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# Financial conflicts of interest of physicians followed by neurosurgical journals on Twitter

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## Abstract

**Background:** Social media, particularly Twitter, has played an increasing role in networking and the dissemination of neurosurgical research. Despite extensive study on financial conflicts of interest (FCOI) influencing medical research, little is known about the function of conflicts of interest on social media and the influence they may have. In this study, we sought to evaluate the FCOI of physicians followed on Twitter by the top three neurosurgical journals.

**Materials and Methods:** We analysed the FCOI of United States (US) physicians followed by the top three neurosurgical journals (*Journal of Neurosurgery*, *World Neurosurgery*, *Neurosurgery*) on Twitter. We determined the FCOIs of each physician using the Open Payments Search Tool located at <https://openpaymentsdata.cms.gov> and summed the data between 2014 and 2021.

**Results:** We examined 2651 Twitter accounts followed by the top three neurosurgical journals on Twitter and determined 705 (26.6%) belonged to US physicians. Of the 705 US physicians, 577 (81.8%) received general payments between 2014 and 2021. After excluding US physicians currently in residency or fellowship ( $n = 157$ ), this percentage increased to 93.2% ( $n = 511/548$ ). In total, nearly \$70 million in general payments were made between 2014 and 2021.

**Conclusion:** These findings raise questions regarding the interaction between neurosurgical journals and the medical community on Twitter. This study may serve as the basis for

future work on best practices for medical journals navigating their affiliations on Twitter.

#### KEYWORDS

financial conflicts of interest, health policy, neurosurgery, social media, Twitter

#### Highlights

- Neurosurgical journals commonly use Twitter to disseminate medical research.
- Financial conflicts of interest (FCOI) are a way medical research is impacted.
- Most physicians followed by neurosurgical journals on Twitter have FCOIs.
- The accounts journals follow may represent constituents who have the capacity to influence research agendas.

## 1 | INTRODUCTION

In the neurosurgical community, social media is widely used by physicians, academic departments, and medical journals.<sup>1</sup> Platforms such as Twitter have begun to play an important role in the dissemination of research results and their interpretation. For example, according to a prospective randomised controlled trial, tweeting articles resulted in increased citations over time.<sup>2</sup> Twitter is also associated with other measures of academic prowess, such as a positive relationship between social media influence and academic influence (i.e., *h*-index) among neurosurgeons.<sup>3</sup> What is unclear, however, is the role of financial conflicts of interest (FCOIs) in academic medicine on Twitter.

Social media platforms offer a unique space to research the effects of FCOIs since users may participate in medical discourse with broad audiences, ranging from the individual level (e.g., the lay public, medical experts) to groups (e.g., medical journals, academic organisations). The influence of FCOIs on social media material is not negligible, as its potential consequences have been widely established in other medical specialties such as haematology-oncology.<sup>4-7</sup> FCOIs are a potential barrier to delivering the best possible patient care because of recognised associations with clinical practice guidelines, scholarly performance, prescription patterns, and medical research outcomes.

Of particular interest are the Twitter accounts followed by top neurosurgical journals. These journals publish the most influential findings, and the accounts they follow may represent constituents who have the capacity to influence research agendas. In other words, the journals consider these individuals important enough to follow, suggesting that the journals may be within their sphere of influence. However, at the time of this writing, there is no research evaluating FCOIs among neurosurgeons on Twitter. For these reasons, we sought to evaluate the FCOIs of physicians followed on Twitter by the top three neurosurgical journals.

## 2 | METHODS

The top three neurosurgical journals were selected based on Google Scholar's ranking: (1) *Journal of Neurosurgery*; (2) *World Neurosurgery*; (3) *Neurosurgery*. All accounts that each medical journal followed on Twitter were collected on 7 April 2022. Accounts that were either (1) not based in the United States (US) or (2) not physicians were omitted from analysis since they would not be covered by the Affordable Care Act's Open Payments provision for the selected

date range (2014–2021).<sup>8</sup> If specified in the account's biographical section, training status (e.g., resident, fellow) was collected.

We determined the FCOIs of each physician using the Open Payments Search Tool located at <https://openpaymentsdata.cms.gov>. FCOI data were collected and summed between 2014 and 2021, which included: (1) general payments (e.g., consultancy fees, honoraria, travel, accommodation, food, and beverage); (2) research payments; and (3) companies making general payments.

R statistical software (version 2022.02.1; Build 461) was used for descriptive statistical analysis. We did not seek permission from the institutional review board since Twitter and Open Payments data are publicly available.

### 3 | RESULTS

We examined 2651 Twitter accounts followed by the top three neurosurgical journals on Twitter and determined 705 (26.6%) belonged to US physicians. Of the 705 US physicians, 577 (81.8%) received general payments between 2014 and 2021. After excluding US physicians currently in residency or fellowship ( $n = 157$ ), this percentage increased to 93.2% ( $n = 511/548$ ).

US physicians followed by the top three neurosurgical journals on Twitter received a median of \$2600 in general payments (interquartile range, \$100–27,000). Of the 577 US physicians that received general payments, 94 (13.3%) received more than \$100,000 in general payments between 2014 and 2021 (Table 1). In total, nearly \$70 million in general payments were made between 2014 and 2021.

The median general payments paid to US physicians followed by the *Journal of Neurosurgery*, *World Neurosurgery*, and *Neurosurgery* were \$10,600, \$2900, and \$3600, respectively. Illustrative data pertaining to companies making general payments are shown in Figure 1.

### 4 | DISCUSSION

As medicine has rapidly advanced over the past century, the markets that have helped facilitate this growth appear to have grown exponentially. Collaboration between the medical sciences and corporate sector has been essential to innovation and, as a natural consequence, the two have become intertwined. There are several benefits to this relationship, including medical education, entrepreneurship, and research and development (R&D).<sup>9</sup> However, the industry's rapid development has not been without problems.

It is now estimated that the industry funds two-thirds (66%, \$161.8 billion) of the US biomedical R&D, with the federal government funding just one-quarter (25%; \$61.5 billion).<sup>10</sup> Because corporations have a for-profit infrastructure, FCOIs among medical journals, physicians, and public health officials are of concern as they obscure the boundaries of ethical patient care and policy-making. FCOIs may be defined as 'a set of conditions in which professional judgement concerning a primary interest (such as a patient's welfare or the validity of research) tends to be unduly influenced by a secondary interest (such as financial gain)'.<sup>11,12</sup> In other words, FCOIs hinder one's capacity to be objective in medical decision making, regardless of how good one's intentions are, conscious or subconscious.

As the private sector has grown, its ties to healthcare have seeped down to the individual level, namely the physician-industry relationship, leaving many areas of medicine exposed to FCOI biases. Here are four examples.

First, FCOIs may affect clinical practice guidelines, resources many physicians utilise for definitive recommendations for the current standard of care. A systematic review analysing approximately 15,000 guideline authors from 37 studies showed nearly half (45%) had at least one FCOI.<sup>13</sup> Not only are FCOIs common among guidelines authors, but conflicted authors may be more likely to endorse a company's drug/device in a clinical guideline.<sup>14</sup>

Among neurosurgeons, a FCOI evaluation of 60 physician-authors of the Congress of Neurological Surgery's clinical practice guidelines revealed \$4.4 million in undisclosed payments.<sup>15</sup> Furthermore, FCOIs among guideline

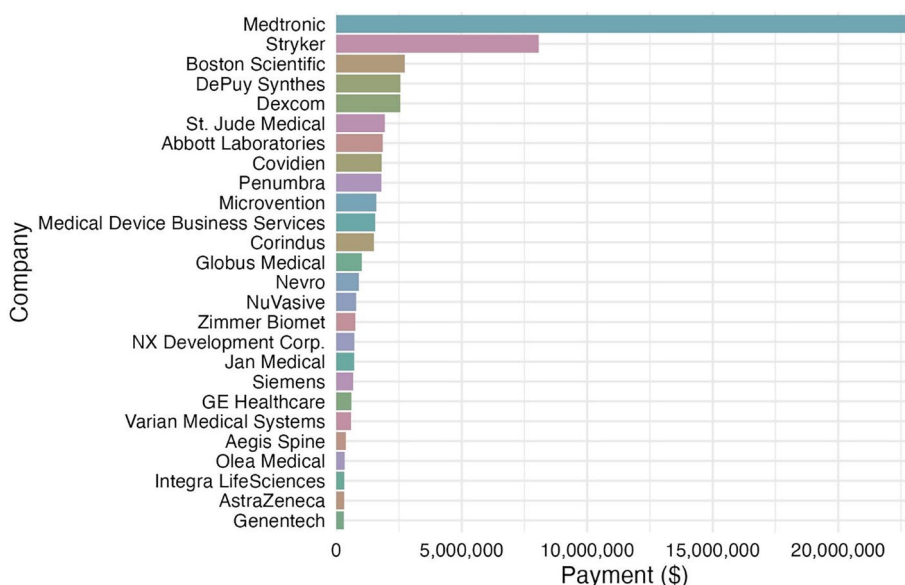
**TABLE 1** Characteristics of US physicians followed by (a) JNS; Journal of Neurosurgery, (b) World Neurosurgery, and (c) Neurosurgery on Twitter between 2014 and 2021

Characteristic	JNS (n = 225)	World neurosurgery (n = 228)	Neurosurgery (n = 620)	Combined (n = 705) <sup>a</sup>
General payments (\$) from 2014 to 2021				
Minimum payment	0	0	0	0
1st Quartile	400	0	200	100
Median	10,600	2900	3600	2600
Mean	167,600	93,800	101,600	97,800
3rd Quartile	62,900	29,700	30,500	27,000
Interquartile range (IQR)	62,500	29,700	30,300	26,900
Maximum payment	3,992,800	3,992,800	5,003,400	5,003,400
Total payment	37,488,600	21,383,500	62,982,700	68,976,800
Distribution of general payments (\$) from 2014 to 2021				
Received \$0, n (%)	29 (12.9)	54 (23.7)	90 (14.5)	128 (18.1)
Received <\$10,000, n (%) <sup>b</sup>	82 (36.4)	87 (38.2)	282 (45.4)	314 (44.5)
Received >\$10,000, n (%) <sup>c</sup>	67 (29.8)	57 (25.0)	161 (26.0)	169 (23.9)
Received >\$100,000, n (%)	47 (20.9)	30 (13.2)	87 (14.0)	94 (13.3)
Research payments (\$) from 2014 to 2021				
Median	0	0	0	0
Mean	4400	1600	2500	2600
Maximum payment	221,300	221,300	221,900	221,900
Total payment	991,600	366,800	1,545,800	1,800,100
Distribution of research payments (\$) from 2014 to 2021				
Received \$0, n (%)	188 (83.6)	205 (91.1)	538 (86.8)	616 (87.4)
Received <\$10,000, n (%) <sup>b</sup>	24 (10.7)	17 (7.6)	56 (9.0)	60 (8.5)
Received >\$10,000, n (%) <sup>c</sup>	12 (5.3)	5 (2.2)	22 (3.5)	23 (3.3)
Received >\$100,000, n (%)	4 (1.2)	1 (0.44)	4 (1.8)	5 (0.71)
Top 3 companies making general payments 2014–2021 (\$)				
	Medtronic (10,721,100)	Medtronic (5,768,300)	Medtronic (21,550,700)	Medtronic (22,776,600)
	Stryker (5,676,500)	Stryker (4,341,100)	Stryker (8,031,900)	Stryker (8,070,700)
	Dexcom (2,554,200)	Dexcom (2,554,200)	Boston Scientific (2,667,300)	Boston Scientific (2,729,500)

<sup>a</sup>Adjusted for duplicates across journals (i.e., physicians were often followed by more than one journal included in the analysis).

<sup>b</sup>Excludes the \$0 value.

<sup>c</sup>Does not include values >\$100,000.



**FIGURE 1** The total amount (\$) in general payments paid by the top 5% of 522 companies to US physicians followed by the top three neurosurgical journals on Twitter between 2014 and 2021.

authors are not a problem limited to the US; a study of the European Society of Cardiology guidelines found that 80% of guideline committee authors had relevant FCOIs. Additionally, a majority of the research cited to support the guidelines had authors with FCOIs.<sup>16</sup> Unfortunately, in contrast with the United States, there is no single, central and mandatory disclosure source in the European Union.

Second, FCOIs impact the conduct of medical research, as evidenced by the link between industry funding and positive study results.<sup>12</sup> In a Cochrane systematic review of 4500 papers, it was discovered that industry sponsored studies were more likely to have favourable conclusions than non-industry sponsored studies.<sup>17</sup> Other researchers have found that industry sponsored cost-effectiveness studies are 30 times more likely to find cost effectiveness.<sup>18</sup>

Third, FCOIs may influence academia and authors of academic publications as there is an association with increased academic productivity<sup>19,20</sup> and impact.<sup>21</sup> An analysis of 435 authors of haematology and oncology papers in the top 3 general medical (e.g., *New England Journal of Medicine*) and oncology journals (e.g., *The Lancet Oncology*) found that for every \$10,000 in general payments received from the pharmaceutical industry by an author, there was an associated increase of 1.99 more papers published.<sup>22</sup> Though these associations have not been established to be causal, they suggest a link between FCOIs and scholarship.

Fourth, content curated by physician-researchers on social media sites like Twitter may serve to educate their audience and shape dialogue around certain topics. Thus, they serve as the digital equivalent of a key opinion leader (i.e., trusted experts or representatives of fields of medicine). If these persons have FCOIs or fail to disclose industry support, the content they create may be subject to bias.

One analysis showed that nearly 80% of US-based hematologists-oncologists on Twitter had FCOIs.<sup>7</sup> Further investigation of 156 physicians who received at least \$1000 in payments revealed that 126 (of 156, 81%) tweeted about a drug from a company they received payments from, and that the content of the tweets referencing these drugs was significantly more likely to be positive than negative.<sup>6</sup> Additionally, of these 156 physicians, only 2 (of 156, 1.3%) disclosed their FCOI on their profile. Moreover, the potential for FCOIs to influence tweet content is not unique at the individual level either, as an analysis of an informal oncology network on Twitter revealed tweets discussing clinical trials or drugs were nearly 10 times more likely to be positive than negative or critical.<sup>4</sup>

Thus, FCOIs have the potential to impact clinical practice guidelines, contribute to positive outcomes in medical research, facilitate academic productivity, and influence social media content. When considering the positive

relationship between social media influence and academic influence (i.e., *h-index*) among neurosurgeons on Twitter,<sup>3</sup> one must question if FCOIs also play a role in academic influence (i.e., shaping the research agenda) on Twitter.

Our results show that 577 (81.8%) of the 705 US physicians followed by the top three neurosurgical journals on Twitter have FCOIs, with over a third receiving more than \$10,000 dollars in general payments between 2014 and 2021. After excluding residents and fellows—physicians in training who may not have adequate time, permission or expertise to engage with the industry—almost 95% of physicians received general payments. One could argue that the content of these physicians' tweets may be inclined towards their industry sponsorships, and that medical journals are more likely to share such content or publish manuscripts of physicians they follow on Twitter; however, we recommend these hypotheses be empirically investigated.

The observation that nearly 95% of fully trained physicians followed by journals have FCOIs is emblematic of a larger issue in medicine that is not limited to any particular specialty. Moving forward, we must consider how to manage FCOIs. The Open Payments provision (Sunshine Act) of the Affordable Care Act has played an essential role in physician financial transparency. However, when such a substantial proportion of physicians are conflicted, disclosure policies may do little to limit the influence of the industry. Prior research has even shown disclosure may lead to false sympathy placed with the discloser.<sup>23</sup> Alternatively, divestment of general payments (e.g., payments unrelated to research) might be a necessary step towards what will ultimately result in improved patient-centered care, unaffected by biases such as conflicted clinical guidelines or prescription patterns.<sup>24,25</sup> This is not a proposal to eliminate research-associated funding, since cooperation between the two groups is vital for R&D, but rather a recommendation to moderate the interaction between physicians and industry.

This study has two limitations. First, the FCOIs of physicians followed by these journals may not represent physicians followed by other neurosurgical medical journals on Twitter. Second, because Open Payments only includes data for US healthcare practitioners, we were not able to evaluate international physicians followed by these journals.

These findings raise questions regarding the interaction between neurosurgical journals and the medical community on Twitter. FCOIs intertwining these parties may influence the messaging and content of the journals' Twitter accounts. Further investigation is required to understand the relationship between medical journals and the physicians they follow on Twitter, as well as if FCOIs have any influence on these ties. Finally, this study may serve as the basis for future work on best practices for medical journals navigating their affiliations on Twitter.

## AUTHOR CONTRIBUTIONS

Kerrington Powell and Vinay Prasad conceptualized study design; Kerrington Powell reviewed the literature; Kerrington Powell, Kyle McCall, Akash Kakkilaya, and Karan Hooda curated data; Vinay Prasad reviewed and confirmed abstracted data; Kerrington Powell wrote the first draft of the manuscript; and all authors reviewed and revised subsequent and finalised drafts of the manuscript.

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## CONFLICTS OF INTEREST

Vinay Prasad discloses research funding from Arnold Ventures; royalties from Johns Hopkins Press, Medscape, and MedPage; consulting fees from UnitedHealthcare and OptumRx; and subscriber fees from Patreon, YouTube, and Substack. All other authors have no financial nor non-financial conflicts of interest to report.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## ETHICS STATEMENT

Not available.

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**Karan Hooda** is a medical student at the Texas A&M School of Medicine. Currently, his interests are in surgical research, particularly in the fields of orthopaedics, plastics, and neurosurgery. Clinically, he aims to improve the knowledge in these fields to better patient outcomes and care.

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**Akash Kakkilaya, BSA** is a medical student at the Texas A&M School of Medicine. His research interests are in health policy, epidemiology, and metascience.

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