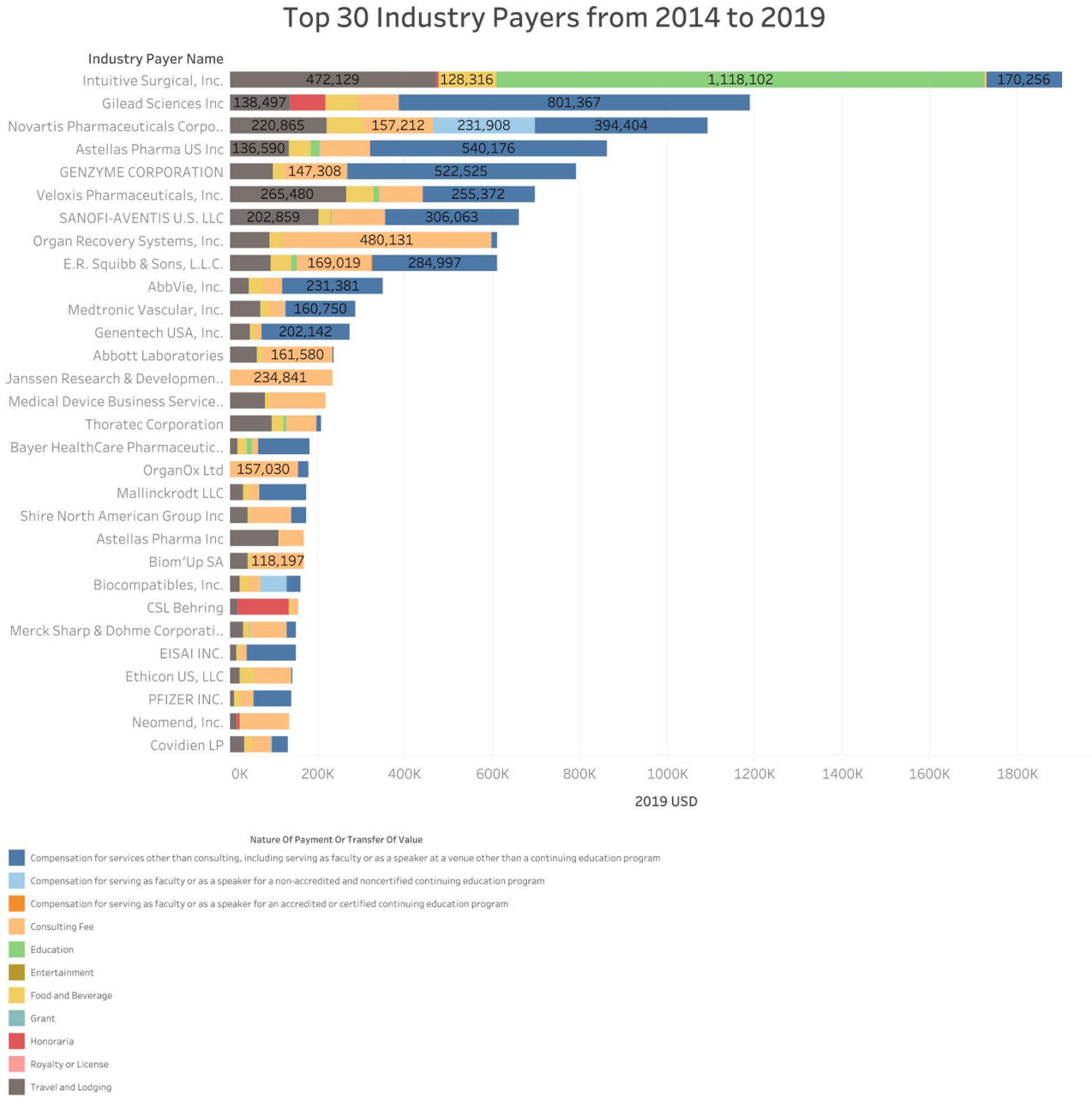

FIGURE 4. Total amount of payments from top 30 industry payers over the study period with breakdown by nature of payment. Companies entered with different international subsidiaries were kept separate for the purpose of this analysis. All reported amounts are in 2019 USD. USD, United States Dollar.

provided by OPP, qualifying and understanding the exact impact of industry-physician relationships is rather difficult. Further research is imperative to understand these complex relationships.

Understanding the results of this study may be helpful to policymakers by providing a more transparent image of industry-transplant surgeon relationships in the United States. Although the OPP program does make all payments public, there is little done by the program to qualify and organize the nature of these payments. This study, and others like it in specialties other than transplant surgery, supplements the data provided by the OPP program and provides a more well-rounded characterization that may be useful in related decision-making. The results should be considered heavily, used in conjunction with other studies, and drive further research into the exact nature of transplant-specific industry-surgeon relationships, but by themselves do not warrant further policies on industry-physician relationships in the United States.

Comparison to Other Subspecialties

A total of $15 661 536 were made to 1335 transplant surgeons over the study period. The mean payment was $436.90 (SD, $1760) and the median payment was $52.94 (IQR, $18.29–$159.80). This median value is slightly larger than the median value for some medical specialties including a median $15 to urologists and $38.11 to orthopedic surgeons but less than other medical specialties such as plastic surgeons with a median of $115.[5,14,15] Utilizing a study examining all physician payments from 2014 to 2018 by Marshall et al, payments to

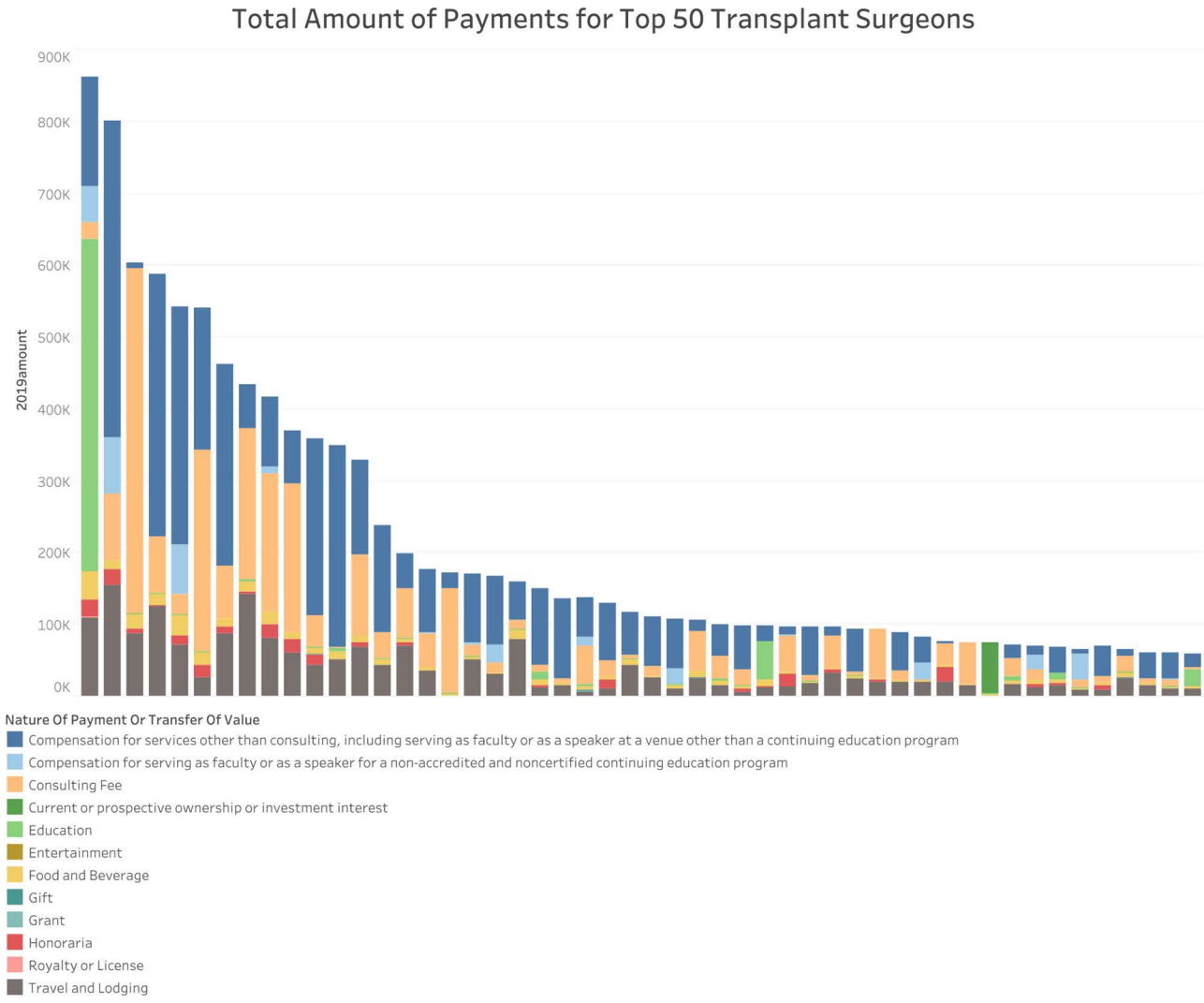

FIGURE 5. Total amount of payments to top 50 transplant surgeons over the study period with breakdown by nature of payments. Physician identifiers were removed for privacy purposes. All amounts are reported in 2019 USD. USD, United States Dollar.

transplant surgeons compute to <0.2% each year of the study and just under 0.4% of the market of payments to all surgeons in each year.[16]

Understanding Payment Types

Transplant surgeons received a wide range of payment types, with most of the payments falling under a few main categories. Compensation for services other than consulting, including serving as faculty or as a speaker at a venue other than a continuing education program, comprised the largest amount in total payment over the study period, at $4 907 236 (31.3%), followed by consulting fees at $4 102 693 (26.2%) and travel and lodging at $3 181 480 (20.3%). These categories remained the top 3 payment categories over the entire study period. Compensation for services other than consulting, including serving as faculty or as a speaker at a venue other than a continuing education, is a broad category that encompasses payments that are made to physicians for speaking, training, or educational purposes that do not count toward continuing education.[17] For example, a pharmaceutical company may compensate a transplant physician to speak, at a conference or private event, on the benefits of using a drug in patient care. Consulting fees are compensation for utilizing the physicians' medical expertise for research and development of a certain drug or device. For example, a company may pay a transplant physician to assist in engineering a medical device to fix a common surgical complication or to design a clinical trial for a new drug. Food and beverage comprised the highest number of payments (n = 24 193) with a median of $25 (IQR, 15–90) made to 257 transplant surgeons, or ≈94% of transplant surgeons.

Top Payers

Both the number of companies making payments to transplant surgeons and the number of transplant surgeons receiving payments are heavily skewed, with a minority of companies making a large sum of payments and a minority of physicians receiving a large sum of payments. Only 15 companies made over $200 000 in payments to physicians. Similarly, only 14 of 1335 transplant physicians received over $200 000 in industry payments. Only 3 companies (Intuitive Surgical, Inc.; Gilead Sciences, Inc.; and Novartis Pharmaceuticals) made over $1 million in payments to physicians. Intuitive Surgical, Inc., which led in total payments with $1 901 546 in industry payments, is the company behind Da Vinci Surgical Systems, the leading robotic

surgical technology allowing surgeons to complete a variety of complex surgical procedures using a minimally invasive approach. Robotic approaches to solid organ transplantation have yielded positive patient outcomes and decreased recovery times, leading to increased utilization across the field.[18,19] Although Intuitive Surgical, Inc., does not release case volumes specific to transplant surgery or other subspecialties, the utilization of the Da Vinci Surgical System has increased in general over the study period, with the use of robotic surgery in all surgical procedures increasing from 1.8% in 2012 to 15.1% in 2015.[20] The vast majority of Intuitive Surgical's payments, over $1 million, were used for education of the company's products, presumably the Da Vinci Surgical System. The impact of advancing this robotic technology within the field and improving outcomes for transplant patients should be considered when characterizing Intuitive Surgical's payments into the industry. Gilead Sciences, Inc.; and Novartis Pharmaceuticals are also instrumental within the field of transplant as each produces several widely used transplantation-related medications. Gilead Sciences, Inc., produces several antivirals (Sovaldi, Veklury, Truvada, etc) useful in treating patients with chronic conditions such as hepatitis B, hepatitis C, and HIV both before and after liver transplant.[12] Novartis Pharmaceuticals, specifically its subsidiary Sandoz, produces several essential drugs for transplantation such as cyclosporine.[21] Many of the companies that reported payments to US transplant physicians under the Sunshine Act like Intuitive Surgical, Inc.; Gilead Sciences, Inc.; and Novartis Pharmaceuticals are foundational, or at the very least supplemental, to the transplant industry as it currently exists.

Geographic Distribution

Transplant physicians in 2 states, New York and California, at $2 058 965 and $2 467 630, respectively, received the largest total amounts of payments over the study period and comprised nearly a third (30.3%) of total payment amount for all states combined. When compiled into regions based on OPTN region, region 5 (AZ, CA, NV, NM, and UT) comprised 19.3% of total payments at 2 889 993, followed by region 3 (AL, AK, FL, GA, LA, MS, and PR), which comprised 14.1% of total payments at $2 107 355, and then region 9 (NY and Western VT), which comprised 13.8% of total payments at $2 060 345. However, when looking at the median payment made by each OPTN region, region 7 (IL, MN, ND, SD, and WI) had the highest median payment of $91 (IQR, 25–284) , followed by region 8 (CO, IA, KS, MO, NE, and WY) at $86 (IQR, 21–264). Regions 9–11 and the US Virgin Islands all had median payments in the range of $70–$75. This suggests that although regions 5 and 3 may have comprised the largest percentage of industry payments in the OPTN, this is likely because of the larger transplant volumes (24 451 and 27 563 transplants, respectively) and the accompanying larger amount of industry payments in these regions.

Study Limitations

The findings of this study should be considered in the context of a few limitations. First and foremost, the Sunshine Act/OPP collects data that is self-reported from medical device and pharmaceutical manufacturers. Of undetermined significance, the accuracy of reporting to the OPP has been consistently called into question since the program's conception, with substantial literature pointing out inaccuracy and underreporting of industry payments.[22-24] It is also important to consider that both physicians and companies can dispute payments made public by the Sunshine Act, so some payments may be withheld because of ongoing disputes. Consideration should also be made for miscategorization bias (ie, miscategorizing a payment type or a physician's specialty type as a transplant surgeon) and for the Hawthorne effect over the study period (ie, a physician recognizes their received payments are publicly available and behaves differently accordingly). Lastly, because of the multispecialty practice of many transplant surgeons, the total amount of payments for transplant-related services may also be overestimated and must be considered when interpreting these results.

CONCLUSIONS

There is a considerable financial relationship between medical device and pharmaceutical manufacturers and transplant surgeons. This study is the first to characterize this relationship over the first 6 y of the Sunshine Act, showing its numerical relationship and delving into the $15 661 536 in industry payments made to 1335 transplant surgeons over the study period. Further studies are needed assessing the impact of industry payments on transplant surgeons' behavior with respect to prescribing or utilization of various medical supplies and devices.

DATA AVAILABILITY STATEMENT

Data from 2014 to 2019 were obtained from the publicly available Open Payments Program database available on the Centers for Medicare and Medicaid Services website (http://www.cms.gov/openpayments).

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