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Changing Trends in Industry Funding for Surgical Oncologists

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ABSTRACT

Background. With reductions in public funding, alternate research funding is essential to surgical oncologists (SOs). We aimed to examine current trends in industry funding of SOs.

Methods. Society of Surgical Oncology surgeons were identified and matched with board certification and years in practice. Departmental and hospital data were evaluated, and industry payments from 2013 to 2017 were matched with the Open Payment Data.

Results. Of the 1670 SOs identified, 922 (55%) had academic positions: 588 (64%) males and 334 (36%) females. Between 2013 and 2017, research payments totaling $46,596,706 were made to 162 SOs (17.5%): $40,774,716 (87%) for research related to drugs and clinical trials, compared with $5,194,199 (11%) for surgical devices ($p = 0.018$). Funding correlated with academic leadership and years in practice ($p = 0.0001$ and $p = 0.0037$). Massachusetts ($9,060,976), Texas ($7,656,228), and New York ($4,210,864) received the most funding, whereas Utah ($1,533,166/SO), Massachusetts ($1,294,425/SO), and Oregon ($1,241,702/SO) received the highest average payments per SO. The majority of funding was from Novartis ($16,045,608), Amgen ($6,810,832), and Merck ($3,758,299), for an oncolytic vaccine (talimogene laherparepvec, $5,939,007), a BRAF inhibitor (dabrafenib, $5,727,309), and a KIT inhibitor (imatinib, $4,323,586). Male SOs received funding more frequently than females (120/588 [20%] vs. 42/334 [12.6%]; $p = 0.0027$). Males also received more general payments (travel/lodging, food/beverage, consulting/speaker fees): $48,830 vs. $11,867 per male and female, respectively ($p = 0.0001$).

Conclusions. The majority of industry research payments to SOs are related to novel pharmaceuticals, which highlights the expanding influence SOs play in systemic therapies. Industry payments are influenced by location, gender, and academic leadership.

From 2003 to 2015, the National Institutes of Health (NIH) budget declined, secondary to spending cuts, sequestration, and inflationary losses.[1] Additionally, NIH funding to surgical departments dropped at a more accelerated pace proportional to the fall of total NIH funding. This and other barriers have been identified that negatively influence the career development of surgeon scientists.[2] Alternate sources of funding have become necessary for the academic advancement and research activities of surgeons, such as professional society grants, private institutional grants, philanthropy, and industry research funding. Surgical oncology is a highly academic discipline with a greater emphasis on outcomes, clinical trials, value-based care, global health, and patient-centered research. This transition away from basic science and translational research is of concern to the scientific community and may have a negative impact on academic advancement.[3,4]

As systemic therapies for cancer become more effective and are increasingly applied in the neoadjuvant setting, surgical oncologists (SOs) are playing a more important role in the multidisciplinary management of the cancer patient. NIH funding contributed directly or indirectly to all 210 new drugs approved by the US FDA between 2010 and 2016, but more than 90% of this funding was directly

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associated with the drug's basic preclinical biomedical research.[5] Randomized controlled trials are paramount for the approval and adoption of newer drugs. However, NIH-funded clinical trials are declining, whereas industry funding has increased (six-times more funded trials than the NIH).[6] Industry-funded clinical trials have become essential for drug development but carry the risk of inherent bias.[7] SOs are therefore becoming more involved with the design and recruitment of clinical trials.

The Centers for Medicare and Medicaid Services Open Payment Data (OPD) is a "national transparency program that collects and publishes information about financial relationships between health care and providers".[8] The data have been reported annually since 2013. The nature of payments include general (i.e. travel and lodging, food and beverage, consulting and speaker fees, and honoraria), research, education, and ownership (i.e. royalties and investment interests). According to the OPD, research payments are "for different types of research activities, including enrolling patients into studies of new drugs or devices. Research payments can include direct compensation to physicians, funding for research study coordination and implementation, or payments to study participants to cover expenses associated with the study".[9]

Utilizing public online data in the OPD, we evaluated industry research payments to academic SOs over a 5-year period (2013–2017). We hypothesized that the majority of research payments originated from major pharmaceutical companies and were related to investigational clinical drugs and trials rather than to surgical devices, and that these payments were influenced by location and academic leadership. We also explored whether gender disparities exist in the financial relationships between industry and academic SOs.

METHODS

Population Selection and Characteristics

Surgeon members of the Society of Surgical Oncology (SSO) were identified in the SSO 'Find a Surgical Oncologist' website and their biographical and geographical data were collected.[10] These data were matched with the American Board of Surgery 'Check a Certification' website in order to establish years in practice since board certification.[11] Next, an extensive online search of each individually identified SO was performed to establish whether the surgeon's primary focus of practice was academic in nature. The search included websites from university-based teaching hospitals, surgery departmental sites, private and community hospitals, private practicing groups, and biographic data from Doximity. We catalogued surgeons into five academic ranks: Assistant Professor, Associate Professor, Professor, Division Chief Professor, and Chair/Chief Executive Officer (CEO) of a health system/Medical School Dean. Finally, NIH funding awarded between 2013 and 2017 was compiled from the Research Portfolio Online Reporting Tools at https://projectreporter.nih.gov/reporter.cfm.

Industry Payment Data

Each academic SO was queried in the OPD and data pertaining to research and general payments between 2013 and 2017 were compiled. These data included year, dollar amount, number and nature of payments, names of companies, and description of the research device or drug. General payments were defined as those "not associated with a research study" and include travel and lodging, food and beverage, consulting and speaker fees, and honoraria. Research payments were defined as those "associated with a research study or funding for a research project or study where the physician is named as a principal investigator".[8]

Statistical Analysis

Frequency variables were compared using the Chi square test, and continuous variables were compared using the Wilcoxon signed-rank score test. Descriptive data were compiled and summarized in graphs and tables. Statistical analysis was performed using SAS software (SAS Institute, Cary, NC, USA) and statistical significance was established as $p < 0.05$.

RESULTS

Population Characteristics

We identified 1670 surgeon members of the SSO. The nature of their practice, gender, and academic characteristics are summarized in Fig. 1a. There were approximately two male SOs for every female SO in both the academic and non-academic settings. Overall, 922 (55%) SOs practiced primarily in the academic setting: 588 were male (64%) and 334 were female (36%). Academic rank was proportionally related to gender: females represented 11, 18, 30, 38, and 53% of Chairs/Presidents/Deans, Division Chief Professors, Professors, Associated Professors, and Assistant Professors, respectively ($p < 0.0001$) (Fig. 1b, c). The median years in practice for all academic SOs were 15 years: 17 years for males and 12 years for females. Academic and geographic characteristics are summarized in electronic supplementary Table S1 and electronic supplementary Fig. S1. New York (128), California (93),

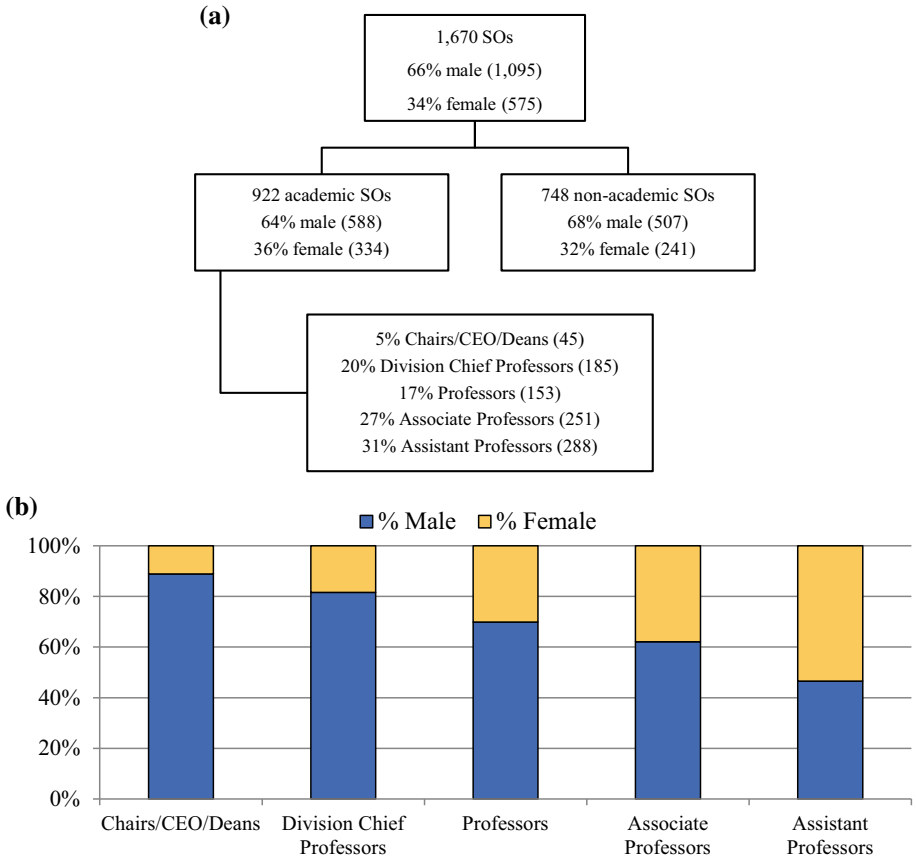

FIG. 1 (**a**) US Society of Surgical Oncology surgical oncologists' nature of practice, gender, and academic rank characteristics. (**b, c**) Gender proportions between surgical oncologists' academic ranks. *SOs* surgical oncologists, *CEO* Chief Executive Officer

(c)

Surgical Oncologists: Academic Rank and Gender

	Males (n=588)	Females (n=334)	*P* value
Academic rank			<0.00001
Chairs/CEO/Deans	40 (89%)	5 (11%)	
Division Chief Professors	151 (82%)	34 (18%)	
Professors	107 (70%)	46 (30%)	
Associate Professors	156 (62%)	95 (38%)	
Assistant Professors	134 (47%)	154 (53%)	

Texas (85), Pennsylvania (60), and Massachusetts (47) were the states with the most academic SOs. Vermont (3/3; 100%), Nebraska (11/12; 92%), Iowa (9/11; 82%), Massachusetts (47/58; 81%), and Kansas (7/9; 78%) were the states with the highest proportion of academic SOs.

Industry Research Payments

Between 2013 and 2017, the industry reported $46,596,706 in research payments to 162 academic SOs (162/922; 17.6%). 1641 payments totaling $40,774,716 were related to drugs and clinical trials, compared with 310 payments totaling $5,194,399 related to surgical devices (87% vs. 11%; $p = 0.018$). Ten payments totaling $627,591 lacked adequate detail and were excluded from the analysis. Drug payments were significantly higher than device payments in all 5 years of data reporting ($p < 0.0181$) (Fig. 2a). Funding correlated with academic rank ($p = 0.0001$) and years in practice ($p = 0.0037$): Division Chief Professors with years in practice between 10 and 19 received the highest payments (Table 1).

Geography of Industry Research Payments

Massachusetts, Texas, New York, California, and Pennsylvania received the most research payments, representing 61% of all industry research funding (Table 2 and Fig. 2b). Massachusetts, Texas, Pennsylvania, California, and Utah were the top recipients of drug research payments (65% of all drug payments). New York, Kentucky, North Carolina, California, and Texas received 87% of device research payments. Academic SOs in Mississippi (1/2;

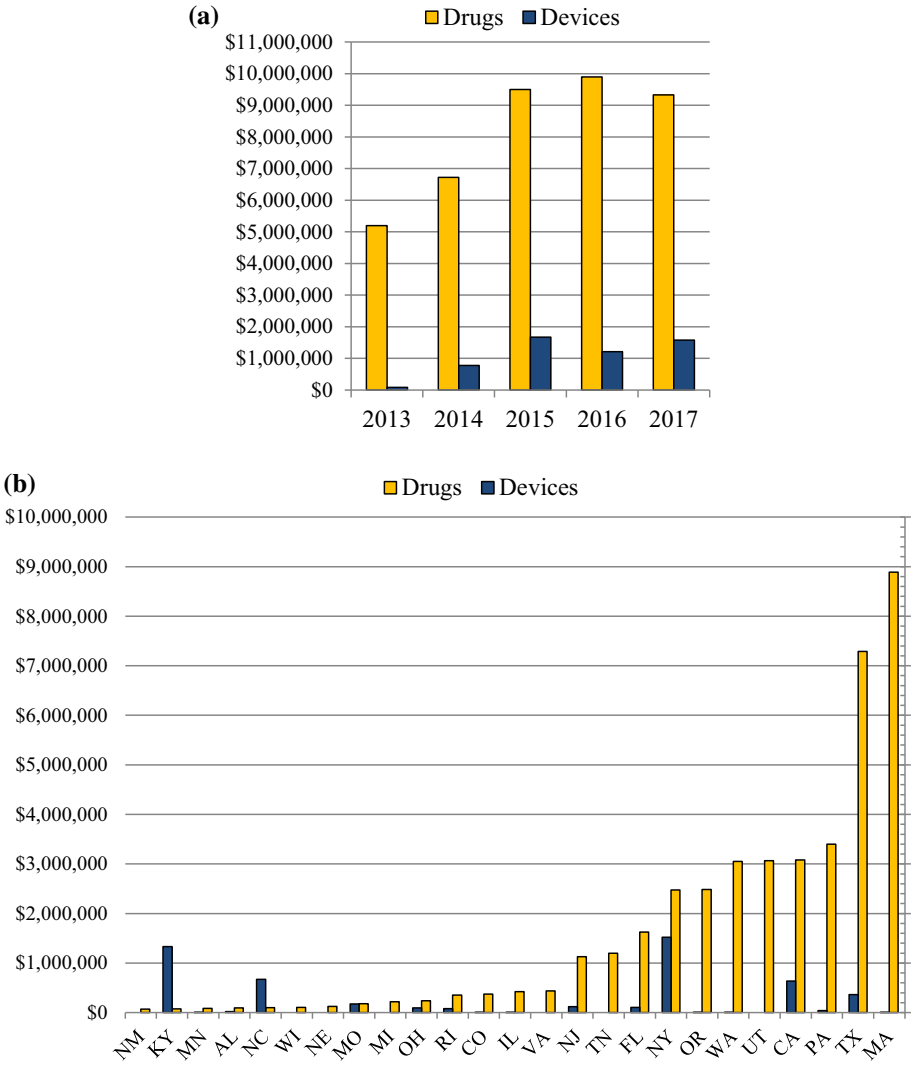

FIG. 2 (**a**) Drugs and devices industry research payments over 5 years made to academic surgical oncologists. (**b**) Total drugs and devices research payments by US states from 2013 to 2017

50%), Washington (4/9; 44%), Florida (17/46; 37%), Colorado (2/7; 29%), and Utah (2/7; 29%) were the more frequently paid, whereas academic SOs in Maryland (1/26; 4%), Michigan (1/17; 6%), Connecticut (1/13; 8%), Nebraska (1/11; 9%), and Iowa (1/9; 11%) were the least frequently paid (Table 2). Finally, Utah ($1,533,166/SO), Massachusetts ($1,294,425/SO), and Oregon ($1,241,702/SO) received the highest average payments per individual SO.

Companies Making Research Payments

We identified 58 companies making research payments to 162 SOs for 120 different drugs and devices (electronic supplementary Tables S2 and S3). The top companies were Novartis ($16,045,608), Amgen ($6,810,832), Merck ($3,758,299), Glaxo Smith Kline ($2,552,314), and Jansen Pharmaceutical ($1,999,700) (Fig. 3a). The most funded drugs were for the oncolytic vaccine talimogene laherparepvec (Imlygec, Amgen; $5,939,007), the BRAF inhibitor dabrafenib (Tafinlar, Novartis and GlaxoSmithKline; $5,727,309), the KIT inhibitor imatinib (Gleevec, Novartis; $4,323,586), the mTOR inhibitor everolimus (Afinitor, Novartis; $3,300,014), and the anti-PD-1 monoclonal antibody pembrolizumab (Keytruda, Merck; $3,217,361) (Fig. 3b). The yearly fluctuation of funding between these five drugs is depicted in Fig. 3c, showing how research funding on these drugs likely correlated with the clinical trial stage. The highest amount of research payments for a device were for an energy device (Thunderbeat; Olympus Corporation), totaling $1,143,174 over 5 years, mostly in New York.

Industry Payment Gender Disparities

Three-quarters of all paid SOs were male (120/162; 74%). Academic male SOs received research funding more frequently than females (120/588 [20%] vs. 42/334

TABLE 1 Comparison between industry research unpaid and paid academic surgical oncologists according to academic rank, years in practice, and gender

Industry research payments 2013–2017			
	Unpaid [n = 760] (%)	Paid [n = 162] (%)	p value
Academic rank			< 0.0001
Chairs/CEOs/Deans	35 (78)	10 (22)	
Division Chief Professors	136 (74)	49 (26)	
Professors	121 (79)	32 (21)	
Associate Professors	209 (83)	42 (17)	
Assistant Professors	259 (90)	29 (10)	
Years in practice			< 0.0001
40 or more	10 (83)	2 (17)	
30–39	79 (81)	19 (19)	
20–29	166 (81)	39 (19)	
10–19	261 (76)	81 (24)	
0–9	244 (92)	21 (8)	
Mean/median years in practice	15.9/14	17.8/16	0.0037
Gender			0.0027
Male	468 (80)	120 (20)	
Female	292 (87.4)	42 (12.6)	

CEOs Chief Executive Officers

[12.6%]; p = 0.0027) (Table 1). Among academic SOs who received any research payments, males received significantly more in general payments (i.e. travel and lodging, food and beverage, consulting and speaker fees, and honoraria): an average of $48,830 to 116 males vs. $11,867 to 38 females ($p$ = 0.0001), totaling $5,664,354 vs. $450,945 in general payments to male and female academic SOs, respectively (electronic supplementary Table S4).

National Institutes of Health Funding Among Industry-Funded Surgical Oncologists

Among academic SOs who received any industry research payments, the top quartile (n = 40) not only received most of the research payments ($41,379,309; 88.8% of all payments), but also were more frequently awarded NIH grants (p = 0.0144): 47.5% (19/40) were NIH funded in at least one fiscal year during the time period of our study, representing a total of 105 combined individual yearly awards. In comparison, the bottom quartile (n = 41) received $82,699 research payments (0.17% of all payments) and were awarded 29 combined fiscal year awards (electronic supplementary Table S5). A more detailed summary of the NIH grants is presented in electronic supplementary Table S6.

DISCUSSION

Despite an increase in NIH funding over the last 3 years, funding cuts and sequestration persisted for well over a decade.[1] Between 2006 and 2016, surgeons were disproportionally funded: NIH grant applications from surgeon principal investigators were successful only 16.4% of times, lower than the mean funding success rate of 19.2%.[12] Furthermore, fewer surgical departments were funded, resulting in a decline in surgeons pursuing careers in basic science and translational research. Additional barriers include excessive administrative duties with little protected time, a focus on clinical productivity and revenue requirements, insufficient academic productivity incentives, and difficulty in obtaining funding.[2] As a result, alternate sources of funding have become an essential component of any academic surgical program. We could not find previous reports of industry research funding to academic SOs. Furthermore, these data were not publicly available until the Senate passed the Sunshine Act and the Centers for Medicare and Medicaid Services OPD was created, mandating full transparency of industry funding to physicians.[8,9]

Our study reports $46,596,706 research payments to 162 academic SOs, mostly related to novel cancer drugs undergoing clinical trials. The top industry-funded surgeons were also more frequently funded by the NIH; however, we cannot causally infer that more industry funding results in more successful NIH funding, or vice versa. The majority of research payments (1851/1951;

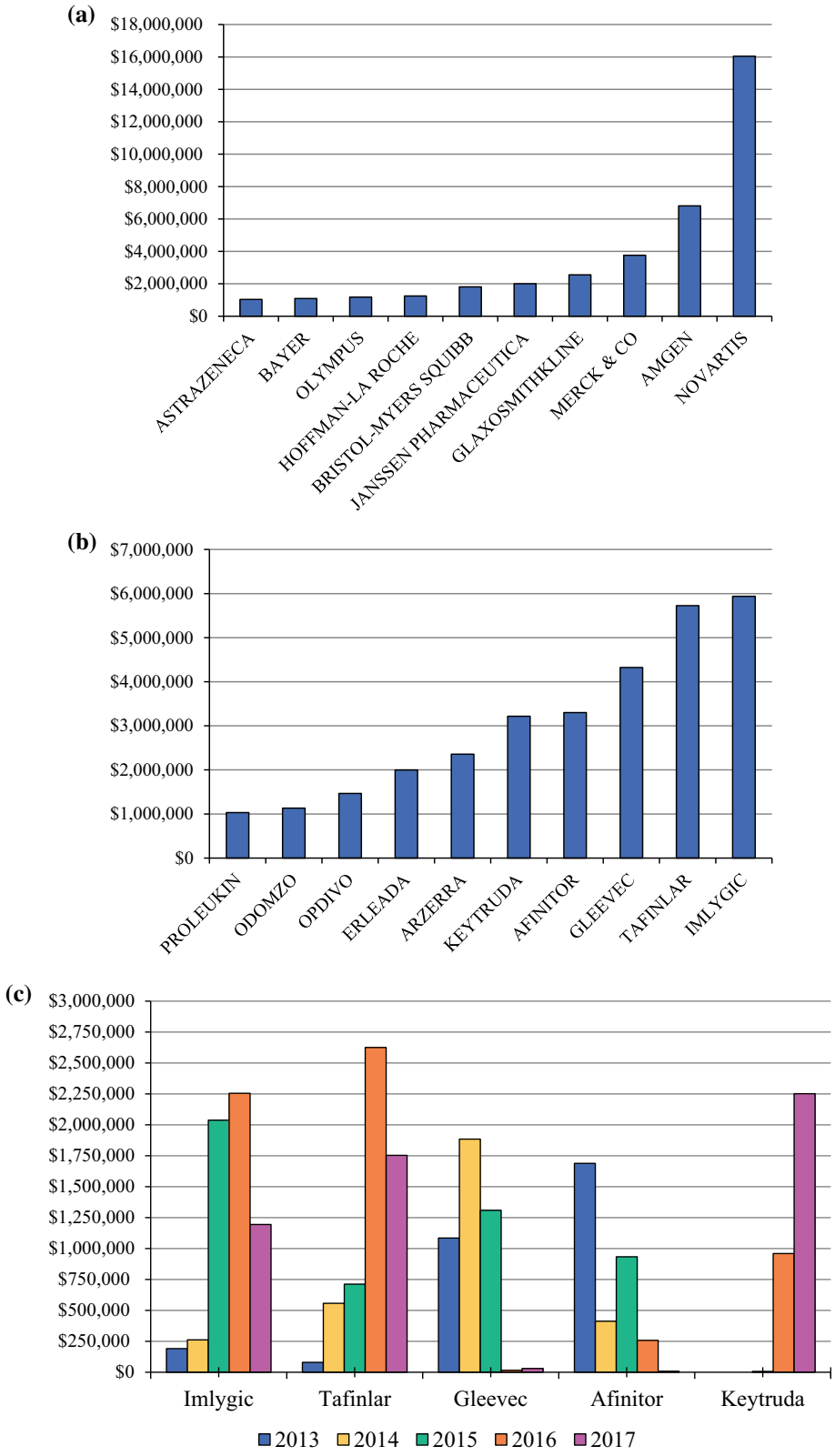

FIG. 3 (**a**) Top companies making research payments to academic surgical oncologists, 2013–2017. (**b**) Top drugs for which research payments were made to academic surgical oncologists, 2013–2017. (**c**) Yearly variation of the five top drugs for which research payments were made to academic surgical oncologists, 2013–2017

95%) were catalogued by the OPD as 'associated research' in nature, in which payments were made towards "funding for a research project or study where the physician is named as a principal investigator".[8] 'Research' payments contained in the OPD were 'associated with a research study' and in our results represented only 5% (100/1951);

TABLE 2 Total industry research payments between 2013 and 2017 by state, according to drug vs. device payment, and total number and percentage of academic surgical oncologists receiving research payments in that state

State	Drug payments	Device payments	Unknown payments	Total payments	No. of academic SOs in the State	No. of academic SOs paid	Percentage of academic SOs paid	Average paid per academic SO
MA	$8,886,579	$3146	$171,251	$9,060,976	47	7	15	$1,294,425
TX	$7,290,497	$365,731	$0	$7,656,228	85	18	21	$425,345
PA	$3,401,002	$39,355	$0	$3,440,357	60	9	15	$382,261
CA	$3,083,143	$636,121	$182,880	$3,902,144	93	20	22	$195,107
UT	$3,066,332	$0	$0	$3,066,332	7	2	29	$1,533,166
WA	$3,053,016	$6231	$0	$3,059,248	9	4	44	$764,811
OR	$2,482,779	$626	$0	$2,483,406	9	2	22	$1,241,702
NY	$2,472,984	$1,523,165	$214,715	$4,210,864	128	18	14	$233,936
FL	$1,627,227	$105,909	$0	$1,733,136	46	17	37	$101,949
TN	$1,199,053	$0	$0	$1,199,053	24	5	21	$239,810
NJ	$1,251,588	$0	$0	$1,251,587	22	4	18	$312,896
VA	$439,643	$0	$0	$439,643	11	2	18	$219,821
IL	$420,725	$473	$0	$421,198	34	6	18	$70,199
CO	$372,340	$750	$0	$373,090	7	2	29	$186,544
RI	$355,980	$78,531	$0	$434,511	8	2	25	$217,255
OH	$238,914	$96,810	$0	$335,724	39	11	28	$30,520
MI	$217,993	$0	$0	$217,993	17	1	6	$217,993
MO	$179,295	$173,961	$0	$353,256	18	4	22	$88,313
NE	$123,242	$0	$0	$123,242	11	1	9	$123,242
WI	$105,175	$0	$0	$105,175	21	3	14	$35,058
NC	$99,722	$671,973	$0	$771,695	31	6	19	$128,615
AL	$96,145	$21,315	$0	$117,460	12	2	17	$58,730
MN	$84,956	$990	$18,745	$104,691	15	2	13	$52,345
KY	$76,467	$1,330,067	$0	$1,406,533	14	2	14	$703,266
NM	$69,726	$0	$0	$69,726	4	1	25	$69,726
GA	$40,135	$19,200	$0	$59,335	23	3	13	$19,778
MS	$14,680	$0	$0	$14,680	2	1	50	$14,680
LA	$10,796	$0	$0	$10,796	7	1	14	$10,796
KS	$10,470	$0	$0	$10,470	7	1	14	$10,470
IA	$4111	$0	$0	$4111	9	1	11	$4110
OK	$0	$68,352	$0	$68,352	7	1	14	$68,352
MD	$0	$49,893	$0	$49,893	26	1	4	$49,893
CT	$0	$0	$40,000	$40,000	13	1	8	$40,000
WV	$0	$1800	$0	$1800	5	1	20	$1800
AZ	$0	$0	$0	$0	10	0	0	$0
IN	$0	$0	$0	$0	8	0	0	$0
SC	$0	$0	$0	$0	8	0	0	$0
AR	$0	$0	$0	$0	5	0	0	$0
DE	$0	$0	$0	$0	5	0	0	$0
NH	$0	$0	$0	$0	5	0	0	$0
DC	$0	$0	$0	$0	4	0	0	$0
VT	$0	$0	$0	$0	3	0	0	$0
NV	$0	$0	$0	$0	2	0	0	$0
HI	$0	$0	$0	$0	1	0	0	$0
TOTAL	$40,774,716	$5,194,399	$627,591	$46,596,706	922	162	17.6	$287,633

SO Surgical oncologist

these named an SO as the primary recipient of the payment. The overwhelming majority of 'associated research' payments were linked to a specific drug clinical trial where the SO was a principal investigator, and up to five principal investigators can be reported in the OPD. There are certain limitations in the interpretation of these data: the specific roles of each principal investigator are not reported and the OPD does not discriminate for investigator-initiated industry funding. Furthermore, each institution receiving payments has different policies and research agreements that dictate how the funds are allocated, therefore the direct and final financial gain for the SO, if any, cannot be established. The OPD also reports industry payments to teaching hospitals, but we did not specifically explore this. We also did not investigate payments made to medical oncologists, which are significantly higher; a recent study reported $209,795,437 in industry payments to a group of 263 US medical oncologists over a shorter 20-month time period, compared with our 5-year study time period.[13]

An inherent limitation of these data is the nature of the OPD; companies are required by law to report these payments, but no mechanism exists to enforce accurate reporting compliance, and discordance in reporting has previously been reported.[14] In 2013 and 2014, fewer payments were reported, and then an increase in research payments occurred over the following years. This likely reflects companies gradually enrolling and complying with the OPD; additionally, 2013 only includes data from 1 August to 31 December 2013. Interestingly, for the first time, 2017 saw a $410 million decrease in all industry payments and it is too early to determine whether this trend continued in 2018.[9]

Similar to other surgical specialties, gender disparities exist in academic surgical oncology. Male SOs outnumbered females two to one, and only two academic ranks approximated this: Professors (30% female) and Associate Professors (38% female), but disparities were found in Chairs/CEOs/Deans (11% female), Division Chief Professors (18% female), and Assistant Professors (53% female). In a recent report by Nguyen et al., female academic SOs were less academically productive compared with their equally ranking male colleagues.[15] Although they provide several reasons for this, one additional possibility supported by our study is that industry supports males more frequently.

In over 5 years, the OPD has reported $9.14 billion in industry general payments to all US physicians.[9] These payments are 'not associated with a research study' and include travel and lodging, food and beverage, consulting and speaker fees, and honoraria. Of this, $6,115,299 were paid to 162 academic SOs. We also report an unappreciated gender disparity gap for industry support that may have a significant impact on academic advancement: male SOs received average general payments 12 times greater than females ($8940 vs. $700). Notably, disparities also exist within the medical industry itself. According to a 2018 survey of 2793 medical sales representatives, females represented 30% of the workforce, earned 20% less compensation, and occupied 15% of the highest paying positions.[16]

Although our study did not specifically evaluate whether industry support influenced physician's practice, two recent studies suggest that it may have. The first found that publications from surgeons sponsored by a robotic medical device company that did not self-declare the payments in the publication's conflict of interest statement, were more likely to recommend robotic surgery.[17] The second reported that self-declared conflict of interest by the top 100 industry-sponsored physicians was highly inconsistent, particularly with regard to funding from the top 10 surgical and medical device manufacturing companies.[18] Further studies are needed to determine the true impact of industry funding on both clinical and translational research, academic advancement, and its potential influence on the practice of SOs.

CONCLUSIONS

We present the first report of industry research funding to academic SOs, as published online in the OPD. The majority of research payments originated from major pharmaceutical companies, and were related to novel pharmaceuticals undergoing clinical trials rather than surgical devices. This highlights the expanding role SOs play in the selection of systemic therapies in the multidisciplinary approach to the cancer patient. Industry payments are influenced by geography, gender, and academic leadership. Gender disparities exist in industry funding; male SOs received funding more frequently and were recipients of larger industry-sponsored general payments. Further studies are needed to assess the impact of industry support on peer-reviewed funding and academic advancement.

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