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Project Title: Conflicts of interest in neurosurgical research: Effects of the 2013 Physician Payments Sunshine Act on voluntary disclosure

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SUMMARY: (no more than 250 words single spaced)

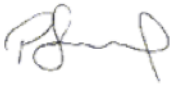
Industry involvement in medical research and the conflicts of interest (COIs) they create are ubiquitous. Most medical journals require voluntary disclosure of such COIs when publishing research. Until recently, there was no method of determining the accuracy of voluntary disclosure. Recent legislation in the U.S. (the Sunshine Act) mandates industry disclosure of all payments to physicians >$10.00, thus the accuracy of disclosure can be determined.

We compared the incidence of voluntary disclosure in major neurosurgical journals (JNS, JNS-Spine, JNS-Pediatrics) before and after the implementation of the Sunshine Act. In addition, we compared voluntary disclosure in these journals as well as in Neurosurgery, with mandated industry disclosure through the Open Payments Database (OPD) to determine the rate of non-disclosure. The OPD also allowed us to determine the scope of industry payments to physicians in the era studied.

The percentage of U.S. M.D. authors with a voluntary disclosure in JNS-Spine was 10.7% in 2011 and 35.4% in 2013 ($p<0.001$). Similar increases were not seen in the other two journals. According to OPD, $32,598,522.97 million of industry payments were provided to 656 U.S. M.D. authors from all four journals studied from August – December 2013, an average of $49,692.87 per author. The average rate of non-disclosure was 38.3% (33.8% - 42.2%).

There was a statistically significant increase in voluntary COI disclosure in JNS- Spine after the implementation of the Sunshine Act. Rates of non-disclosure remain high in all journals studied. Industry payments to physicians publishing in neurosurgery journals are common.

Student Signature



Supervisor Signature

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INTRODUCTION AND BACKGROUND

Conflicts of interest (COIs) are common, and almost unavoidable among medical professionals. A COI can be defined as “a set of conditions in which professional judgment concerning a primary interest tends to be unduly influenced by a secondary interest”(1). For a practicing physician, the primary interest should be the care of patients, while secondary interests may be financial such as stock ownership or royalties, or non-financial such as prestige, promotion, or publication(1). The presence of a COI, however, does not necessarily imply unethical behavior by the physician; rather it is how a physician manages the COI that may be cause for concern(2). However, even when no misconduct has resulted from a COI, the mere appearance of a COI can erode public trust and damage scientific integrity(3). Major issues arise when a COI is not addressed properly. The founding bioethical principle of non-maleficence is violated when the secondary interest is prioritized over the primary interest potentially leading to poor patient outcomes and loss of trust between patient and physician as well as a loss of trust in the profession as a whole(4).

While COIs are ubiquitous among medical professionals, few studies have been conducted on the rates and accuracy of COI disclosure by physicians who publish research. The recent passage of the Physician Payment Sunshine Act in the United States now allows for a simple way to verify the accuracy of the voluntary physician disclosure required by most medical journals(5). The Sunshine Act requires manufacturers of drugs, medical devices and biologicals to disclose payments to physicians greater than $10.00 on a publically accessible website(5). To date, the only analysis comparing voluntary disclosure to industry-provided data showed a large discrepancy between voluntary disclosure by orthopedic surgeons presenting at a national society meeting and industry-supplied data(6). There has been no similar analysis done examining the neurosurgical literature. This study analyzed the rate of voluntary disclosure of COIs in neurosurgical research both pre- and post-Sunshine Act and compared this voluntary disclosure to legally mandated disclosure by industry. To our knowledge, this is the first study comparing voluntary disclosure in published research with data obtained from the Open Payments Database (OPD) – the publically accessible database mandated by the Sunshine Act. An overview of the literature that outlines the extent of industry involvement in clinical research will provide a rationale for the importance of this study. Understanding COIs and where physicians stand with respect to the accuracy of disclosure is fundamental in managing COIs(7).

Industry involvement in medical research is significant and therefore the potential for COIs is enormous. The relationship between academic institutions and industry, “is growing denser, more complex, and much more lucrative for all involved.”(8) One study showed that over two thirds of academic institutions had an equity interest in industry that funded research projects conducted at that institution(9). Industry provided as much as $60 billion in 2000 towards research and development, but in that same year funding from the U.S. government was approximately half of this amount, and philanthropic or private funding was only one quarter(8). Industry funding as a percentage of total research funding has increased from 29% in 1977 to 58% in 2008 and it continues to rise as NIH funding and other governmental and philanthropic support decreases(10). Legitimate concerns do and should exist about the extensive financial involvement of industry in research and its capacity to introduce bias into study results(11). Studies have shown that industry sponsored research is 3.6 times more likely to produce a positive or ‘pro-industry’ result(9). Negative or adverse results are also more likely to be

suppressed or concealed in order to favor industry products or devices and biased study designed are more likely to be associated with industry-funded research(6). While these statistics are unsettling, some physicians argue that industry is a business, and businesses are more likely to invest in research that is going to produce a successful and marketable product(7). What's more, the average cost of developing a new drug is nearly $500 million, providing compelling motivation and need for industry sponsorship, especially given the limitations on institutional and government funding(12).

In the current research environment, the existence of COIs seems inevitable. Now more than ever, industry provides integral financial support to the profession, without which medical advancement would be seriously impaired. In neurosurgery, as in all areas of medicine, the relationship between industry and the practicing neurosurgeon has become essential for research, device development and ultimately patient care. Attempting to prohibit all COIs would undoubtedly impede the advancement of medicine. Therefore, the health care profession must find a suitable means of managing COIs in order to maintain patient trust. Disclosure of COIs is one way to manage them. As medical professionals, we understand the role of industry in research, but studies show that patients also recognize and appreciate the value of industry in medicine(13). A voluntary survey of people visiting the SpineUniverse website (www.spineuniverse.com) indicated that 50% of respondents believed that industry funding can affect the quality of their care, but interestingly, 80% of respondents thought industry funded research was valuable(13,14).

In order to prevent the adverse sequelae of poorly managed COIs, measures have been taken by the federal government in the United States (U.S.) to increase the transparency of the relationship between physicians and industry through the Physician Payments Sunshine Act(15). The Sunshine Act is based on the principle of disclosure, which involves acknowledging and communicating the nature of a COI to patients, universities, hospitals, Research Ethics Boards (REBs), and journals(4). In 2013, the Sunshine Act was fully implemented in the U.S. and required manufacturers of drugs, medical devices and biologicals to disclose payments greater than $10.00 to physicians(5). The Center for Medicare and Medicaid Services (CMS) created the Open Payments Database (OPD), as a means of publicly displaying the annual disclosures required under the Sunshine Act(5). The information collected by the CMS is submitted by industry(5). Physicians are given a 45-day period to review the industry-provided data and either approve or refute the disclosures(5). If the COI is approved, or refuted and resolved within the allotted period of time, then it will be released in that year's set of data(5). If the disclosure is refuted but no agreement is made within the allotted time period, then the disclosure is not released for public display in that year's report(5). Manufacturers are required to disclose all payments or transfer of goods valued at greater than $10.00, however, if the annual sum of payments less than $10.00 exceeds $100.00 then it must be reported(5). An escalating series of fines are levied against a company that has failed to disclose a physician payment.

As public, media and the medical community's concern over COIs is growing, governments and other regulatory bodies will need to respond and actively manage these concerns(4). A solution that balances the promotion of innovation and the prevention of perturbed judgment is imperative(8). The first phase of this project compared the rate of voluntary disclosures in three neurosurgery journals before and after the implementation of the Sunshine Act, to determine if there has been an increase in voluntary disclosure by physicians. The second phase of this project compared

voluntary disclosure in journals with mandatory industry-provided data on OPD to determine the rate of non-disclosure, and analyzed the scope of industry payments to physicians in the era studied.

METHODS

Phase 1

The first phase of this project involved using online E-journal versions of the Journal of Neurosurgery (JNS), the Journal of Neurosurgery – Pediatrics (JNS-Pediatrics) and the Journal of Neurosurgery – Spine (JNS-Spine). A Microsoft Excel database was created for all three journals from two distinct epochs: August – December 2011 and August – December 2013. These two time frames were chosen to contrast a time before and after the implementation of the Sunshine Act; therefore, allowing conclusions to be drawn about the effectiveness of the Sunshine Act at increasing voluntary disclosure of COIs by authors. For each issue, the following information was recorded: journal name, month of issue, title of article, study type, author names, degree designation and country of origin, and disclosures. The data were subsequently analyzed.

The Sunshine Act only applies to U.S.-based physicians, and as such, this study only looked at articles that contained at least one author whose primary affiliation was in the U.S. These were termed “U.S. authors” and were categorized in two ways: the total number of U.S. authors (regardless of their degree designation), and the number of U.S. authors who fall under the Sunshine Act based on their degree designation. The professional degrees that are included in the Sunshine Act are Doctor of Medicine (M.D.), Doctor of Osteopathy, Doctor of Dentistry or Dental Surgery, Doctor of Podiatry, Doctor of Optometry and Doctor of Chiropractic Medicine; these will collectively be referred to as “U.S. M.D. authors” for the rest of this paper(5).

Using U.S. articles (i.e., articles with at least one U.S. author), the following information was recorded and used to calculate four main outcomes. The percentage of U.S. articles with disclosures (outcome 1) was calculated using the total number of U.S. articles with at least one disclosure and the total number of U.S. articles. The average number of disclosures per U.S. article (outcome 2) was calculated using the total sum of disclosures from all U.S. articles and the total number of U.S. articles. The percentage of U.S. authors with disclosures (outcome 3) was calculated using the number of U.S. authors with disclosures and the total number of U.S. authors. Lastly, the percentage of U.S. M.D. authors with disclosures (outcome 4) was calculated using the number of U.S. M.D. authors with disclosures and the total number of U.S. M.D. authors. For each of these four outcomes, an independent sample t-test and/or a chi-square test was performed to obtain a p-value and determine the statistical significance of any increase between the these four outcomes during the two time frames studied. Analyses were stratified by journal (JNS, JNS-Spine and JNS-Pediatrics).

The types of disclosures for each author were also recorded and categorized into the following categories: not-for-profit grant (NFPG), industry grant (IG), other industry support (IS), industry consultant (C), stock ownership (SO), royalties (R), honoraria (H), industry employee (E) and patents (P). All but NFPG are considered industry related disclosures.

To create consistency in data collection, the following protocols were generated and followed for this phase of the project. Certain descriptions of COIs were ambiguous and thus this system of classification was followed: travel expenses and equipment donations from industry were considered other industry support (IS), members of an advisory board or board of directors were considered consultants (C), members of a speaker's bureau or lecturers were considered to be an honorarium (H). Grants were categorized as industry grants (IG), which included grants from any company or industry, and not-for-profit grants (NFPG), which included grants from philanthropic foundations, government, universities and hospitals, and physician associations. When a grant was listed in the disclosure section without the name of a specific author recipient, the article was noted and each non-specific grant was counted as one disclosure, as if it were assigned to one author.

Phase 2

The second phase of this project studied U.S. M.D. authors from four leading neurosurgical journals, JNS, JNS-Spine, JNS-Pediatrics, and Neurosurgery, during a five-month period from August – December 2013 (the first partial year of available data on OPD). For each author, the following data were recorded: presence of voluntary disclosure in the academic journal, number of COIs disclosed and type of COI disclosed (using the nine categories listed above). Each author was subsequently searched on the OPD and the following information was recorded: the presence of an industry-reported disclosure, the number of disclosures/transactions, the type of COI (classified under four categories: general, research funding, associated research funding, and ownership), and the exact monetary amount, which was further classified into four categories: <$1,000.00, $1,000.00 - $9,999.99, $10,000.00 - $99,999.99, and >$100,000.00. The total monetary value of all disclosures from each journal was calculated to quantify the true impact of industry on physicians who publish research in leading neurosurgery journals. The mean, standard deviation, median and range of OPD disclosures from August – December 2013 for researchers in each journal were also calculated using Microsoft Excel.

U.S. M.D. authors were categorized into four groups based on the presence or absence of a voluntary disclosure in the journal and a mandatory industry disclosure on OPD. The following data were calculated: the percentage of physicians who reported a COI to the journal and were also found to have received industry funding on OPD, the percentage of physicians who neither reported a COI to the journal and were not found on OPD, the percentage of physicians who reported a COI to the journal but were not found on OPD, and the percentage of physicians who did not report a COI to the journal but were found to have received industry funding on OPD. Further analysis was conducted to characterize the scope of industry payments, according to OPD, for authors who failed to disclose (i.e. authors who did not report a COI in the journal but who were found to have received industry funding on OPD). For this group of authors, the size of the disclosure was classified into four categories: <$1,000.00, $1,000.00 - $9,999.99, $10,000.00 - $99,999.99, and >$100,000.00. The mean, standard deviation, median and range of OPD disclosures from August – December 2013 for researchers who failed to disclose in the same time period were also calculated using Microsoft Excel.

Similar to Phase 1 of the study, several protocols were created to maintain consistency in data collection. The specialty or area of practice and the city/state of practice were used to identify physicians on OPD, when they could not be identified based on their first

and last name alone. In many cases, there were discrepancies between the journal and OPD on one of these two variables. When the author information matched the department and city/state on OPD we assumed the person was correctly identified. Conversely, if neither the department nor city/state on OPD matched the author information, then we assumed that the person on the database was not a match for the author. When an author could not be definitively matched to a physician on OPD, we excluded this author from the data; there were six authors excluded from JNS and none excluded from the other three journals.

RESULTS

Phase 1

In JNS-Spine, the percentage of U.S. articles with at least one disclosure was 36.6% in 2011 and 73.1% in 2013 ($p<0.001$). The average number of disclosures per U.S. based article was 1.85 in 2011 and 8.54 in 2013 ($p=0.008$). The percentage of all U.S. authors with disclosures was 10.6% in 2011 and 31.8% in 2013 ($p<0.001$). The percentage of U.S. M.D. authors with disclosures was 10.7% in 2011 and 35.4% in 2013 ($p<0.001$) (See Figure 1). Each of these four findings showed a statistically significant increase in voluntary disclosure between the two time frames studied. The results from JNS and JNS-Pediatrics showed no similar increase.

In JNS, the percentage of U.S. articles with at least one disclosure was 43.0% in 2011 and 43.7% in 2013 ($p=0.93$). The average number of disclosures per U.S. article was 1.53 in 2011 and 1.29 in 2013 ($p=0.46$). The percentage of all U.S. authors with disclosures was 11.6% in 2011 and 10.3% in 2013 ($p=0.53$). The percentage of U.S. M.D. authors with disclosures was 13.2% in 2011 and 11.1% in 2013 ($p=0.39$) (See Figure 2).

In JNS-Pediatrics, the percentage of U.S. articles with at least one disclosure was 28.0% in 2011 and 26.9% in 2013 ($p=0.90$). The average number of disclosures per U.S. article was 0.76 in 2011 and 0.87 in 2013 ($p=0.81$). The percentage of all U.S. authors with disclosures was 9.4% in 2011 and 6.4% in 2013 ($p=0.21$). The percentage of U.S. M.D. authors with disclosures was 9.3% in 2011 and 5.6% in 2013 ($p=0.14$) (See Figure 3).

Phase 2

The primary purpose of the second phase of the study was to verify the accuracy of voluntary disclosure of COIs in the journals by comparing it to mandatory disclosure made available on the OPD in the same epoch (August – December 2013 – the first partial year available on the OPD). In addition, we sought to obtain a snapshot of the extent of industry support, in any form, to authors publishing in major neurosurgery journals. The results from the second phase of the study quantified the amount of monies involved in physician-industry relationships, and thus highlighted the magnitude of the COI.

Several pieces of data were calculated to describe the scope of industry involvement in in neurosurgical research. The total value of all monetary disclosures in OPD from August – December 2013, was calculated for each of the four journals. The total value of disclosures was $4,004,566.26 in JNS, $16,029,231.56 in JNS-Spine, $554,569.57 in JNS-Pediatrics and $12,010,155.58 in Neurosurgery (See Figure 4). Thus, overall,

$32,598,522.97 million of industry payments were provided to 656 U.S. M.D. authors, an average of $49,692.87 per author. Each disclosure was classified into four ranges: <$1,000.00, $1,000.00 - $9,999.99, $10,000.00 - $99,999.99, and >$100,000.00 (See Figure 4). The mean, standard deviation, median and range of OPD disclosures from August – December 2013 for researchers in each journal were also calculated to further characterize the scope of industry payments to physicians (See Figure 5).

A comparison of the presence of voluntary disclosure in journals with mandatory industry disclosure on OPD provided an estimate of the rate of failure to disclose among physicians publishing in neurosurgical journals. Of the 443 U.S. M.D. authors in JNS, 8.4% had a disclosure in both the journal and on OPD, 46.7% had neither a journal disclosure nor a disclosure on OPD, 2.7% had only a journal disclosure, and 42.2% had a disclosure on OPD that was not voluntarily disclosed in the journal (See Figure 6). Of the 240 U.S. M.D. authors in JNS-Spine, 32.9% had a disclosure in both the journal and on OPD, 30.4% had neither a journal disclosure nor a disclosure on OPD, 2.5% had only a journal disclosure, and 34.2% had a disclosure on OPD that was not voluntarily disclosed in the journal (See Figure 7). Of the 216 U.S. M.D. authors in JNS-Pediatrics, 2.8% had a disclosure in both the journal and on OPD, 60.6% had neither a journal disclosure nor a disclosure on OPD, 2.8% had only a journal disclosure, and 33.8% had only a disclosure on OPD that was not voluntarily disclosed in the journal (See Figure 8). Of the 357 U.S. M.D. authors in Neurosurgery, 14.8% had a disclosure in both the journal and on OPD, 42.9% had neither a journal disclosure nor a disclosure on OPD, 3.4% had only a journal disclosure, and 38.9% had a disclosure on OPD that was not voluntarily disclosed in the journal (See Figure 9).

For those authors who failed to disclose in papers published from August – December 2013, the total monetary value of industry payments was calculated. These disclosures were then classified into four ranges: <$1,000.00, $1,000.00 - $9,999.99, $10,000.00 - $99,999.99, and >$100,000.00 (See Figure 10).

The mean and range of OPD disclosures from August – December 2013 for researchers who failed to disclose in papers published in the same time period were calculated. For JNS, the mean value of disclosure per author was $16,396.06 and the range was $10.39 - $760,137.85. For JNS-Spine, the mean value of disclosure per author was $37,084.30 and the range was $10.50 - $299,995.17. For JNS-Pediatrics, the mean value of disclosure per author was $6,076.51 and the range was $10.11 - $257,095.74. For Neurosurgery, the mean value of disclosure per author was $47,265.21 and the range was $10.80 - $899,372.96 (See Figure 11).

DISCUSSION

We hypothesized that the advent of mandatory industry disclosure in OPD would result in an increase in voluntary disclosure of COIs in major neurosurgery journals. While this was true in JNS-Spine, there was no similar statistically significant increase in voluntary disclosure in JNS and JNS-Pediatrics. The increase in the number of authors who disclosed COI in JNS-Spine may be due to many factors including increased awareness of the importance of disclosing COIs, increasingly stringent disclosure requirements from journals as well as the implementation of the Sunshine Act. It is possible that there has also been a true increase in COIs that require disclosure between the two time frames studied. The lack of significant increase in the number of authors with disclosures from 2011 to 2013 in JNS and JNS-Pediatrics may be related to an overall greater amount of

industry involvement in spine surgery as suggested by the significantly larger payments to those publishing in JNS-Spine.

Our findings show that 38.3% of U.S. M.D. authors had a payment disclosed in OPD that was not voluntarily disclosed in research published in the journals analyzed in the same time period. This failure to disclose ranged from 33.8% in JNS-Pediatrics to 42.2% in JNS. While the majority of those who failed to disclose received a relatively small amount of compensation (40.2% - 61.0% of authors had a disclosure <$1,000), in some cases, the amount not disclosed was significant, as much as $899,372.96 for one author in Neurosurgery. These results are consistent with literature on rates of disclosure of COI in other surgical specialties. In Okike *et. al.*'s 2009 study on disclosure by orthopedic surgeons, the rate of non-disclosure was 28.8%(6). Their method involved comparing payment reports to physicians from five major device manufacturers in 2007 to voluntary disclosures from physicians who attended the 2008 annual meeting of the American Academy of Orthopedic Surgeons(6).

There are a number of reasons why a researcher may have not disclosed a COI: 1) they may have felt the compensation received from industry was unrelated to the research published, 2) they may not have received the compensation found in the OPD when the research was being conducted 3) it may have been a true failure to disclose a COI. The purpose of this study was to obtain a snapshot of COI disclosure at the start of the "Open Payments" era and so a detailed analysis of the reasons for a failure to disclose is beyond its scope. We suspect that at least some of the discrepancy is related to a true failure to disclose what is in many cases a significant monetary COI. This underscores the limitations of voluntary disclosure. In addition, the disclosure requirements in the journals studied left it up to the individual researcher to decide whether compensation received was relevant to the research published. We suggest that all compensation from industry should be disclosed and that it be left to either the reader or the editorial board of the journal to decide its significance.

Physician-Industry Relationships

Medical professionals are exposed to industry early in their career. Medical students, residents, those engaged in continuing medical education (CME), and those involved in clinical practice and research all interact with, and often receive support from industry(10). Moreover, these interactions increase in frequency and importance as physicians gain experience and stature(10). Many recognize when an interaction with industry is inappropriate but unfortunately, this attitude does not always appear to reflect behavior(10). In a survey of medical students, more than 85% of those who thought accepting a small gift or lunch was inappropriate reported accepting them anyway(16). In a similar survey of internal medicine residents, 100% of those who thought interactions with industry were inappropriate accepted at least a lunch or a pen(17). Physicians frequently deny any changes in their behavior as a result of their relationships with industry and often become irritated at the suggestion(10). However, recent studies have revealed that relationships with industry do indeed alter our clinical actions through pharmaceutical detailing (hired personnel devoted to advertising products) and medication samples(10). As much as $57.5 billion was spent on promotional activities in 2004; $15.9 billion on samples and $20.4 billion on detailing(18). In one survey, 61% of physicians reported that their actions were uninfluenced by industry, but only 16% thought that their colleagues had remained uninfluenced(17).

Given the disparity between the attitude and behavior of medical professionals and the apparent self-proclaimed immunity from bias by physicians, it is clear that COIs are poorly understood, infrequently disclosed and inconsistently managed by physicians and institutions(10). This underlines the importance of this study and understanding the current rate of non-disclosure among physicians publishing in neurosurgical literature.

Limitations of the Sunshine Act and Voluntary Disclosure

The Sunshine Act does not require manufacturers to report relationships with other medical professionals or university employees such as Ph.D.s or nurse practitioners. Although these professionals may not always interact directly with patients, they may be involved in research studies whose results will impact patient care, and therefore they should be held to the same standard as physicians when it comes to reporting COIs. The appeal process outlined by the Sunshine Act and OPD allows physicians to refute company data and thus delay its publication online. This is a major limitation of the Sunshine Act as these controversial physician-industry relationships may be most likely to go undisclosed by physicians in academic journals. While the U.S. has been a pioneer in the area of COIs and disclosure, laws like the Sunshine Act need to be implemented in other countries as well. Of the three U.S. journals studied in the first phase of the project, over 35% of the articles from the 2013 time frame were not from the U.S., leaving a large group of authors and research studies without pressure to disclose.

Disclosure, by physician and industry, is an important first step in managing COIs, but it is by no means a panacea(4). The disclosures required from physicians in the journals studied are simple disclosures, that is, they do not require monetary values(4). This is a major limitation of the voluntary disclosure process. In our opinion, the size of the COI is critical in determining the possibility of bias; it has been argued that the “greater the value of the secondary interest – the larger the financial gain – the more likely its influence on researchers judgment”(19). In the context of research, disclosure allows reviewers and ultimately readers to determine for themselves if a COI is large enough to bias the results of the study, and therefore enough information must be given to readers to form an opinion (4). Beyond the actual value of the disclosure, context, including the nature and distribution of the funds and length of the relationship with industry should also be required in order for the public to make an informed decision(1,20).

Is Disclosure Enough?

If we imagine that the limitations of both voluntary author disclosure and mandatory industry disclosure are resolved, we are still left to question if disclosure remains useful. The significant rates of non-disclosure in the journals analyzed suggest that physicians themselves may not appreciate the potential for bias that monetary COIs introduce. Disclosure places the burden of interpretation and action on to readers, patients and the public as a whole, who may not know how to interpret this information(10). Thompson argues that, “disclosing a conflict only reveals a problem, without providing any guidance for resolving it”(1). In a recent series of articles in the New England Journal of Medicine, Rosenbaum argues that “as the public observes this spiral of blame and shame, the conflict-of-interest movement has paradoxically achieved what it set out to avert: an erosion of public trust in medicine and science”(21). Both Rosenbaum and Thompson outline an important point about disclosure; it shines a light on the potential for bias without providing a solution, and often results in misinterpretation by the public(1,21). Rosenbaum rightly explores other forms of COIs and states that our judgments may be

motivated as much by financial support as they are by fatigue, the diagnosis of a previous patient, or a memory of a patient who died(22).

While there are important questions about the effectiveness of disclosure, we believe that it remains an important and logical step in the management of COIs and efforts should continue to be made by the medical profession to improve the process of disclosure. It is our contention that more disclosure is required, not less.

Clinical Implications

Industry funded research has significantly increased over the past decades(10). We wish to make it clear that we are not suggesting that industry should not play a role in research. Physician-industry relationships are critical to the development of novel therapies and devices and without it, much clinical research would come to a grinding halt. Because of this, however, we believe the results of this study underscore how important disclosure of these relationships is to maintaining the integrity of industry sponsored research and relationships with physicians.

Limitations & Strengths

Our study has several limitations. First, we compared data in OPD from August – December 2013 with research published in the journals studied in the same epoch. It is possible that no industry relationship was present at the time the research was carried out, and hence no COI present. We believe, however, that it is likely that relationships with industry are sustained over time. Results from our data collection showed that of the physicians who had a disclosure in OPD in 2013, an average of 91.9% (89.1% - 98.1%) had another disclosure in OPD in 2014, supporting our conjecture about the sustained nature of physician and industry relationships over time. Thus, we feel it likely that a relationship with industry in 2013 was likely present at the time the research was conducted.

Second, we studied a relatively short interval – the first five months of available data on OPD. Further study of later data will confirm whether or not these trends are robust. Third, we looked at only four neurosurgical journals. Although the journals studied are the leading neurosurgery journals in North America and among the leading neurosurgical journals in the world, they may not be representative of the world-wide neurosurgical research. Finally, the Sunshine Act applies only to U.S. based physicians and so our data does not include research conducted outside the U.S. Over 35% of the research published in the journals studied was undertaken by non-U.S. based physicians. Industry payment to physicians outside the U.S. may not follow the same patterns.

Despite the limitations of this study, we believe it provides an interesting snapshot of monetary COIs in neurosurgical research and raises concerns about the limitations of voluntary disclosure of COIs in neurosurgical research.

Future Directions

Future directions for this study include continuous analysis of the large databases that were created for this project. The information presented in this article is only a small subset of the potential data that could be collected. As more data is released onto the

OPD, further data can be collected and compared to the four academic journals as well as other academic journals. Finally, as mentioned in the limitations of this study, when the time frames align the accuracy of the content of disclosures can be analyzed using OPD.

Conclusion

Our results indicate a statistically significant increase in the percentage of U.S. M.D. authors with disclosures in JNS-Spine from 2011 (10.7%) to 2013 (35.4%) ($p<0.001$). Potential reasons for this increase include increased awareness of the importance of disclosure, increased stringency from medical journals, the implementation of the Sunshine Act or an actual increase in funding requiring disclosure. While the increase in the rate of disclosure among physicians is encouraging, the results from the other two journals, JNS and JNS-Pediatrics, indicate that there continue to be many issues with the process of disclosure. Disclosure is an important first step to managing COIs as it creates transparency about the large monies involved in physician-industry relationships. According to OPD, $32,598,522.97 million of industry payments were provided to 656 U.S. M.D. authors from all four journals studied from August – December 2013, an average of $49,692.87 per author. The average rate of non-disclosure in all four neurosurgical journals was 38.3% (33.8% - 42.2%). This number is significant and indicates that there are ongoing limitations of voluntary disclosure. We argue strongly that more disclosure is at least part of the solution, thus leaving it to the individual reader to decide if the COI creates enough bias to render the results of a study open to question.

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FIGURES

Figure 1: COI Disclosure in JNS-Spine between 2011 and 2013

	2011 (78 total articles)	2013 (85 total articles)	p-value
U.S. articles with disclosures (percent)	15 of 41 (36.6%)	38 of 52 (73.1%)	<0.001
Mean number of disclosures per U.S. article (SD)	1.85 (4.64)	8.54 (15.14)	0.008
U.S. authors with disclosures (percent)	23 of 218 (10.6%)	92 of 289 (31.8%)	<0.001
U.S. M.D. authors with disclosures (percent)	19 of 177 (10.7%)	85 of 240 (35.4%)	<0.001

Figure 2: COI Disclosure in JNS between 2011 and 2013

	2011 (128 total articles)	2013 (177 total articles)	p-value
U.S. articles with disclosures (percent)	34 of 79 (43.0%)	52 of 119 (43.7%)	0.93
Mean number of disclosures per U.S. article (SD)	1.53 (2.46)	1.29 (2.14)	0.46
U.S. authors with disclosures (percent)	48 of 415 (11.6%)	61 of 592 (10.3%)	0.53
U.S. M.D. authors with disclosures (percent)	41 of 311 (13.2%)	50 of 449 (11.1%)	0.39

Figure 3: COI Disclosure in JNS-Pediatrics between 2011 and 2013

	2011 (81 total articles)	2013 (84 total articles)	p-value
U.S. articles with disclosures (percent)	14 of 50 (28.0%)	14 of 52 (26.9%)	0.90
Mean number of disclosures per U.S. article (SD)	0.76 (1.62)	0.87 (2.68)	0.81
U.S. authors with disclosures (percent)	23 of 244 (9.4%)	17 of 265 (6.4%)	0.21
U.S. M.D. authors with disclosures (percent)	19 of 205 (9.3%)	12 of 216 (5.6%)	0.14

Figure 4: OPD disclosure from August – December 2013 for researchers publishing in same time frame

	JNS	JNS-Spine	JNS-Pediatrics	Neurosurgery
Total value (USD)	$4,004,566.26	$16,029,231.56	$554,569.57	$12,010,155.58
Total authors on OPD	224	161	79	192
Disclosures <$1,000.00 (percent)	131 of 224 (58.5%)	40 of 161 (24.8%)	52 of 79 (65.8%)	83 of 192 (43.2%)
Disclosures $1,000.00 - $9,999.99 (percent)	56 of 224 (25.0%)	27 of 161 (16.8%)	19 of 79 (24.1%)	39 of 192 (20.3%)
Disclosures $10,000.00 - $99,999.99 (percent)	30 of 224 (13.4%)	50 of 161 (31.1%)	7 of 79 (8.9%)	47 of 192 (24.5%)
Disclosures >$100,000.00 (percent)	7 of 224 (3.1%)	44 of 161 (27.3%)	1 of 79 (1.3%)	23 of 192 (12.0%)

Figure 5: Mean, median and range of OPD disclosures for researchers from August – December 2013

	JNS	JNS-Spine	JNS-Pediatrics	Neurosurgery
Mean (USD) (SD)	$17,877.53 ($78,386.57)	$99,560.44 ($208,672.10)	$7,019.87 ($30,572.20)	$62,552.89 ($178,527.26)
Median (USD)	$339.39	$23,514.43	$330.73	$3,040.94
Range (USD)	$10.39 – $760,137.85	$10.50 – $1,985,082.70	$10.11 - $257.095.74	$10.80 – $1,360,603.75

Figure 6: Voluntary disclosure in JNS compared to mandatory industry-disclosed data on OPD from August – December 2013

	2013 (443 total authors)
Authors with disclosure in journal and OPD (percent)	37 of 443 (8.4%)
Authors with no disclosure in both journal and OPD (percent)	207 of 443 (46.7%)
Authors with disclosure in journal only (percent)	12 of 443 (2.7%)
Authors with disclosure in OPD only (percent)	187 of 443 (42.2%)

Figure 7: Voluntary disclosure in JNS-Spine compared to mandatory industry-disclosed data on OPD from August – December 2013

	2013 (240 total authors)
Authors with disclosure in journal and OPD (percent)	79 of 240 (32.9%)
Authors with no disclosure in both journal and OPD (percent)	73 of 240 (30.4%)
Authors with disclosure in journal only (percent)	6 of 240 (2.5%)
Authors with disclosure in OPD only (percent)	82 of 240 (34.2%)

Figure 8: Voluntary disclosure in JNS-Pediatrics compared to mandatory industry-disclosed data on OPD from August – December 2013

	2013 (216 total authors)
Authors with disclosure in journal and OPD (percent)	6 of 216 (2.8%)
Authors with no disclosure in both journal and OPD (percent)	131 of 216 (60.6%)
Authors with disclosure in journal only (percent)	6 of 216 (2.8%)
Authors with disclosure in OPD only (percent)	73 of 216 (33.8%)

Figure 9: Voluntary disclosure in Neurosurgery compared to mandatory industry-disclosed data on OPD from August – December 2013

	2013 (357 total authors)
Authors with disclosure in journal and OPD (percent)	53 of 357 (14.8%)
Authors with no disclosure in both journal and OPD (percent)	153 of 357 (42.9%)
Authors with disclosure in journal only (percent)	12 of 357 (3.4%)
Authors with disclosure in OPD only (percent)	139 of 357 (38.9%)

Figure 10: OPD disclosure from August – December 2013 for researchers who failed to disclose in the same time frame

	JNS	JNS-Spine	JNS-Pediatrics	Neurosurgery
Total value (USD)	$3,066,063.02	$3,040,912.31	$443,585.31	$6,569,863.89
Authors who failed to disclose (percent)	187 of 443 (42.2%)	82 of 240 (34.2%)	73 of 216 (33.8%)	139 of 357 (38.9%)
Disclosures <$1,000.00 (percent)	114 of 187 (61.0%)	33 of 82 (40.2%)	50 of 73 (68.5%)	74 of 139 (53.2%)
Disclosures $1,000.00 - $9,999.99 (percent)	47 of 187 (25.1%)	20 of 82 (24.4%)	18 of 73 (24.7%)	29 of 139 (20.9%)
Disclosures $10,000.00 - $99,999.99 (percent)	20 of 187 (10.7%)	16 of 82 (19.5%)	4 of 73 (5.5%)	25 of 139 (18.0%)
Disclosures >$100,000.00 (percent)	6 of 187 (3.2%)	13 of 82 (15.9%)	1 of 73 (1.4%)	11 of 139 (7.9%)

Figure 11: Mean, median and range of OPD disclosures from August – December 2013 for researchers who failed to disclose in the same time frame

	JNS	JNS-Spine	JNS-Pediatrics	Neurosurgery
Mean (USD) (SD)	$16,396.06 ($77,015.62)	$37,084.30 ($75,322.09)	$6,076.51 ($31,112.35)	$47,265.21 ($153,322.75)
Median (USD)	$323.00	$2,725.00	$248.75	$462.17
Range (USD)	$10.39 - $760,137.85	$10.50 - $299,995.17	$10.11 - $257,095.74	$10.80 - $899,372.96