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Effects of the physician payments sunshine act on the patient experience and perception of care amongst neurosurgeons: A comparative study of online PRW ratings and industry payments

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ABSTRACT

Objective: Growing relationships between industry related financial payments and physicians have become an increasingly controversial topic as they relate to clinical judgment and patient care.

Our objective is to analyze and quantify the effects of physician reported industry payments on the patient experience and patient satisfaction as defined by Physician Rating Websites (PRW).

Patients and methods: We analyzed physician-reported industry payments received by neurosurgeons over four consecutive years as defined by the Physician Payments Sunshine Act (PPSA). All board-certified neurosurgeons on three widely used PRWs were further identified. Data was collected on average rating, number of ratings and composite ratings. Demographic, training-related and practice-related data were also collected. Each physician was identified and matched to their individually reported payments from the PPSA database.

Results: Receiving higher amounts of industrial payments had no correlation to average PRW ratings, however was associated with receiving higher composite PRW ratings ($p = 0.0389$). Higher composite ratings ($p = 0.0389$), decreasing age ($p = 0.005$), being male (OR 1.7960, $p = 0.005$), completing a fellowship (OR 1.3310, $p = 0.0085$), having a more complete profile (OR 1.1121, $p = 0.0057$) and speaking more languages (OR 1.1253, $p = 0.03802$) all were correlated with receiving more total monetary payments. Training at a top 25 residency program was predictive of being in the bottom quartile of total monetary payments received (OR 1.676, $p = 0.0002$).

Conclusions: Patient experience as defined by PRW ratings are likely not strongly influenced by industry related monetary payments, however some relationship may exist. Further study is needed to determine the true relationship between industry related monetary payments and the patient experience.

1. Introduction

Growing relationships between industry related financial payments and physicians have recently become an increasingly controversial topic in its relationship to clinical judgment and patient care. Recent literature has shown that physicians believe themselves to be uninfluenced by marketing strategies employed by such medical device and pharmaceutical companies [1,2]. However, it has been further reported that prescribing patterns and decision making is altered under implementation of such financial payments [3–5]. As such, a growing disconnect exists between physician perspective and industry payment incentive [3–5]. Due to this overwhelmingly negative perception, the Physician Payments Sunshine Act (PPSA) was established as part of the Affordable Care Act (ACA) in 2010 to further protect consumers' rights as disclosure of all industry related payments was mandated nationally [6,7]. Despite the overwhelming perception that financial payments harm the physician patient relationship, the effects of receiving payments on the patient experience and patient satisfaction have yet to be adequately studied [8–18].

Similarly, physician rating websites (PRW) have become an increasingly important method of determining patient satisfaction and quantifying the patient experience [19–21]. These PRWs have even become a relevant factor in referral bases, insurance based reimbursement and even awards on a national scale [19–21]. While often

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scrutinized for inaccuracies, biased scoring methods and lack of relevance, PRWs continue to remain the only publicly available method for patients to evaluate and verbalize their experience to the community, and as such warrant study of their own despite the above noted inaccuracies [19–21].

The goal of this study is to assess trends in industry-based payment payments as defined by the PPSA and their relationship with PRW ratings amongst board certified Neurosurgeons. Given the complexity of each patient encounter and numerous factors associated with providing good patient care, the authors hypothesize that monetary payments are unlikely to correlate significantly with patient satisfaction ratings and are unlikely to show any relevant contribution to either improving or worsening patient experience scores as defined by PRWs. To the best of our knowledge, this is the first study to consider these relationships in this specific subset of physicians.

2. Patients and methods

2.1. Physician payments sunshine act data

Physician reported payments data was downloaded from the openpaymentsdata.cms.org website for the years of 2013-2016. Physicians were included that listed their specialty as “Neurosurgery” or “Neurological Surgery” and who had listed their board certifications to be certified under the American Board of Neurological Surgery.

2.2. Physician rating website data

A key term search was done for all providers containing the key terms “Neurosurgery” and “Neurological Surgery” for the three most widely used provider rating websites; RateMD.com, Healthgrades.com and Vitals.com [22]. Search results were further narrowed to include only providers who were listed as American Board of Neurological Surgery board certified by their profile data. Data was collected for each of the remaining providers by means of third party freeware application “Webscraper”. The following information was collected for each provider: Average Rating, Number of Ratings, Age, Sex, Address, Medical School Attended, Graduation Date, Residency Attended, Completion Date, Fellowship Attended, Languages Spoken, Awards Earned, Conditions Treated and Procedures Performed. Profile completeness was defined by the number of columns each provider had filled out online including age, gender, number of board certifications, residency, fellowship, conditions treated, procedures performed, awards received and languages spoken. Providers were manually matched between website data as categorized by full name, and address. Data acquisition was completed in June of 2017. Data was subsequently cleaned and duplicate values were deleted.

Medical School Rank was noted as determined by US News & World Report, Top Medical Schools 2017 –Research [23]. Residency Rank was determined through Doximity.com’s Top Neurological Surgery Residency Programs- Reputation Rank [24]. Providers who graduated from U.S. medical schools ranked in the top 25 or from U.S. residency programs ranked in the top 20 were identified.

2.3. Data linkage and analysis

Each Neurosurgeon was matched to their associated PRW ratings manually in Microsoft Excel function by full name and address of practice. Any Neurosurgeon without matching data from at least one PRW were excluded from the study. A total of 3959 Neurosurgeons remained after the matching process. For simplicity of analysis, ratings from the three PRWs were modified in two methods. The metric average rating in our study was defined by the sum of cumulative ratings of all 3 PRWs divided by the total number of ratings from all three PRWs. The metric composite rating in our study was defined as the average rating multiplied by the total number of ratings from all three PRWs, to be used as a surrogate for overall positive online activity and recognition of each physician. Outcomes of interest for each unique physician were defined as year to year variance in payment amount, total additive amount of money received over the four years of analysis, the total amount of individual payments received over the four-year period, the average amount per payment received and the total number of years physicians recorded industry payment.

2.4. Statistical methods

Microsoft Excel 2011 (Microsoft, Redmond, WA, USA) was used to manage data. Statistical analysis was performed using and Stata 12.0 (StataCorp, College Station, TX, USA). Skewness and kurtosis tests for normality were applied to all ratings data. Parametric data was given as mean ± standard deviation and compared using a *t*-test. Non-parametric data was compared using Wilcoxon rank-sum test (Mann-Whitney *U* test), Chi-square test, or Fisher’s exact test, as appropriate. Regression analysis was performed using stepwise, multivariable logistic regression, with an inclusion threshold for the multivariable model of $p < 0.10$ for candidate variables on single-variable logistic regression. A value of $p < 0.05$ was considered statistically significant. Figures were generated using Prism 6.0b (GraphPad Software, Inc., La Jolla, CA, USA).

3. Results

3.1. Demographic data

Data from all board-certified neurosurgeons with ratings in at least one of the most used PRWs were obtained (n = 3959). Out of these providers, 518 attended top 25 medical schools (13.1%), 311 were from top 25 residencies (7.86%), and 511 were fellowship-trained (12.9%) (Table 1). The median number of years out of medical school for all providers was 24 with an interquartile range (IQR) of [16,34], and the mean was 25.7 ± 11.2. **(**Table 1**)**. Distributions of Average Ratings and Composite Ratings for all 3 PRWs are shown in Fig. 1. Payment demographics are shown in Table 2.

3.2. Predictors of higher composite PRW ratings

Receiving more money composite, receiving more individual payments, receiving a higher average payment amount and more years receiving payments all significantly predicted higher composite ratings on linear regression ($p = 0.0389$, $p < 0.0001$, $p = 0.0372$, $p < 0.0001$ respectively) (Fig. 2). Being in the top quartile of composite ratings was predicted by receiving more individual payments (OR 1.0047, $p < 0.0001$) and receiving a higher average amount per payment (OR 1.00001, $p = 0.012$). Receiving more payments (OR 0.99194, $p < 0.0001$) and receiving payments over a higher number of years (OR 0.5963, $p < 0.0001$) was further protective against being in the bottom quartile of composite ratings on logistic regression (Table 3).

Table 1
Provider Demographics.

Age (mean ± SD)	53.38 ± 10.34
Male (%)	0.94
Number of Languages (mean ± SD)	1.37 ± 0.80
Award Received (%)	66.20%
Top 25 Medical School (%)	13.10%
Top 25 Residency (%)	7.86%
Fellowship Trained (%)	12.90%
Years Since MD (mean ± SD)	25.7 ± 11.2
Median	24
IQR	[16,34]

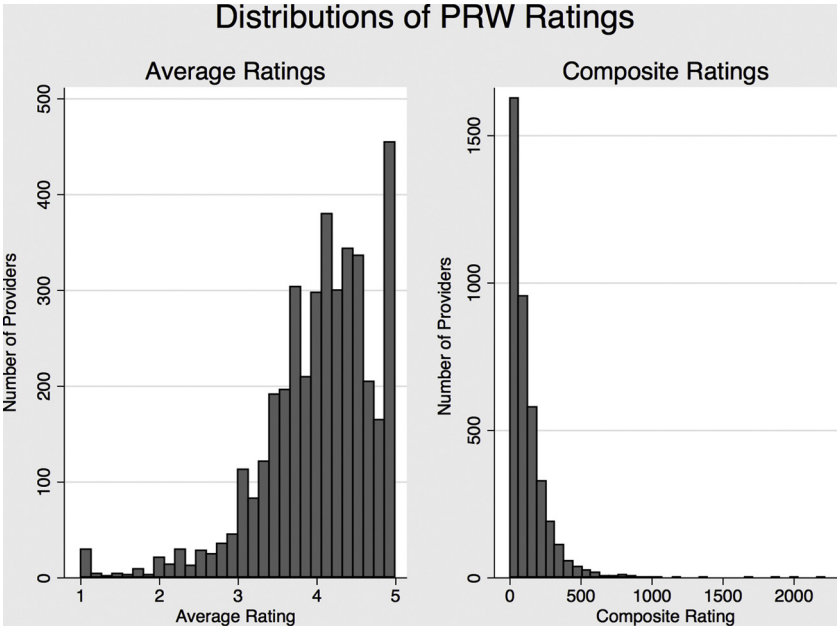

Fig. 1. Left: Histogram showing distribution of average ratings amongst providers on 3 PRWs (Healthgrades.com, Vitals.com, RateMDs.com). Right: Histogram showing distribution of composite ratings amongst providers on all 3 PRWs (Healthgrades.com, Vitals.com, RateMDs.com).

Table 2
Payment Demographics.

Year		Mean	Median
2013	Total Reimbursement ($/Provider)	6315.20	124.29
	Number of Total Payments Received	7.22	3.00
2014	Total Reimbursement ($/Provider)	21,019.48	419.91
	Number of Total Payments Received	17.51	8.00
2015	Total Reimbursement ($/Provider)	1235.58	34.75
	Number of Total Payments Received	1.18	1.00
2016	Total Reimbursement ($/Provider)	19,781.99	376.53
	Number of Total Payments Received	15.83	7.00
Overall	**Total Number of Years Paid**	**3.43**	**4.00**
	Yearly Variance in Reimbursement by Provider	**5.34E+10**	**7.30E+05**
	Total Overall Reimbursement ($/Provider)	**48,340.04**	**2,580.64**
	Number of Total Payments Received	**41.74**	**27.00**
	Average Amount Per Payment ($)	**894.93**	**87.34**

3.3. Predictors of higher average PRW ratings

No metrics were predictive of receiving higher average PRW ratings on linear regression. Being in top quartile on average rating was predicted by a lower number of payments received (OR 0.9978, $p = 0.0118$) and a lower number of years receiving payments (OR 0.8168, $p < 0.0001$). Being in the bottom quartile of average rating was not predicted by any metrics on logistic regression.

3.4. Predictors of receiving monetary payments

Having a higher composite rating ($p = 0.0389$) and having a more complete profile ($p = 0.0594$) were both predictive of receiving more total money on univariate linear regression. Age, Average rating, variance between ratings, state, gender, training from a top 25 medical school, training from a top 25 residency, completing a fellowship, number of board certifications, receiving an award and speaking more languages did not significantly predict receiving more total money on univariate linear regression. No metrics were significant predictors of receiving more total money on multivariate regression.

3.5. Predictors of top quartile of total money received

Having a higher composite rating (OR 1.0014, $p < 0.0001$), being male (OR 1.7960, $p = 0.005$), completing a fellowship (OR 1.3310, $p = 0.0085$), receiving an award (OR 1.2367, $p = 0.03015$), speaking more languages (OR 1.1253, $p = 0.03802$) and having a more complete profile (OR 1.1121, $p = 0.0057$) were all associated with being in the top quartile of total money received. Increasing age was also found to be protective against being in the top quartile of total money received (OR 0.9857, $p = 0.00259$). On multivariate regression, composite rating (OR 1.0013, $p = 0.001$), profile completeness (OR 1.2413, $p = 0.018$) and being male (OR 2.0307, $p = 0.026$) all remained as significant predictors of being in the top quartile of total money received (Table 4). On multivariate regression, increasing age also remained protective against being in the top quartile of total money received. (OR 0.9800, $p = 0.0069$).

3.6. Predictors of bottom quartile of total money received

Increasing age (OR 1.0366, $p < 0.0001$) and completing a residency at a top 25 training program (OR 1.676, $p = 0.0002$) were both associated with an increased likelihood of being in the bottom quartile of total money received on univariate regression. Similarly, having a higher composite rating (OR 0.9988, $p = 0.0007$), being male (OR 0.6792, $p = 0.0407$), completing a fellowship (OR 0.77, $p = 0.0436$) and speaking more languages (OR 0.8197, $p = 0.0155$) were all protective against being in the bottom quartile of total money received on univariate regression (Table 4). On multivariate analysis, both age (OR 1.0355, $p < 0.0001$) and completing a residency at a top 25 program (OR 1.578, $p = 0.004$) remained significant predictors of being in the bottom quartile of total money received. Completing a fellowship (OR 0.7779, $p < 0.069$), having a higher composite rating (0.9981, $p < 0.0001$), and being male (OR 0.5528, $p = 0.007$) all remained protective against being in the bottom quartile of total money received on multivariate regression.

4. Discussion

The relationship between industry and physicians remains complex

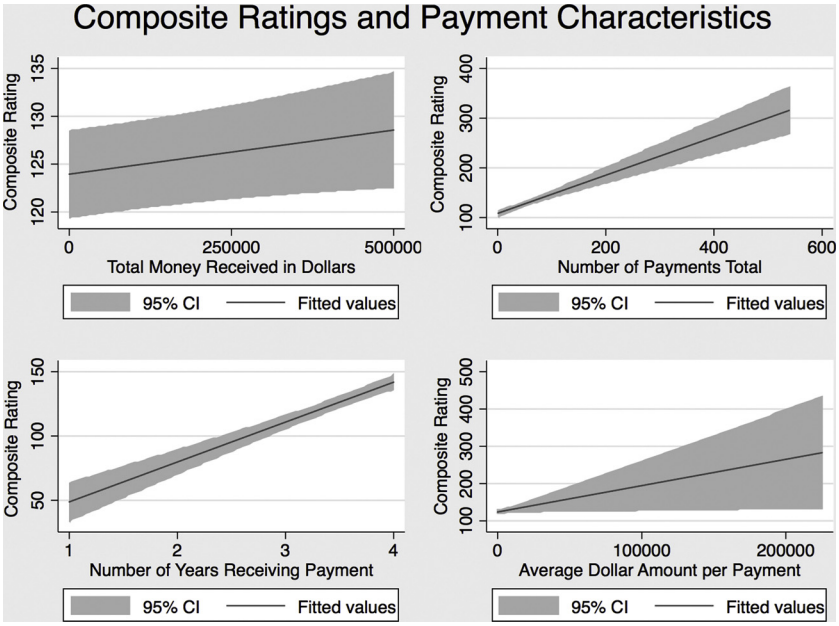

Fig. 2. Composite Ratings and Payment Characteristics. Top Left- Linear regression line of best fit for total money received in dollars versus composite ratings. Top Right- Linear regression line of best fit for number of payments received versus composite ratings. Bottom Left- Linear regression line of best fit for number of years receiving some form of payment (out of 4) versus composite ratings. Bottom Right- Linear regression line of best fit for average dollar amount received per payment versus composite ratings.

Table 3
Predictors of Composite Ratings.

Top Quartile of Composite Ratings	**OR**	**p-value**
Variance in Total Yearly Payment Amounts	1.0000	0.3314
Total Money Received	**1.0000**	**0.0273**
Number of Total Payments Received	**1.0047**	**< 0.0001**
Average Dollar Amount per Payment	1.0000	**0.0127**
Total Number of Years Receiving Payment	**1.6473**	**< 0.0001**
Bottom Quartile of Composite Ratings	**OR**	**p-value**
Variance in Total Yearly Payment Amounts	1.0000	0.5650
Total Money Received	1.0000	0.4252
Number of Total Payments Received	**0.9919**	**< 0.0001**
Average Dollar Amount per Payment	1.0000	0.8467
Total Number of Years Receiving Payment	**0.5963**	**< 0.0001**

Table 4
Predictors of Receiving More Total Money.

Top Quartile of Total Money Received	**OR**	**p-value**
Age	**0.9857**	**0.0026**
Average Rating	1.0200	0.6820
Composite Rating	**1.0014**	**< 0.0001**
Variance Between Different PRWs	0.9398	0.2268
State	1.0003	0.9154
Gender (Male)	**1.7960**	**0.0057**
Top 25 Medical School	1.0806	0.4760
Top 25 Residency	0.9408	0.6523
Fellowship Completed	**1.3310**	**0.0085**
Number of Board Certifications	0.7218	0.5702
Award Received	**1.2366**	**0.0302**
Number of Languages Spoken	**1.1253**	**0.0381**
Profile Completeness	**1.1121**	**0.0057**
Bottom Quartile of Total Money Received	**OR**	**p-value**
Age	**1.0366**	**< 0.0001**
Average Rating	0.9317	0.2035
Composite Rating	**0.9988**	**0.0007**
Variance Between Different PRWs	1.0614	0.2711
State	0.9978	0.5219
Gender (Male)	**0.6793**	**0.0407**
Top 25 Medical School	0.8709	0.2690
Top 25 Residency	**1.6762**	**0.0002**
Fellowship Completed	**0.7700**	**0.0436**
Number of Board Certifications	0.9051	0.8517
Award Received	1.1966	0.1007
Number of Languages Spoken	**0.8197**	**0.0155**
Profile Completeness	0.9778	0.5919

and poorly understood. Due to the nature of these relationships, the direct effects such payments have on the patient experience remain understudied and difficult to quantify. However, with the existence of the PPSA and the growing prevalence patient satisfaction surveys, it has become possible to begin to quantify this complicated relationship. To the best of our knowledge this is the first study to look at the effects of industry provided physician industry payments on the patient experience and patient satisfaction as defined by online PRW ratings. While newer, more accurate methods of identifying trends in patient satisfaction are currently being utilized by individual organizations and hospitals such as HCAHPS or Press Ganey surveys, PRWs remain the sole source of information accessible to the patient, and as such warrant study of their own despite the above noted inaccuracies [25,26].

Previous studies on the PPSA have noted neurosurgeons to have the highest percentage of total board certified physicians receiving industry payments [8–12,15–18]. Similarly, studies have also noted neurosurgery to have the received the highest median dollar amount of any specialty in 2013–2014 ($700.02), secondary only to orthopedic surgery ($1571.80) [8,9,11,12,15–18]. This number is consistent with the median total dollar amount received per neurosurgeon in the current study when averaged over the four consecutive years studied ($645.16). Such high payments have been hypothesized to be tied to the increasing prevalence of spinal fusion procedures in both orthopedics and neurosurgery and the overwhelmingly tight connection industry has with such procedures [15]. Further study, however, is needed in order to determine true predictors and influences associated with receiving industry backed payments.

The current study found average ratings across PRWs not to be correlated with increasing or decreasing amounts of payment. These results alone would imply financial payments from industry to not be a significant factor in determining patient perceived quality of care. However, the current study also found composite ratings to be loosely linked to increasing amount of financial payments as evidenced by the fact that receiving more money, having more individual payments and having a higher average dollar amount per payment all correlated with higher ratings. Similarly, higher composite ratings continued to predict being in the top quartile of total money received and protected against being in the bottom quartile of total money received. This association, while intriguing, is not completely understood to the authors. Likewise, a clear correlation was further noted between physicians with more complete profiles (including information listed highlighting medical school, residency, fellowship, languages spoken and whether they had

received awards) and those receiving higher total amounts of payments. To the best of our knowledge, the current study is the first to note this observation. This link could represent a propensity for physicians that are more active and engaged in the online community and their own online public image to be more sought out by industry. On the other hand, the correlation may rather be instead reflective of a propensity of the industry to seek out the best, most qualified and personable physicians to associate with irrespective of online ratings. As such it would be logical that these same physicians would have higher composite PRW ratings, higher patient satisfaction scores and a more robust online presence as a result. As such, the above findings, while interesting are more likely to represent simple correlation as opposed to causation itself. Further study, however, is needed to determine the true relationship between online activity, PRW ratings and industry payments.

The current study also found many other factors to be predictive of receiving more total money including decreasing age, being male, completing a fellowship and speaking more languages. Previous studies have documented an inverse relationship concerning receiving more total payments and age amongst spine surgeons, however no definite significant conclusions were found regarding total monetary amount [15]. These findings are consistent with the current study and may be driven by continuing medical education and career development pressures on younger physicians that tend to decrease as they age and become more settled into their given specialty [15]. Further study, however, is needed to understand the relationship between age and industry payments. Similarly, male gender has been shown to be predictive of more payments, consistent with the current study [27,28]. While the exact causes of this relationship remain unclear, it has been thought to be related to the gender pay gap amongst physicians [15]. The gender pay discrepancy has been well documented in the literature suggesting that not only that the majority of top earners in each specialty are male, but that male physicians across all specialties may be earning as much as $13,399 more on average per year than women [15,27,28]. Likewise, having completed a fellowship predicted more total monetary amount. To our knowledge, this is the first study to report such findings and may be related to the narrow specialization associated with most fellowship training. Completing such training opens the door for industries to work with surgeons on very specific procedures or instrumentation. Similarly, fellowship training distinguishes surgeons as credentialed and in many aspects experts in their respective procedures. This distinction may work to draw considerably more industry attention towards such surgeons as compared to peers in more generalized practices. Further study, however, is indicated in order to better understand the effects of fellowship on industry payments. Lastly, speaking more languages was found to be positively associated with a higher payment amounts. To the best of our knowledge this is the first study to report such findings. This finding is not entirely intuitive to the authors, although may reflect a propensity of medical industries to seek out individuals who are able to communicate and connect to patients in more than one demographic and could as such reach people from many different backgrounds. Further study is needed, however, to draw any conclusions.

It was further noted that training at a residency ranked amongst the top 25 most reputable programs was a significant predictor of being amongst the lowest quartile of total monetary payments received. As the vast majority of the reputable residency programs are located at large academic centers, many of such trainees end up receiving considerably more exposure to academic research and clinical investigation [29,30]. It has further been documented in the literature that training at such academic centers is highly predictive of pursuing a career in academic medicine and research [31–34]. Similarly, the role industry should play in research and academic medicine is highly debated within the academic community, with considerable stigma being placed on physicians that have both large financial relationships with industry and research driven practices [35]. As such, this propensity to be involved in research may predispose such trainees to be less inclined to pursue industry relationships so long as their interest in academic medicine persists [35]. Further study is needed, however, to better understand the role residency plays on determining future relationships with industry payments.

Our study is not without limitations. Due to the fluidity of online ratings, ratings one day may differ from ratings then next, making our analysis only relevant for a snapshot in time. We only analyzed data from the top three PRWs were included in the analysis, which may not be reflective of other PRWs. There is no verification process on such websites for board certification, which was one of our inclusion criteria for the providers we analyzed. There is no method in place on many of these websites to verify whether physicians listed are currently in practice, so providers who have subsequently retired may skew our data. We could not readily differentiate providers based on the type of surgeries they offered, e.g. cranial versus spine, which may lead to comparisons between dissimilar surgical practices. We have no clinical outcomes data to analyze from these providers, and cannot therefore determine what outcomes driver surgeons' ratings, if any. PRWs themselves are not as accurate as other hospital specific rating systems and therefore are subject to additional biases as they are not internally controlled or monitored. Moreover, we cannot determine whether factors outside of a surgeon's control, such as nursing staff or hospital facilities, impact a patient's impression of their care and their subsequent rating. Lastly, it should be noted that current medical school and residency rating systems are not perfect and similar to PRWs are only a snapshot in time, likely not reflecting the dynamic state of training over years past. It is also important to note that not all the surgeons listed under the Sunshine Act were found on online rating websites. Instead, we could only accurately identify 3959 of the 6616 unique physician identification numbers published by the Sunshine Act. Lastly, it is important to take all findings in context as to clinical relevance. While some findings do display some statistical significance, it remains unclear which of these translate into clinical effects. Despite these limitations, our study is the first in the neurosurgical literature to examine PRWs and their relationship to the PPSA.

5. Conclusion

Patient experience as defined by PRW ratings is likely not strongly influenced by industry related monetary payments. Some relationship, although minimal, may exist between composite online ratings as noted by PRWs and total monetary value received. Decreasing age, being male, completing a fellowship and speaking more languages all were correlated with receiving more total monetary payment. Training at a top 25 residency program was predictive of being in the bottom quartile of total monetary payments received. Further study is needed to determine the true relationship between industry related monetary payments and the patient experience.

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Conflict of interest

The above authors have no disclosures and no conflicts of interest to declare.

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