The Role of Physician Networks and Receipt of Opioid-Related Payments

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BACKGROUND: Opioid-related promotional payments are associated with increased prescribing of the promoted drug, but little is known about whether physicians receiving payments influence peers to accept similar payments.
OBJECTIVE: We examine the association of physician network-level position among peers and the acceptance of opioid-related promotional payments using national publicly available datasets from 2015.
Design
National cross-sectional data from the Centers for Medicare and Medicaid Services (CMS) National Downloadable File and Open Payment data.
SUBJECTS: Physicians who shared Medicare patients with at least two other physicians in 2015.
MAIN MEASURES: Modified Poisson's regressions are used to estimate the adjusted incidence rate ratio (aIRR) for social network position (i.e., degree, betweenness, and transitivity) and number of peers with payments as a function of individual receipt of opioid-related promotional payment and among those with payments, those who have five or more payments, and those who have $100 or more in payments.
KEY RESULTS: Physicians with opioid-related payments were significantly more likely to have at least one peer with an opioid-related payment (IRR: 2.5, 95% CI: 2.3–2.8), but had fewer shared patients (i.e., top quartile compared to the first quartile for degree centrality: 0.4, 95% CI: 0.3–0.4) and belonged to less cohesive networks (i.e., top quartile compared to the first quartile for betweenness centrality: 0.9, 95% CI: 0.8–0.9).
CONCLUSIONS: Our study demonstrates that physicians receiving opioid-related payments are more likely to cluster within physician networks.

KEY WORDS: physician behavior; opioids; social network analysis; promotional payments.

J Gen Intern Med 38(8):1812–20
DOI: 10.1007/s11606-022-07870-1

Prior Presentation: None

Received June 30, 2022
Accepted October 21, 2022
Published online November 14, 2022

INTRODUCTION

Prior to 2018, drugmakers frequently made opioid-related promotional payments to providers to influence prescribing.[1–5] Promotional payments to physicians can take various forms (e.g., payment for meals, travel, honoraria, or gifts). While physicians tend to believe marketing interactions do not impact decision-making, research on reciprocity and influence demonstrates the contrary.[6–10] For example, studies have found promotional payments are associated with greater prescribing costs per patient and higher rates of brand-name prescribing.[11–14]

Prior research evaluating promotional payment influence focused on individual provider behavior and largely ignored network-level attributes, such as the physician's position within their professional community and whether peer receipt of payment influences individual likelihood of payment acceptance. Peer relationships and a provider's network position can influence provider behavior in several ways. First, professional relationships are indicative of direct information channels. Colleagues may share information on work-related tasks, but may also communicate opinions, advice, and whether they have relationships with industry. It is challenging to parse communication specifically related to industry influence; however, structural effects like the number of peers with payments and network position of a provider may serve as a proxy for industry communication.[15] Previous work has used similar indicators to demonstrate individuals within academia are more likely to become entrepreneurs or patent holders if they have colleagues engaging in similar commercial activity.[15,16]

Second, the social norm of a provider receiving industry payments may influence acceptability or receptivity to marketing. For example, one study found higher peer acceptance of general industry payments associated with individual acceptance of payments.[17] These effects can have a profound return on investment for drugmakers, with another study finding promotional payments went disproportionately to physicians with multiple peers; furthermore, these peers increased usage of promoted drugs by two percent on average.[18]

Third, peers can influence provider behavior if the peer is a "key opinion leader" or well-connected within a network with greater sway over colleagues due to social or professional ranking. Models on behavior and influence posit that these influential individuals can increase adoption and momentum of an innovation if they are first to subscribe to the product, idea, or behavior.[19] Among physician opinion leaders who are clinical investigators and top-cited authors, local peers have been found to increase prescribing of new cancer drugs.[20]

We examine the association of physician network-level position among peers and the acceptance of opioid-related promotional payments using national publicly available datasets from 2015. First, we create a social network analysis by constructing networks based on physicians who share patients. Second, we assess the proportion of a physician's peers who received opioid payments alongside other network characteristics including the overall number of shared peers, how central the physician is within the network, and how dense the network is. Third, among providers with opioid-related payments, we determine the influence of the number and dollar amount of payments on network-level characteristics.

METHODS

Data Sources

To establish patient-sharing networks, we use the CMS Referral Data from 2015 (i.e., the most current available data). This publicly available dataset is derived from 100% Medicare claims data and lists pairs of providers that share at least 11 patients during 30-, 60-, 90-, and 180-day intervals per year. We utilize the 30-day interval data since it most closely measures possible direct communication between providers. Previous studies have utilized similar patient-sharing networks to reflect communication opportunities between providers.[21,22]

We identify physicians with opioid-related promotional payments using the 2015 general payment files within the Sunshine Act's Open Payments data from Centers for Medicare and Medicaid Services (CMS).[23] Open Payment data provide legally mandated information on the amount of industry payments made to physicians, the drug name associated with payment, and date of payment. The list of opioid drugs used to subset the Open Payment dataset comes from the CMS Part D Prescriber PUF Drug List Summary which contains an opioid flag variable (see Appendix Figure C).[24]

We merge additional physician characteristics within the CMS National Downloadable File to Open Payment data using an iterative matching process of full name and ZIP code (see Appendix Table 1). The National Downloadable File contains information on physician gender, credentials, specialty, years in practice, practice location, and medical school. We group specialties into four categories including general medicine (internal medicine, family medicine, general practice, pediatric medicine, obstetrics/gynecology, hospitalists, geriatric medicine, and preventive medicine), surgery, pain-related specialties (pain management, physiatrists, anesthesiology, and interventional radiology), and other specialists (e.g., cardiology, oncology, emergency medicine, psychiatry). To determine medical school ranking, we use the *US News & World Report* to create four categories: schools ranked in the top 20, schools ranked between 21 and 50, schools ranked greater than 50, and unranked schools (including foreign medical schools).[25] We identify teaching hospitals from the CMS Open Payment Teaching Hospital list from 2015 and match them to physician-hospital affiliation listed within the National Downloadable File.

Measures

Our main dependent variable is a binary indicator for whether a physician received at least one opioid payment (*0=no, 1=yes*). Previous work shows physicians who receive a greater number of payments or higher value payments increase prescribing costs per patient[11]; as such, these providers may differ from peers with no payments or very few payments by having stronger industry relationships. Therefore, we also examine, among those who have payments, the number who have five payments or more (i.e., the median number of payments in our sample; *0=no, 1=yes*), and those who receive $100 or more in payments within the year (*0=no, 1=yes*). We chose $100 as a rounded threshold close to the median number of payments within our sample.

Additional physician-level covariates include gender, number of years practicing, metropolitan practice, region, hospital referral region (HRR), medical school ranking, teaching hospital affiliation, specialty, and number of peers with payments.

Network Measures

We construct a social network analysis using providers who share patients as determined from the CMS referral data. In social network analysis, an edge (link) reflects a relationship between two nodes (physicians) within a given network. The edge can be directed, meaning only one provider influences the other, or undirected, meaning both providers influence each other equally. For this analysis, we assume undirected edges so that relationships between providers are assumed to be the same. We construct several social network centrality measures to determine variations in physician network composition:

- Degree centrality: assess the number of connections (i.e., shared patients) a physician has with other physicians within a network. The higher the degree centrality, the more well-connected the physician is. We weigh degree centrality by the average number of patients shared between physicians.
- Betweenness centrality: measures the number of times a physician acts as a link along the shortest path between two other physicians, divided by the shortest paths between all the physicians within a network. Physicians with high betweenness centrality act as hubs connecting other physicians and thus may be more influential. Physicians with lower betweenness centrality have fewer links to other providers and therefore may be less influential.

- Transitivity: also known as the clustering coefficient, transitivity measures the number of closed triplets (i.e., three physician connections) in a physician's network over the total number of closed triplets within the network. Higher transitivity within a network indicates dense connections and the possibility of greater physician communication. Lower transitivity within a network indicates less dense connections and may indicate less communication between providers.

Appendix Figure D provides additional information on each social network metric.

Since HRRs are indicative of unique healthcare markets where providers practice, we create quartiles of each social network metric within a physician's respective HRR. We remove physicians linked to another provider in a different HRR (*n*=22,222). To calculate transitivity, which requires a provider have at least two other ties within the network, we drop anyone who has less than three connections (*n*=9543).

Statistical Analysis

We generate summary statistics across providers who receive opioid payments and those who do not. Modified Poisson's regressions with standard errors clustered at the HRR level are used to estimate the adjusted incidence rate ratio (IRR) for social network position (i.e., degree, betweenness, and transitivity) and number of peers with payments as a function of individual receipt of opioid payments (*n*=124,043). Among those with payments (*n*=7855), we run additional modified Poisson's models to examine those who have five or more payments and those who have $100 or more in payments. Robust Poisson's regression models are commonly used to estimate risk ratios for common outcomes when using a logistic regression which may overestimate the risk.[26] All social network analyses are performed using R version 1.3 using the igraph package version 1.2.6.[27] All other statistical analyses are run with Stata/MP version 16.1.[28]

Sensitivity Analysis

A challenge in estimating peer effects is endogeneity or the "reflection problem," which arises in assessing endogenous influences on an individual's behavior compared to the average behavior of the individuals comprising the peer group.[29] In other words, it is possible that our index physician is influencing the behavior of peers to accept opioid payments, rather than peers influencing the index physician. Employing lagged instruments to assess identification and model specification can help solve this problem, with the assumption that average prior-year influence of a peer group is unconnected to the current-year behavior of an individual physician of interest.[17] To assess endogeneity, we conduct a sensitivity analysis by lagging peer opioid payments received in the previous year among peers as a proxy for current-year acceptance of payments among index physicians, including index physician receipt of 2014 payments to control for prior susceptibility to influence.

We conduct additional sensitivity analyses to evaluate whether heterogeneity of physician specialty groups and opioid drug type associated with payments alters relationships between peer receipt of payment and network position. A modified Poisson regression with standard errors clustered at the HRR level is run for each additional analysis and then predicted probabilities using marginal standardization are used.

RESULTS

Our final sample includes 124,043 physicians sharing patients with at least two other physicians in 2015, of whom 6% received at least one opioid-related payment (Table 1). On average, physicians receive six payments (SD: 12) or an average of $404 (SD: $4359). Physicians with opioid-related payments have a higher percentage of peers with similar payments compared to physicians with no opioid payments (49% versus 31%). Overall, physicians with payments are less likely to be within the top 25th percentile of each network metric indicating they may have fewer connections, may not be as influential (based on betweenness centrality), and may belong to less dense networks (based on transitivity).

After adjustment, physicians are more likely to accept opioid payments if they have peers with opioid payments (Table 2). For instance, physicians are 2.5 (95% CI: 2.3–2.8) times as likely to accept payment if they have one peer in their network with an opioid payment, and 3.2 (95% CI: 2.1–3.8) times as likely if they have between two to five peers with opioid payments.

In terms of network characteristics, physicians with opioid payments are less likely to be well-connected by having fewer shared patients (i.e., top quartile compared to the first quartile for degree centrality: 0.4, 95% CI: 0.3–0.4), play a smaller central role in network cohesiveness (i.e., top quartile compared to the first quartile for betweenness centrality: 0.9, 95% CI: 0.8–0.9), and belong to less dense networks (i.e., second and third quartiles compared to the first quartile for transitivity centrality: 1.2, 95% CI: 1.2–1.3 and 1.1–1.3, respectively). Among physicians with opioid payments, we find no statistically significant findings on the impact of the number of peers with opioid-related payments and very little difference between network metrics when compared to our first model examining physicians with any payments.

In our sensitivity analysis, we assess lagged opioid payments made to peers in 2014 and whether this influences our index physicians to receive an opioid payment in 2015 (Table 3). We find similar results to our main model with a smaller magnitude in associations. We also assess the heterogeneity of physician specialties across network and peer metrics (Fig. 1). Pain-related specialists are more likely to fall within the first and second quartiles in terms of degree centrality and count of peers

Table 1 Descriptive Characteristics by Recipient of Opioid-Related Payments, 2015

	Physicians with opioid-related payments *N*=7855 (6.3%)	Physicians with no opioid-related payments *N*=116,188 (93.7%)
Physician characteristics		
Male, *N* (%)	6369 (81%)	90,296 (78%)
Years practicing, mean (SD)	24.8 (8.3)	24.5 (8.6)
Metropolitan practice, *N* (%)	6997 (89%)	104,992 (90%)
US Census Region, *N* (%)		
Northeast	1426 (18%)	28,290 (24%)
Midwest	1777 (23%)	27,159 (23%)
South	3259 (41%)	39,683 (34%)
West	1393 (18%)	21,056 (18%)
Medical school ranking, *N* (%)		
Top 20	314 (4%)	8547 (7%)
Ranked 21 to 50	757 (10%)	13,720 (12%)
Ranked 50+	1158 (15%)	16,004 (14%)
Unraked	5626 (72%)	77,917 (67%)
Teaching hospital, *N* (%)	504 (6%)	11,426 (10%)
Specialty, *N* (%)		
General medicine	4593 (58%)	34,803 (30%)
Surgery	453 (6%)	12,411 (11%)
Pain specialties	1277 (16%)	8683 (7%)
Other specialties	1532 (20%)	60,291 (52%)
Payment characteristics		
Number of payments, total	44,923	0
Mean (SD)	6 (12)	0
Median (min, max)	2 (1, 285)	0
Payment amount, total $	$3,169,947	$0
Mean (SD)	$404 ($4359)	$0
Median (min, max)	$31 ($0.63, $150,724)	$0
Payment characteristics among network		
Peers with payments, *N* (%)	3863 (49%)	36,053 (31%)
Peers with payments within provider network, mean % (SD)	10% (19%)	4% (9%)
Number of payments, total	47,859	509,902
Mean (SD)	12 (22)	14 (25)
Median (min, max)	5 (1, 340)	5 (1, 386)
Payment amount, total $	$2,695,324	$28,083,170
Mean (SD)	$697 ($5926)	$779 ($5307)
Median (min, max)	$70 ($3, $141,391)	$82 ($0.63, $150,756)
Network characteristics		
Number peers in network, mean (SD)	13 (15)	19 (26)
Degree centrality, (%)		
Q1	25%	26%
Q2	29%	24%
Q3	30%	24%
Q4	16%	25%
Betweenness centrality, (%)		
Q1	29%	26%
Q2	30%	23%
Q3	25%	25%
Q4	16%	26%
Transitivity, (%)		
Q1	20%	25%
Q2	30%	24%
Q3	31%	26%
Q4	17%	22%

**Observations <11 are censored by CMS to protect patient privacy; NA, not applicable*

indicating they are less connected overall; however, in terms of transitivity centrality, pain-related specialists exhibit greater diversity in clustering within their network and fall within the second to third quartiles.

Finally, we examine the top five opioid drugs associated with payments to assess if the presence of a drug-specific payment was associated with the likelihood of a peer having a payment for the same drug (Fig. 2). Hysingla ER (hydrocodone) and OxyContin (oxycodone) are the most frequently promoted drug in 2015 among networks. Physicians with a higher degree centrality, betweenness centrality, and more peers (i.e., physicians in the fourth quartiles) are more likely to have at least one peer with a similar drug-related promotional payment compared to those in quartile one. In terms of transitivity centrality, physicians are more likely to be less clustered within their network (i.e., reside in quartile one) and have peers with similar drug-related payments compared to physicians who are more tightly clustered (i.e., physicians in the fourth quartile).

Table 2 GLM Poisson Regression

	Model 1- any payments (*n*=124,043)		Model 2- 5+ payments (*n*=7855)		Model 3- payment amount $100+ (*n*=7855)	
	IRR	*95% CI*	*IRR*	*95% CI*	*IRR*	*95% CI*
Female	0.8***	(0.7–0.8)	0.8***	(0.7–0.9)	0.8***	(0.7–0.9)
Tenure (ref = ≤10 years)						
11 to 20 years	1.2	(0.8–1.6)	0.5***	(0.4–0.8)	0.6*	(0.4–0.9)
21+ years	1.3	(0.9–1.8)	0.5***	(0.4–0.8)	0.6	(0.4–1.0)
Metropolitan practice	1.3***	(1.2–1.5)	1.2	(1.0–1.4)	1.3**	(1.1–1.6)
US Census Region (ref=northeast)						
Midwest	0.9	(0.7–1.3)	0.8	(0.6–1.3)	0.8	(0.3–1.8)
South	1.0	(0.7–1.4)	1.1	(0.8–3.0)	1.7*	(1.1–2.5)
West	0.7	(0.4–1.5)	0.2***	(0.1–0.3)	1.2	(0.3–5.4)
Teaching hospital affiliation	0.8***	(0.7–0.9)	0.7**	(0.5–0.8)	0.7**	(0.5–0.9)
Specialty (ref= general medicine)						
Surgical	0.3***	(0.2–0.3)	0.3***	(0.2–0.5)	0.7*	(0.5–1.0)
Pain specialists	1.1**	(1.0–1.2)	3.7***	(3.4–4.2)	4.7***	(4.1–5.3)
Other specialists	0.2***	(0.2–0.2)	1.1	(0.9–1.3)	1.4***	(1.2–1.7)
Peers with payment (ref=none)						
One peer	2.5***	(2.3–2.8)	1.1	(0.9–1.2)	1.0	(0.9–1.1)
2 to 5 peers	3.2***	(2.9–3.6)	1.1	(1.0–1.3)	1.0	(0.9–1.2)
6 to 9 peers	3.0***	(2.1–3.8)	1.2	(0.9–1.7)	1.1	(0.8–1.7)
10+ peers	2.6**	(1.2–4.6)	1.4	(0.9–2.3)	1.4	(0.7–3.1)
Degree (ref=Q1)						
Q2	1.0	(0.9–1.1)	0.9	(0.8–1)	1.0	(0.9–1.1)
Q3	0.8***	(0.6–0.8)	0.9*	(0.7–0.9)	0.9	(0.8–1.1)
Q4	0.4***	(0.3–0.4)	0.7**	(0.5–0.7)	0.7**	(0.6–0.9)
Betweenness (ref=Q1)						
Q2	1.1	(1.0–1.1)	1.2**	(1.1–1.4)	1.0	(0.9–1.2)
Q3	1.0	(0.9–1.0)	1.1*	(1–1.3)	1.1	(0.9–1.2)
Q4	0.9***	(0.8–0.9)	1.0	(1–1.3)	1.0	(0.9–1.2)
Transitivity (ref=Q1)						
Q2	1.2***	(1.2–1.3)	1.1	(1.0–1.3)	1.1	(1.0–1.2)
Q3	1.2***	(1.1–1.3)	1.1	(0.9–1.2)	1.1	(0.9–1.2)
Q4	0.8**	(0.8–1.0)	1.0	(0.9–1.1)	0.9	(0.8–1.1)

*Note: all models include dummy variables for HRR; *p-value< 0.05; **p-value< 0.01; ***p-value< 0.001*

DISCUSSION

Our results suggest that network-level characteristics may play a role in physicians' likelihood of or receptivity to accepting opioid-related promotional payments. We find physicians with opioid payments to be associated with twice the likelihood of at least one peer also having an opioid payment

Table 3 GLM Poisson Regression Using Peers with Lagged Opioid-Related Promotional Payments

	Model 1- any payments (*n*=124,043)		Model 2- 5+ payments (*n*=7855)		Model 3- payment amount $100+ (*n*=7855)	
	IRR	*95% CI*	*IRR*	*95% CI*	*IRR*	*95% CI*
Peers with payment (ref=none)						
One peer	1.5***	(1.4–1.6)	1.1	(0.9–1.2)	0.9	(0.8–1.0)
2 to 5 peers	1.8***	(1.7–1.9)	0.9	(0.8–1.1)	1.0	(0.9–1.1)
6 to 9 peers	2.1***	(1.9–2.4)	1.0	(0.8–1.2)	1.1	(0.9–1.4)
10+ peers	2.2***	(1.8–2.6)	1.2	(0.9–1.7)	1.3	(0.9–1.9)
Degree (ref=Q1)						
Q2	1.0	(0.9–1.1)	1.0	(0.9–1.1)	1.0	(0.9–1.1)
Q3	0.9**	(0.8–1.0)	0.9	(0.8–1.1)	0.9	(0.8–1.1)
Q4	0.6***	(0.6–0.7)	0.8	(0.7–1.0)	0.8**	(0.6–0.9)
Betweenness (ref=Q1)						
Q2	1.1	(1.0–1.1)	1.2**	(1.1–1.3)	1.1	(0.9–1.2)
Q3	1.0	(1.0–1.1)	1.1*	(1.0–1.3)	1.1	(0.9–1.2)
Q4	0.9*	(0.9–1.0)	1.1	(0.9–1.2)	1.1	(0.9–1.2)
Transitivity (ref=Q1)						
Q2	1.2***	(1.1–1.3)	1.1	(1.0–1.2)	1.1	(0.9–1.2)
Q3	1.2***	(1.1–1.3)	1.0	(0.9–1.2)	1.1	(0.9–1.2)
Q4	1.0	(0.9–1.1)	1.0	(0.9–1.1)	1.0	(0.8–1.1)

*Note: All models adjust for specialty, gender, tenure, urbanicity, region, teaching hospital affiliation, and HRR; *p-value< 0.05; **p-value< 0.01; ***p-value< 0.001*

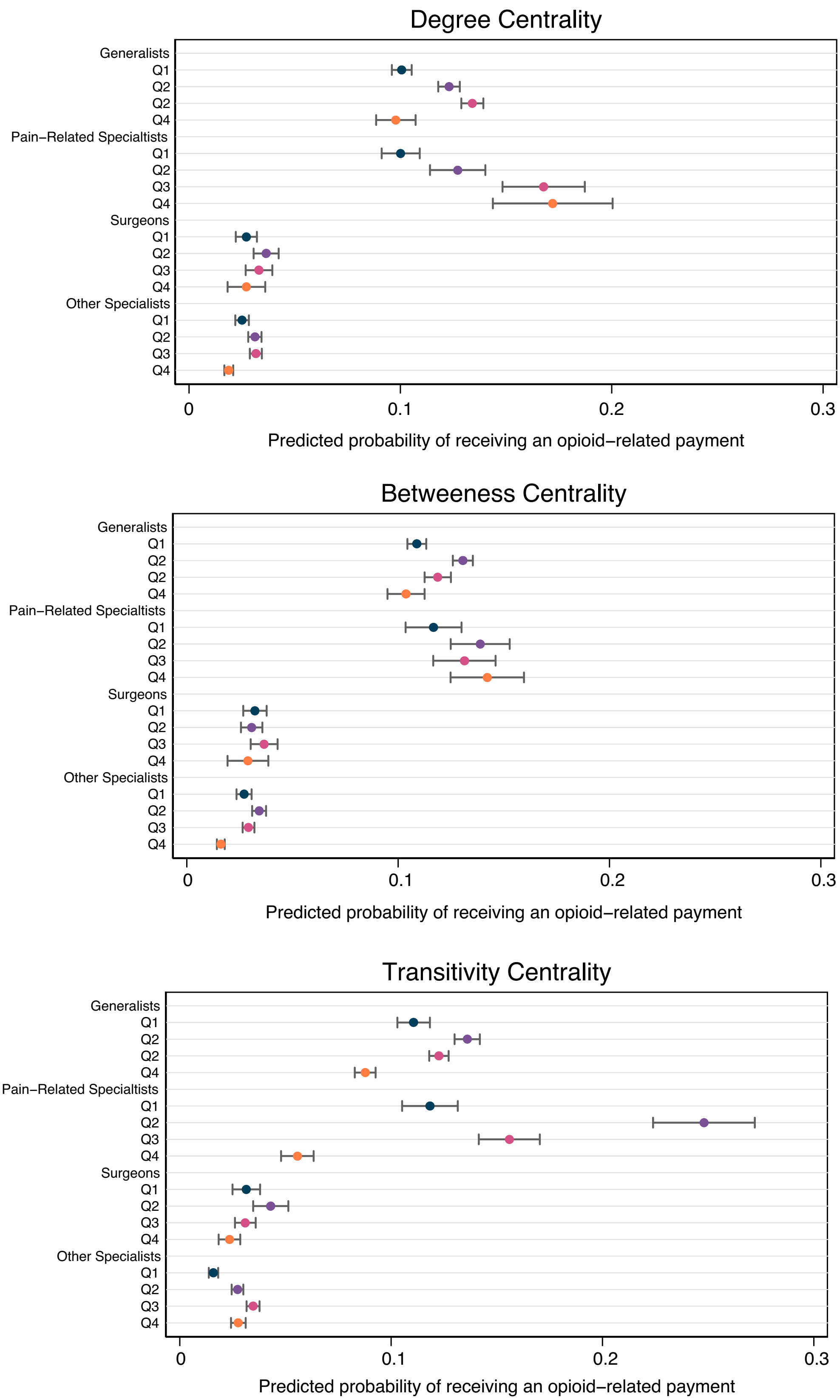

Figure 1 Adjusted marginal predictions of specialty group likelihood of accepting an opioid-related payment across network characteristic quadrants.

compared to physicians who did not have opioid payments in 2015. Network-level characteristics revealed these physicians are more likely to belong to smaller, less cohesive, and less clustered patient-sharing networks. These findings may

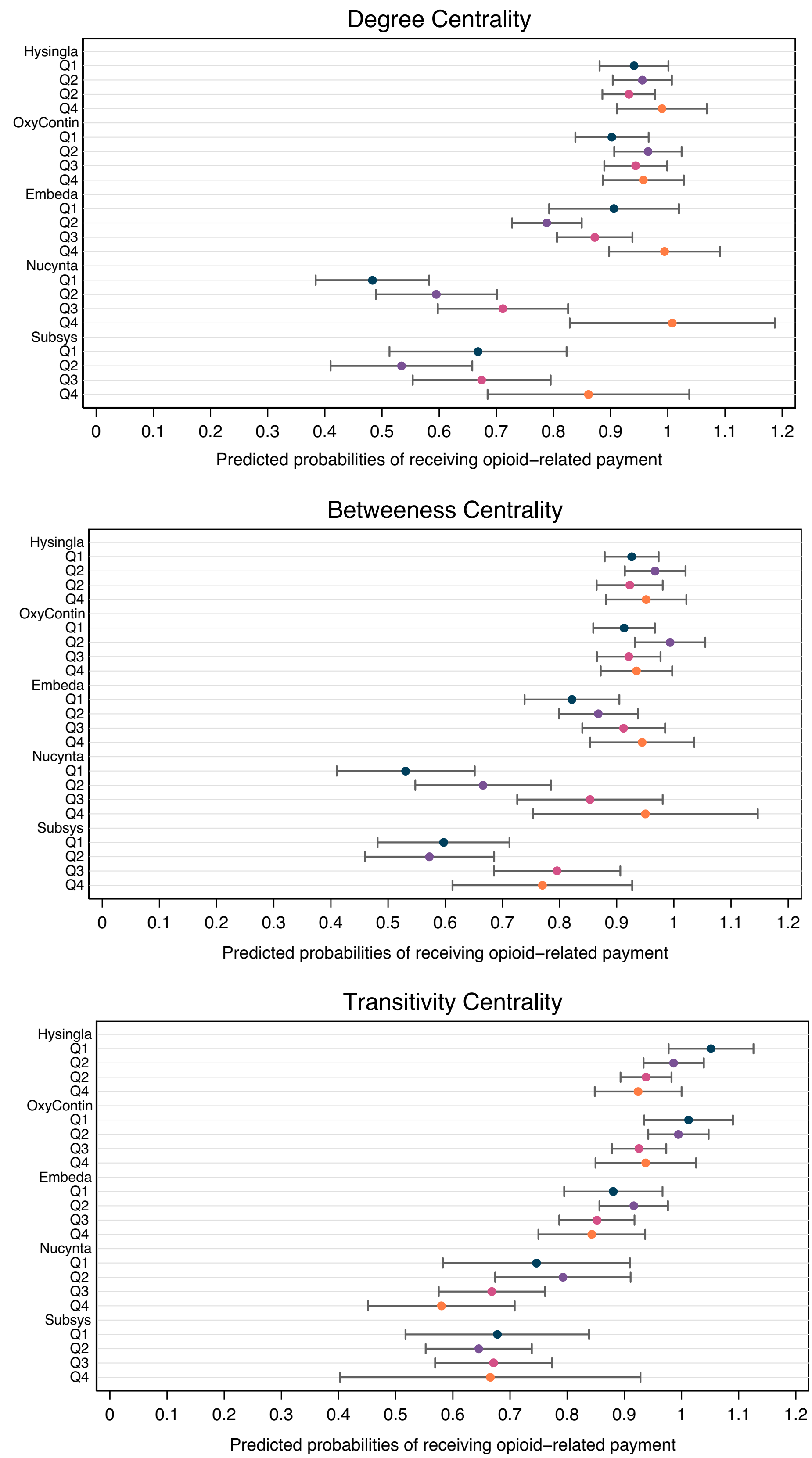

Figure 2 Adjusted marginal predictions for network centrality quadrants dependent on the type of opioid-related drug payment received.

indicate either isolation due to geographical location (e.g., rural practices) or isolation from prescribing peers with reduced clinical time. In either case, there is evidence that providers in rural areas with pain-heavy populations (e.g., mining communities in Appalachia) were disproportionately targeted by opioid drugmakers; and highly paid physician "thought leaders" targeted by opioid drugmakers did not always hold full-time clinical positions and instead served as pharmaceutical executives or academic researchers.[30–32]

Among specialties, generalists are most likely to have an opioid-related payment, although pain specialists are more likely to have accepted more payments and higher payment amounts. These findings may reflect the targeting of opioid payments to pain medicine leaders who speak at conferences, give promotional symposiums, or serve as consultants.

Two drugs manufactured by Purdue Pharma, Hysingla ER (hydrocodone) and OxyContin (oxycodone), are the most frequently promoted drugs to physicians in our sample. Purdue is famously known as one of the largest contributors to igniting the opioid epidemic due to the misleading and aggressive marketing of OxyContin in the early 1990s.[33] It is therefore notable that in 2015, nearly three decades after OxyContin's initial marketing, we find Purdue products to be the most frequently accepted and shared among physician peers; however, in 2018, Purdue Pharma announced they would no longer promote opioid products.[34] Various high-profile lawsuits against opioid drugmakers and wholesalers, as well as heightened attention to the role that physician marketing played in perpetuating the opioid epidemic, have led to dramatic decreases in the number of opioid-related promotional payments received by doctors.[35,36]

Prior work has also demonstrated relationships between physician acceptance of payment and peer acceptance of payment. For instance, Winn et al. (2021) analyzed general promotional payments for drugs and devices and found the receipt of payment strongly associated with the likelihood that peers within the focal physician's network also received a payment.[17] The authors also found an inverse relationship between strong network clustering and receipt of payment. However, in contrast to our findings, they find more central physicians are more likely to have payments. Likewise, Agha and Zeltzer (2019) find physicians more likely to be targeted for anticoagulant payments if they are highly connected within their network.[18] We find the opposite to be true for physicians with opioid-related payments, suggesting there may be unique factors associated with opioid drugs that may cause physicians to distinguish them from other drug payments. For instance, media attention towards the opioid epidemic and the role that drugmakers and physicians played in contributing to its initiation and perpetuation may have led to hesitancy among well-connected providers to accept opioid payments out of concern for reputation. In addition, medical schools, centers, and associations may have restricted promotional activity via conflict-of-interest policies which may directly curtail the likelihood of a physician with a larger professional network from accepting payment.[37–39]

Limitations

Our study has several limitations. First, our study is cross-sectional and therefore does not capture payments received over time which may influence our results if prior payments from years before 2015 influenced network dynamics in a way that predisposed relationships between physicians, peers, and industry. However, previous work has shown that post-payment effects on prescribing behavior are seen within the first year.[40] Given our assessment of patient-sharing networks within a 30-day interval, it is likely we are still capturing subsequent impacts that receipt of an opioid payment among peers has on an individual provider. Second, our patient-sharing networks originated from Medicare data; therefore, we cannot account for non-Medicare provider patient-sharing relationships. Third, there are additional physician characteristics that may influence provider or network-level acceptance of promotional payments that we are unable to control for. These include a physician's prestige within a network, friendships, personal beliefs, morals, and ethics, as well as policies on acceptance of promotional payments at affiliated institutions. We also do not include additional networks that may influence a physician's acceptance of a promotional payment like those at the group practice level, hospital level, or training level. However, prior work has shown that patient-sharing relationships tend to be the most meaningful in terms of influencing behavior.[41] Finally, we do not account for opioid prescribing within our sample and therefore cannot state the impact that payments may have had on influencing prescribing behavior.

CONCLUSION

Our study suggests that physicians who accept opioid-related payments may be more likely to have peers with a similar likelihood or receptivity to accepting opioid-related payments. This work highlights the importance of peer networks on physician behavior and the potential amplifying effect of promotional activities.

Supplementary Information *The online version contains supplementary material available at https://doi.org/10.1007/s11606-022-07870-1.*

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Declarations:

Conflict of Interest: *The authors declare that they do not have a conflict of interes.*

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