Defensive Medicine in Neurosurgery: Does State-Level Liability Risk Matter?

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BACKGROUND: Defensive medicine is prevalent among US neurosurgeons due to the high risk of malpractice claims. This study provides national estimates of US neurosurgeons' defensive behaviors and perceptions.

OBJECTIVE: To examine the relationship of defensive medicine—both "assurance" behaviors and "avoidance" behaviors—to the liability environment.

METHODS: A 51-question online survey was sent to 3344 US neurosurgeon members of the American Board of Neurological Surgeons (ABNS). The survey was anonymous and conducted over 6 weeks in the spring of 2011. The previously validated questionnaire contained questions on neurosurgeon, patient, and practice characteristics; perceptions of the liability environment; and defensive-medicine behaviors. Bivariate and multivariate analyses examined the state liability risk environment as a predictor of a neurosurgeon's likelihood of practicing defensive medicine.

RESULTS: A total of 1026 neurosurgeons completed the survey (31% response rate). Neurosurgeons' perceptions of their state's liability environment generally corresponded well to more objective measures of state-level liability risk because 83% of respondents correctly identified that they were practicing in a high-risk environment. When controlling for surgeon experience, income, high-risk patient load, liability history, and type of patient insurance, neurosurgeons were 50% more likely to practice defensive medicine in high-risk states compared with low-risk-risk states (odds ratio: 1.5, $P < .05$).

CONCLUSION: Both avoidance and assurance behaviors are prevalent among US neurosurgeons and are correlated with subjective and objective measures of state-level liability risk. Defensive medicine practices do not align with patient-centered care and may contribute to increased inefficiency in an already taxed health care system.

KEY WORDS: Defensive medicine, Health reform, Liability, Malpractice, Neurosurgery, Tort

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The medical liability system has been criticized for failing to promote either equity or economic efficiency in medical injury compensation. Malpractice claims are often without merit; 37% do not involve errors and 3% have no verifiable medical injuries.[1-5] Rather than producing the intended balance between the costs of precautionary measures and the costs of avoidable injuries, the system produces an incentive to administer precautionary treatment with minimal expected medical benefit out of fear of litigation, a practice referred to as "defensive medicine."[4-6]

Many physicians argue that defensive medicine significantly contributes to increasing health care expenditures, whereas many health policy experts counter that the total contribution of defensive medicine to health care costs is minimal. Political interest groups involved in policy debates about liability reform have contested how large a contribution defensive medicine makes to national health expenditures, but the best expert estimates are approximately $60.2 billion per year.[7]

Defensive-medicine practices tend to predominate in high-risk specialties such as neurosurgery, obstetrics and gynecology, and orthopedic surgery.[6,8-17] Neurosurgeons are not only at high risk of costly claims, but insurance companies pay out more for neurosurgery claims than other specialties.[16] The consistent belief among physicians, especially those in high-risk specialties, is that defensive medicine plays a significant factor in clinical decision making, and for this reason, continued research in this area is warranted.[18-21]

The extent of defensive medicine remains controversial.[22] Although there are a number of articles that include neurosurgery among a larger study population,[8,9,14,16,18,21,23-25] there are limited data published on the defensive practice of neurosurgeons exclusively in the United States.[26] The objective of this article is to examine the relationship of the state liability environment to the practice of defensive medicine in the practice of neurosurgery.

METHODS

A 51-question, online survey incorporating previously validated questions on defensive medicine[8] was used to measure neurosurgeons' defensive practices and perceptions of liability risk. The questionnaire was developed over the course of 6 months with input from numerous professional societies within organized neurosurgery (the American Association of Neurological Surgery, American Board of Neurological Surgery, Congress of Neurological Surgeons, Society of Neurological Surgeons, Neurosurgical Society of America, Society of University Neurosurgeons, Council of State Neurosurgical Societies, and Illinois State Neurosurgical Society). The final questionnaire contained 8 question domains: surgeon characteristics, patient characteristics, practice type, patient insurance type, surgeon liability profile, surgeon reimbursement, perceptions of the liability environment, and defensive-medicine behaviors.

The survey was pretested on 25 leaders in the field of neurosurgery and took 10 minutes, on average, to complete. All board-certified US neurosurgeon members of the American Association of Neurological

TABLE 1. Characteristics of Board-Certified US Neurosurgeons Stratified by Dichotomized State Medicolegal Risk Grade[a] (N = 1026)

Characteristic	Low Risk	High Risk	Total	Odds Ratio[b] (*P* Value)
Response rate, mean % (SD)	29.8 (7.2)	36.8 (9.1)	33.2 (8.6)	<.001
Surgeons/population, millions	9.1/2.0	8.2/2.0	8.6/2.1	<.001
Sex, no. (%)				
Male	467 (93.8)	447 (89.8)	922 (91.6)	—
Female	34 (6.8)	48 (9.6)	82 (8.4)	—
Experience, y, no. (%)				
<5	68 (13.4)	61 (12.0)	129 (12.5)	—
6-10	83 (16.4)	71 (14.0)	156 (15.2)	—
11-20	180 (35.6)	190 (37.6)	371 (36.2)	—
21-30	130 (25.8)	122 (24.2)	255 (24.9)	—
>30	46 (9.2)	59 (11.6)	108 (10.5)	—
Specialty, no. (%[c])				
Pediatrics	63 (12.4)	61 (12.0)	124 (12.2)	—
Functional	40 (7.8)	61 (12.0)	101 (10.0)	1.6 (.024)
Cerebrovascular	103 (20.4)	82 (16.2)	185 (18.2)	—
Tumor	176 (34.8)	195 (38.4)	434 (42.3)	—
Spine	248 (49.0)	253 (50.0)	568 (55.4)	—
Trauma	147 (29.0)	133 (26.2)	338 (33.9)	—
General	309 (61.0)	261 (51.4)	685 (66.8)	—
Annual case volume, no. (%)				
<50	3 (0.6)	8 (91.6)	11 (1.1)	—
51-100	25 (5.0)	23 (4.6)	48 (4.8)	—
101-200	123 (24.6)	116 (23.2)	239 (23.9)	—
201-300	193 (38.6)	192 (38.4)	385 (38.5)	—
301-400	102 (20.4)	112 (22.2)	214 (21.4)	—
401-500	38 (7.4)	32 (6.4)	70 (7.0)	—
>500	16 (3.2)	16 (3.2)	32 (3.2)	—
Lifetime case volume, no. (%)				
<500	13 (2.6)	7 (1.4)	20 (2.0)	—
501-1000	21 (4.2)	16 (3.2)	37 (3.7)	—
1001-2000	65 (13.0)	48 (9.6)	113 (11.4)	—
2001-3000	77 (15.4)	96 (19.2)	173 (17.4)	—
3001-4000	80 (16.0)	77 (15.4)	157 (15.8)	—
4001-5000	63 (12.6)	66 (13.2)	129 (13.0)	—
5001-10 000	142 (28.6)	153 (30.8)	295 (29.6)	—
>10 000 cases	38 (7.4)	33 (6.6)	71 (7.1)	—

[a]The National Report Card on the State of Emergency Medicine: A-F dichotomized into low risk (grades A-C) and high risk (grades D-F).
[b]Odds ratio calculated where appropriate (Mantel-Haenszel), $P < .05$ significant; where appropriate, Student *t* and χ^2 tests were used.
[c]Percentages can total more than 100% because many respondents categorized themselves in more than 1 specialty.

TABLE 2. Patient Characteristics Treated by Board-Certified US Neurosurgeons Stratified by Dichotomized State Medicolegal Risk Grade[a] (N = 1026)

Characteristic	Low Risk	High Risk	Total	Odds Ratio[b] (*P* Value)
Majority ethnicity, no. (%)				
White	314 (86.0)	343 (93.8)	657 (89.9)	1.4 (.026)
African American	10 (2.8)	7 (2.0)	17 (1.6)	—
Hispanic	27 (7.4)	16 (4.4)	49 (4.8)	.093
Asian American	8 (2.2)	6 (1.6)	14 (1.4)	—
>50% Patients private insurance, no. (%)	164 (35.4)	188 (40.6)	352 (38.1)	1.4 (.027)
>50% Patients public insurance, no. (%)	152 (32.6)	117 (25.0)	269 (28.8)	1.4 (.027)

[a]The National Report Card on the State of Emergency Medicine: A-F dichotomized into low risk (grades A-C) and high risk (grades D-F).
[b]Odds ratio calculated where appropriate (Mantel-Haenszel), $P < .05$ significant, where appropriate. Student *t* tests and χ^2 were used. Percentages can sum to greater than 100%, because many respondents categorized themselves in more than one specialty.

Surgery were sent an e-mail. This association represents more than 95% of practicing neurosurgeons in the United States, and e-mail addresses were verified by online public records. The survey was completed anonymously and was administered over 6 weeks in the spring of 2011. No financial incentives were provided for survey completion.

A measure of the riskiness of states' liability environment was obtained from a report published in 2009 in which all US states were categorized and ranked according to malpractice risk.[20] This report was generated by American College of Emergency Physicians and creates objective risk profiles by state based on 3 main domains: legal atmosphere, tort reform, and insurance availability. Risk level was ranked from 1 to 50, and states were categorized into 5 groups, from the worst liability environment (grade F) to the best (grade A).

TABLE 3. Practice Characteristics of Board-Certified US Neurosurgeons Stratified by Dichotomized State Medicolegal Risk Grade[a,b] (N = 1026)

Characteristic	Low Risk	High Risk	Total	Odds Ratio[c] (*P* Value)
Type, no. (%)				
Private	197 (38.4)	159 (31.4)	356 (35.1)	1.4 (.018)
Academic	120 (23.6)	150 (25.4)	270 (26.6)	1.4 (.025)
Mixed	61 (12.0)	92 (18.2)	153 (15.1)	1.6 (.005)
Military	6 (1.2)	5 (1.0)	11 (1.1)	—
Hospital	80 (15.8)	76 (15.0)	156 (15.4)	—
Group	113 (22.2)	97 (19.2)	210 (20.7)	—
Solo	40 (7.8)	32 (6.4)	72 (7.1)	—
Colleagues, no. (%)				
0	99 (20.6)	74 (15.4)	173 (18.0)	1.5 (.028)
1-2	99 (20.4)	92 (19.2)	191 (19.8)	—
3-5	137 (28.4)	138 (28.6)	275 (28.6)	—
6-10	88 (18.2)	93 (19.4)	181 (18.8)	—
11-15	37 (7.4)	40 (8.4)	77 (8.0)	—
>15	18 (3.8)	48 (10.0)	66 (6.9)	2.8 (<.001)
High-risk procedures, no. (%)				
Shunts (pediatric)	145 (28.6)	133 (26.2)	278 (27.4)	—
Spine trauma	300 (59.2)	300 (59.2)	600 (59.2)	—
Workers' Compensation	219 (43.2)	255 (50.2)	474 (46.7)	1.4 (.015)
Head trauma	267 (52.6)	270 (53.2)	537 (53.0)	—
Acute SDH	224 (44.2)	224 (44.2)	448 (44.2)	—
EDH	204 (40.2)	198 (39.0)	402 (39.6)	—
IA coiling	46 (9.0)	40 (7.8)	86 (8.5)	—
IA clipping	155 (30.6)	132 (26.0)	287 (28.3)	—
Tumor	232 (45.8)	229 (45.2)	461 (45.5)	—
Any	410 (80.8)	439 (86.6)	849 (83.7)	1.6 (.004)
Total, mean (SD)	3.5 (2.7)	3.5 (2.6)	3.5 (2.6)	—

[a]SDH, subdural hematoma; EDH, epidural hematoma; IA, intracranial aneurysm.
[b]The National Report Card on the State of Emergency Medicine: A-F dichotomized into low risk (grades A-C) and high risk (grades D-F).
[c]Odds ratio calculated where appropriate (Mantel-Haenszel), $P < .05$ significant; where appropriate, Student *t* and χ^2 tests were used.

TABLE 4. Insurance Characteristics of Board-Certified US Neurosurgeons

Characteristic	Low Risk[a]	High Risk[a]	Total	Odds Ratio[b] (*P* Value)
Annual premium, average in K, mean (SD)	75 (51)	128 (79)	103 (72)	<.001
Annual premium as a percentage of income, average in K, mean (SD)	14.8 (11.5)	19.5 (13.0)	17.2 (12.5)	<.001
Percentage of change in annual premium in past 3 years, average percentage of change (SD)	3.4 (14.3)	9.0 (14.3)	6.4 (14.5)	<.001
Inadequacy of coverage, no. (%)	250 (71.8)	225 (65.2)	475 (68.5)	1.4 (.06)

[a]The National Report Card on the State of Emergency Medicine: A-F dichotomized into low risk (grades A-C) and high risk (grades D-F).
[b]Odds ratio calculated where appropriate (Mantel-Haenszel), $P < .05$ significant; where appropriate, Student *t* and χ^2 tests were used.

Bivariate (*t* tests, Pearson correlation, odds ratios [ORs], analysis of variance) and multivariate (logistic and linear regression) analyses were used to examine the liability risk environment as a predictor of defensive medicine. Physician perceptions of medicolegal environment reported in the survey were also compared with the previously reported state liability risk profiles. Analyses were conducted in SAS version 9.2 (SAS Institute, Cary, North Carolina), SPSS version 22 (IBM SPSS Inc, Armonk, New York), and Excel 2011 (Microsoft Corp, Redmond, Washington).

RESULTS

Of the possible 3344 neurosurgeons surveyed, 1026 completed the questionnaire (31% overall response rate). Table 1 outlines respondent characteristics categorized by state medical legal risk grade. Surgeons from low-risk states (medical legal risk grade of A, B, or C) had an overall response rate of 30% (SD = 7.2%), and those from high-risk states (medicolegal grade of D or F) had a response rate of 37% (SD = 9.1%, $P < .001$). There were significantly more neurosurgeons per population in low-risk states compared with high-risk states, 9.1 neurosurgeons/million (SD = 2.0) vs 8.2 neurosurgeons/million (SD = 2.1, $P < .001$), with an overall level of 8.6 neurosurgeons for every million persons (SD = 2.1).

Almost 90% of responders reported that more than half of their patient population was classified as white (Table 2). Surgeons working in high-risk states were 1.4 times as likely to report a majority white patient population ($P = .026$). Overall, 38.1% reported that more than half of their patients had private health insurance, and responders in high-risk states were 1.4 times as likely to report this ($P = .027$) compared with those in low-risk-risk states. Just less than 29% reported that a majority of their patients carried public insurance, and this was 1.4 times as likely among neurosurgeons in low-risk states ($P = .027$).

The largest percentage of respondents was in private practice (35.1%), with a majority having 3 to 5 colleagues (28.6%), and they identified their practices as mainly spine surgery (59.2%) (Table 3). Solo practitioners were more likely to practice in low-risk states (OR = 1.5, $P = .028$), and large practices (>15 colleagues) were also almost 3 times as likely to practice in high-risk states. Private practice neurosurgeons were 1.4 times more likely to be from low-risk states ($P = .018$), and academic surgeons were more likely to be from high-risk states (OR = 1.4, $P = .025$). High-risk states were 1.4 times more likely to have neurosurgeons treating Workers' Compensation patients ($P = .015$) and 1.6 times more likely to have neurosurgeons treating any patients regarded as high medicolegal risk ($P = .004$).

According to respondents, the average annual malpractice insurance premium for US neurosurgeons in 2011 was $103 000

TABLE 5. Liability and Reimbursement Characteristics of Board-Certified US Neurosurgeons

Characteristic	Low Risk[a]	High Risk[a]	Total	Odds Ratio[b] (*P* Value)
Claims in past 3 y, mean (SD)	0.6 (1.3)	0.9 (1.5)	0.8 (1.4)	.043
Ever sued, no. (%)	150 (32.2)	216 (46.2)	366 (39.0)	1.8 (<.001)
Lifetime settlements, mean (SD)	1.0 (1.4)	1.0 (91.5)	1.0 (1.5)	—
Liability crisis, no. (%)	296 (62.8)	393 (82.9)	689 (73.0)	1.6 (<.001)
Liability affects location, no. (%)	350 (74.8)	319 (67.6)	669 (76.1)	1.3 (.025)
Patient as a lawsuit, no. (%)	338 (73.6)	351 (76.3)	689 (75.0)	—
Burden of insurance, no. (%)	387 (86.7)	432 (95.2)	819 (90.8)	3.1 (<.001)
Percentage of change in reimbursement/CPT, mean (SD)	−16.8 (9.9)	−16.7 (11.0)	−16.7 (10.5)	—

[a]The National Report Card on the State of Emergency Medicine: A-F dichotomized into low risk (grades A-C) and high risk (grades D-F).
[b]Odds ratio calculated where appropriate (Mantel-Haenszel), $P < .05$ significant; where appropriate, Student *t* and χ^2 tests were used.

TABLE 6. Defensive Behaviors of Board-Certified US Neurosurgeons

Characteristic	Low Risk[a]	High Risk[a]	Total	Odds Ratio[b] (*P* Value)
Any form solely for liability concerns, no. (%)	432 (42.6)	449 (44.3)	881 (86.9)	1.5 (.04)
Laboratory tests	370 (36.5)	403 (39.7)	773 (76.2)	1.5 (.006)
Referrals	378 (37.3)	389 (38.4)	767 (75.6)	—
Medications	222 (21.9)	247 (24.4)	469 (46.3)	1.3 (.08)
Procedures	205 (20.2)	211 (20.8)	416 (41.0)	—
Imaging	409 (40.3)	425 (41.9)	834 (82.2)	1.3 (.086)
Total, mean (SD)	3.1 (1.7)	3.3 (1.6)	3.2 (1.7)	.042
Frequency of additional laboratory tests				
Always/often, no. (%)	173, (37.4)	210 (44.9)	383 (41.1)	1.4 (.02)
Average, mean % (SD)	35.3, (25.3)	38.5 (25.7)	37.0 (25.6)	.05
Frequency of additional imaging				
Always/often, no. (%)	248 (53.8)	278 (59.4)	526 (56.6)	1.3 (.085)
Average, mean % (SD)	42.5 (26.8)	44.7 (25.6)	43.7 (26.2)	—
Frequency of additional consults				
Always/often, no. (%)	176 (38.3)	201 (43.1)	377 (40.7)	—
Average, mean % (SD)	34.8 (23.9)	37.0 (25.9)	36.0 (25.0)	—
Frequency of additional referrals				
Always/often, no. (%)	146 (31.7)	161 (34.4)	307 (33.0)	—
Average, mean % (SD)	31.3 (22.1)	33.2 (24.1)	32.2 (23.1)	—
Asset protection strategies, no. (%)	121 (31.1)	114 (29.3)	235 (30.2)	—
Discontinuing high-risk procedures, no. (%)				
Liability	123 (40.2)	136 (46.3)	259 (43.2)	—
Technical skill required	28 (9.2)	20 (6.8)	48 (8.0)	—
Dislike	39 (12.7)	29 (9.9)	68 (11.3)	—
Changing practice	61 (19.9)	68 (23.1)	129 (21.5)	—
Reason for discontinuing cranial privileges, no. (%)				
Cost of annual premiums	7 (11.1)	10 (21.3)	17 (15.5)	—
Risk of lawsuit	15 (23.8)	11 (23.4)	26 (23.6)	—
Unpredictable schedule	41 (65.1)	26 (55.3)	67 (60.9)	—
Thinking about retirement due to liability, no. (%)	47 (38.2)	45 (38.8)	92 (38.5)	—

[a]The National Report Card on the State of Emergency Medicine: A-F dichotomized into low risk (grades A-C) and high risk (grades D-F).
[b]Odds ratio calculated where appropriate (Mantel-Haenszel), $P < .05$ significant; where appropriate, Student *t* and χ^2 tests were used.

(SD = $72 000) (Table 4). Neurosurgeons from high-risk states paid almost twice as much ($128 000, SD = $79 000) in insurance premiums compared with those from low-risk states ($75 000, SD = $51 000, $P < .001$). This difference in absolute premium costs translates into approximately 20% of the annual income for those neurosurgeons in high-risk states (SD = 13.0%) compared with 15% (SD = 11.5%) for those in low-risk states ($P < .001$). Almost 70% of those surveyed reported that their insurance coverage was inadequate.

Respondents had an average of nearly 1 claim over the past 3 years, with physicians in high-risk states being almost twice as likely to have a claim made against them ($P = .043$) (Table 5). Those from high-risk areas also were almost twice as likely to have ever been sued in their lifetimes ($P < .001$). Neurosurgeons from high-risk regions were 1.6 times as likely to report that their state was in a liability crisis ($P < .001$). Respondents from low-risk states reported that liability affected their practice location more often (OR = 1.3, $P = .025$). A large majority (76%) of respondents reported that liability risk affects their choice of practice location. Moreover, three-fourths of all respondents stated that they view patients as a potential lawsuit. Nine out of 10 neurosurgeons reported that their liability insurance is a financial burden, and those in high-risk areas were 3 times as likely to acknowledge this burden ($P < .001$).

The vast majority of US neurosurgeons participate in some form of defensive medicine (Table 6). More than 8 out of 10 neurosurgeons report having ordered imaging solely for defensive purposes and more so in high-risk states (OR = 1.3, $P = .042$). More than three-fourths of responding neurosurgeons reported to have ordered laboratory tests and made extra referrals for defensive purposes, and 40% to 50% claim to order more medications and procedures out of the fear of being sued. The majority of assurance behaviors are more prevalent in high-risk states. More than 40% of neurosurgeons report that they always or often order additional laboratory tests, 56% say they always/often ordered additional imaging, and more than one-third of those responding order additional consults and referrals always or often.

TABLE 7. Multivariate Logistic Regression With Defensive Behavior as the Outcome Variable and Medicolegal Risk Environment as the Predictor[a,b]

Factor	OR	*P* Value	95% CI
Experience	0.67	.04[c]	0.45-0.99
Medical legal risk	1.5	.02[c]	1.08-2.27
Reimbursement	2.35	.00[c]	1.31-4.22
High-risk procedures	1.23	.02[c]	1.04-1.45
Claims	1.59	.22	0.77-3.28
Total coverage	0.86	.24	0.68-1.10
Premium as percentage of income	1.02	.91	0.72-1.45
Public insurance	0.30	.03[c]	0.10-0.91

[a]OR, odds ratio; CI, confidence interval.
[b]The National Report Card on the State of Emergency Medicine: grades A-F.
[c]$P < .05$ considered significant. Model: forced entry (1 step), Wald = 35.52, $df = 8$, $P < .001$.

Neurosurgeons also claim to avoid certain patients and procedures (Table 6). Almost half of neurosurgeons in high-risk states claim to have discontinued high-risk procedures because of liability concerns. Almost one-fourth (23%) of respondents relinquished their cranial surgery hospital privileges because of the fear of being sued, and 38% are considering retirement because of the local liability environment.

A multivariate logistic regression model, controlling for factors from each domain (surgeon experience, reimbursement patterns, high-risk procedures, claims history, insurance coverage and cost, and public insurance), was developed with defensive behavior as the outcome, and state medicolegal grade as the predictor. When controlling for other factors that might influence defensive behavior, neurosurgeons are 1.5 times as likely to act defensively for every 1-grade change (on a scale from A to F) in risk environment ($P = .02$) (Table 7).

DISCUSSION

It appears that neurosurgeons from high-risk states are able to perceive the medicolegal risk environment and may be more conscious of and receptive to surveys on this topic (Figure 1). For example, 48% of neurosurgeons in Illinois who pay the highest insurance premiums (~$300 000/yr), responded to the survey compared with only 15% of Texas neurosurgeons (who pay <$50 000/yr).

Although neurosurgeons high-risk states were 1.4 times more likely to report having a majority of privately insured patients and those in the low-risk states were 1.4 times as likely to have a majority of publically insured patients ($P = .027$), this may not be driven by a fear of litigation. Previous reports demonstrate that race and ethnicity are not correlated with increased risk of litigation.[27,28] In fact, patients of low socioeconomic status and the uninsured actually sue their doctors 5 to 10 times less than patients of higher socioeconomic status.[27,28]

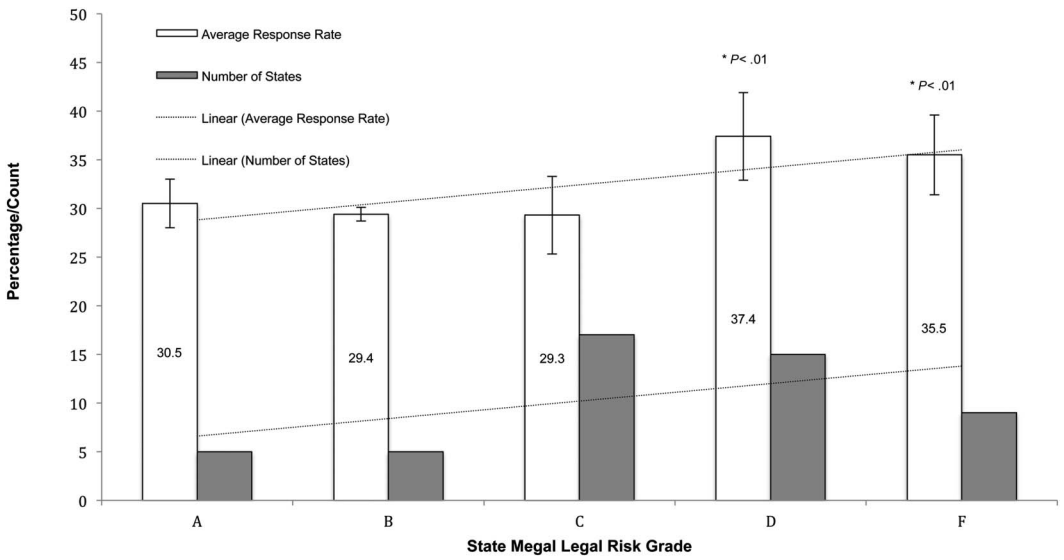

FIGURE 1. *Relationship of state medicolegal risk grade to US neurosurgeon response rate. The National Report Card on the State of Emergency Medicine:* **A-F**, *grade A: Colorado, Texas, Kansas, Georgia, South Carolina; grade B: Idaho, Montana, Alaska, California, Oklahoma; grade C: Nevada, Arkansas, Nevada, North Dakota, Wisconsin, Hawaii, Louisiana, Ohio, Mississippi, West Virginia, South Dakota, Maryland, Utah, Virginia, Tennessee, Minnesota; grade D: Florida, Maine, Indiana, New Mexico, Alabama, Iowa, Massachusetts, Illinois, Connecticut, New Hampshire, Oregon, Pennsylvania, Maryland, Washington, Michigan, Wyoming; grade F: New York, Vermont, Delaware, North Carolina, Kentucky, Arizona, Rhode Island, New Jersey, District of Columbia, Oregon, Pennsylvania, Maryland, Washington.*

The majority of neurosurgeons, regardless of state, believe that their coverage is inadequate (65%-71%), even though they are paying 15% to 20% of their annual income in insurance premiums. This corroborates previous reports. A New York-based study found that neurosurgery was found to be the most vulnerable specialty with more than $600 000 paid out per neurosurgeon over the study period (twice as much as the next highest specialty of obstetrics and gynecology).[16] In addition, about half of the neurosurgeons in this study had at least 1 lawsuit filed against them over 5 years, and almost one-fourth quarter had 2 lawsuits filed against them.[16]

Malpractice insurance perceptions are tightly linked to litigation history (Table 5). The risk of being sued was higher in the poorer grade states (Table 5). Neurosurgeons in high-risk areas were about twice as likely to have 1 claim against them in the past 3 years compared with their counterparts in lower risk regions (P = .043). Among New York neurosurgeons, Lawthers et al[24] examined the relationship between the actual and perceived risk of being sued. They found that the perceived risk of litigation was 34.4%, whereas the actual risk of being sued was only 20.8%.[24] This is within the range that our survey discovered (~33% per year).

What about defensive medicine practices? Although ordering extra laboratory tests, imaging studies, etc. was prevalent everywhere, it was even more so in high-risk states (Figure 2). For example, surgeons in high-risk states were 1.5 times more likely to order more laboratory tests solely for liability concerns (P = .006). More than 80% of US neurosurgeons reported ordering imaging studies out of the fear of being sued. There appears to be an inverse relationship between invasiveness and likelihood of ordering additional tests for medicolegal reasons. For example, the rates for ordering additional imaging, studies, laboratory tests, and referrals (all minimally invasive to the patient) were 75% to 80%, whereas the rates for additional procedures or medications were 41% to 46%.

The findings in this survey are comparable to those of a 2008 medical society report investigating defensive medicine in Massachusetts.[13] In particular, 18% to 19% of neurosurgeons reported ordering imaging studies for defensive reasons.[13] Approximately 40% of neurosurgeons queried reported reducing the number of high-risk services, and 36% reduced their number of high-risk patients over a 5-year period. Many neurosurgeons were consciously aware of medicolegal issues as well. More than one-fourth of those queried reported that liability concerns significantly

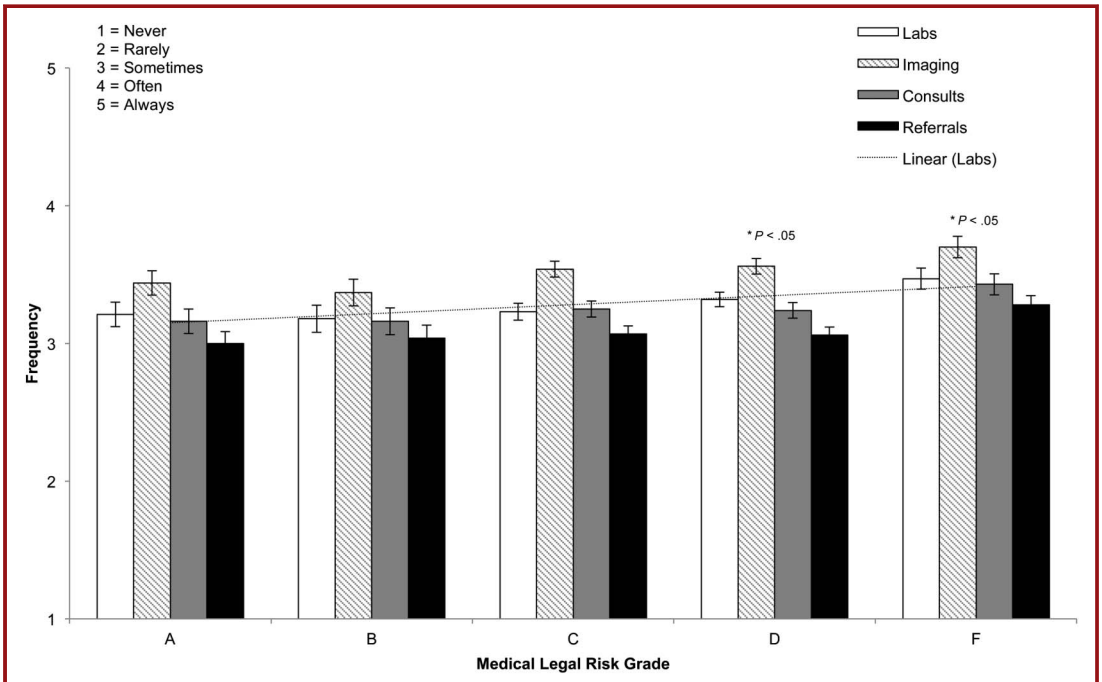

FIGURE 2. *Defensive medicine of US neurosurgeons categorized by state medicolegal risk. The National Report Card on the State of Emergency Medicine:* **A-F**, *grade A: Colorado, Texas, Kansas, Georgia, South Carolina; grade B: Idaho, Montana, Alaska, California, Oklahoma; Grade C: Nevada, Arkansas, Nevada, North Dakota, Wisconsin, Hawaii, Louisiana, Ohio, Mississippi, West Virginia, South Dakota, Maryland, Utah, Virginia, Tennessee, Minnesota; grade D: Florida, Maine, Indiana, New Mexico, Alabama, Iowa, Massachusetts, Illinois, Connecticut, New Hampshire, Oregon, Pennsylvania, Maryland, Washington, Michigan, Wyoming; grade F: New York, Vermont, Delaware, North Carolina, Kentucky, Arizona, Rhode Island, New Jersey, District of Columbia, Oregon, Pennsylvania, Maryland, Washington.*

affect medical care, almost 70% consider liability insurance premiums to be very burdensome, and more than 70% were very concerned about the impact of a lawsuit on their practices.[13]

Although our survey demonstrates significant differences in the number of surgeons, patient distributions, practice type, insurance rates, reimbursement, and litigation history between high-risk and low-risk states, is there any difference in how physicians actually practice when controlling for these factors? A multivariate logistic regression model was developed with defensive behavior as the outcome, and medicolegal risk grade as the predictor, controlling for surgeon experience, high-risk procedures, claims history, reimbursement trends, insurance premiums/coverage, and patient insurance type (Table 7). Controlling for these domains, there is a 50% increase in defensive behaviors moving down each medicolegal grade (95% confidence interval: = 1.1-2.3). For example, a neurosurgeon practicing in a C grade state would be 3 times as likely to practice defensively compared with those working in A grade regions, and a physician in a state graded as F would be 6 times more likely to be defensive than his or her counterpart in an A state.

Limitations

Accurately estimating the extent of defensive behaviors is elusive. Hermer and Brody[29] recognized that the exact measurement of defensive medicine would ultimately require the quantification of a counterfactual state. Even the definition of defensive medicine is somewhat subjective in nature because it is shaped by physician beliefs, and these are inherently difficult to measure and isolate. Mello[19] detailed many of the difficulties of defining and quantifying defensive medicine: extrapolation from local to national levels, mixed motivations for clinical behaviors, variations across specialties, perceptions of legal risk, and self-reporting bias.

Apart from well-described conceptual difficulties of capturing the practice of defensive medicine, this study has several practical limitations. First, a cross-sectional survey of practitioner perceptions is susceptible to bias. What physicians are willing to report and how they actually practice may be quite different. There is also uncontrolled response bias in an anonymous survey. There is no opportunity for comparison of basic demographic features with the nonresponders. It could be that those neurosurgeons with a heightened sense of their medicolegal environment responded to the survey. Second, this survey provides information on attitudes at a single point in time; a longitudinal series of surveys would provide more information as to whether or how practitioners' views have changed and how self-reported behaviors may be correspondingly altered. Third, this was an anonymous survey. Anonymity can provide benefit in that potential respondents may feel more at ease to give truthful answers without fear of reprisal. However, anonymity is also harmful in that some may either fabricate or embellish responses knowing that there is no mechanism in place for establishing data veracity. On balance, the authors thought that not requiring respondents to identify themselves was less harmful and would result in more truthful responses and that this benefit was crucial to obtaining the valuable information contained in this report.

CONCLUSION

Defensive medicine is prevalent among US neurosurgeons and is correlated with subjective and objective measures of state-level liability risk. Defensive medicine practices do not align with patient-centered care and may contribute to increased inefficiency in an already taxed health care system.

Disclosure

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COMMENTS

As health care reform evolves from volume-based to value-based purchasing and the development of accountable care organizations, strategic efforts will be focused on minimizing duplication of resources and more effective coordination and integration of care. To this end, it is important that the neurosurgery community partner together and transform the care we provide by developing standardized guidelines/interventions around specific neurosurgery procedures and diseases to decrease physician practice variation, which will perhaps limit defensive medicine and lead to decreased costs and improved quality care. To this end, this article provides estimates of neurosurgeons' defensive medicine behaviors and their perceptions of the liability environment in the United States and will serve as a baseline for future defensive medicine and liability studies.

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This study adds new and useful data to the controversy over tort medical liability and the practice of defensive medicine. The survey of AANS members had a relatively high response rate (31%), giving the data reasonable credibility. As might be expected, malpractice premium rates were higher (70%) in states with a higher confirmed risk of lawsuits and states with lower risk had slightly greater neurosurgeon-to-population ratios (9 vs 8 per million). An interesting trend was fewer small group practices and more large group and academic practices in higher risk states. The study reconfirmed the high risk of malpractice claims against neurosurgeons with an average of 1 claim in the past 3 years among respondents. A counterintuitive finding was lower malpractice claims from uninsured and publicly insured patients.

Defensive medical practice includes both assurance (eg, extra medical testing) and avoidance (eg, discontinuing high-risk procedures) tactics. Both forms of defensive practice were more frequent among neurosurgeons in higher liability risk states in this survey. Assurance measures are the cause of unnecessarily higher health care costs, assuming the extra tests or procedures would not be ordered in a lower risk climate. The amount of extra cost has been debated. The CBO estimated only an $11 billion savings in 2009 (0.5% of total health care spending) if federal tort reform were instituted, with 40% coming from reduced liability premiums and 60% from reduced defensive medicine costs.[1] On the other hand, Kessler and McClellan[2] estimated that tort reform could reduce 5% to 9% of total health care spending, well over $100 billion, by reducing defensive medical spending. The cost in this study was estimated at $55 billion in 2011.

The study correctly notes that there is a "disconnect between defensive practices that physicians 'on the ground' perceive and the ability of researchers to measure those practices." Every doctor knows that it occurs, but nowhere is it accurately recorded, nor can it be openly acknowledged, and thus, there is no accurate measurement. In fact, the distinction between testing for thoroughness and testing for self-protection may become blurred, as over time testing that might once have been deemed self-protective may become standard as usage proves it prudent and patient protective.

The concept of stopping high-risk procedures to avoid liability may not be as effective a strategy as it appears. Richard Wohns[3] found that the highest frequency malpractice case in the Doctors Company database was routine spinal procedures, not trauma or complex cranial surgery.

The authors should be commended for a well-analyzed survey and thoughtful report adding data in support of reasonable and proven tort medical liability reform.

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3. Wohns RN. Liability is rooted in elective spine cases: four years of TDC data analyzed. *AANS Bulletin.* 2005;14(2).

The authors report on the results of a survey among neurosurgeons in the United States and provide an estimate of defensive behaviors and perceptions of the liability environment. The authors sought to examine the relationship of defensive medicine and assess the facets of both "assurance" behaviors such as ordering additional tests and procedures and "avoidance" behaviors such as avoiding high-risk procedures and patients compared with the liability environment in the states in which neurosurgeons practice. Although there are a number of difficult-to-control biases linked to the survey approach, the authors should be congratulated for obtaining a good response rate that allowed them to paint a reasonably comprehensive picture of the problem. This type of data is in particular relevant given that neurosurgeons are increasingly often caught in the maelstrom of pressures to keep health care spending in check but catering at the same time to patients demanding unnecessary services, plaintiffs' attorneys looking for allegedly "negligent" care, and hospitals and managers that encourage employed physicians to bring in more revenue and volume or market share. There have been attempts to funnel cost-saving pressures into reasonable practice guidelines and consensus, including the Choosing Wisely campaign. Voluntary programs like this include a push for price transparency, more access to and reliance on clinical guidelines, and elimination of unnecessary or less

useful tests and procedures. Unfortunately, there are, however, powerful incentives that stand in the way of these changes. Patients demand unnecessary services, and when a physician cuts out tests like MRI for nonspecified back pain, they are not protected from the risk of a malpractice suit for not ordering them. The study uncovers some interesting trends—eg, it will remain to be seen whether the movement to larger group practices in higher risk states will give neurosurgeons the perceived increased safety net they desire. Does the reduced risk of being sued by uninsured patients mean exactly what the legal profession is concerned about—that filing a malpractice suit comes with a fairly high threshold? It also remains to be seen whether the pressures created by the risk environment in a given region or state amount to a practice-altering environment or are they balanced by economic incentives that reward that risk. It has, for example, been noted that spine surgery results more often in litigation than cranial surgery, which goes against the argument that many surgeons make who voluntarily relinquish their cranial practice privileges to reduce their practice risk but really may represent a shift for economic or noneconomic reasons.[1]

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1. Taylor CL. Neurosurgery jury verdicts and settlements: 2012 prevalence by case type. Paper Presented at: AANS Annual Meeting 2014, San Francisco, CA, Abstract #715.

Here, the authors present a fascinating glimpse into the self-reported practices of American neurosurgeons, stratified according to the medicolegal environment in which they practice. The authors conclude that practicing in a high-risk environment leads one to practice neurosurgery more defensively, as evidenced by 1 data point—an increased likelihood of ordering laboratory tests strictly for defensive purposes. They do concede that the majority of US neurosurgeons practice defensively regardless of the medicolegal environment in which they practice, reporting that, on average, they engage in defensive medical practices sometimes. It should also be noted that the difference in defensive practices reported by the low- and high-risk groups is almost entirely attributable to the ordering of laboratory tests, which, by and large, is not a particularly expensive proposition. This supports the general conclusions of economists that, although defensive medical practices do contribute to economic waste in the US health care system, the dollar value attributable to defensive medicine is fairly modest compared with other wasteful practices. Contradicting the authors' conclusions, the study also shows that neurosurgeons working in high-risk environments are actually 1.6 times more likely to perform high-risk surgeries (Table 3) and are no more likely to engage in asset protection strategies than their colleagues who practice in low-risk environments. Certainly, if one is a rational economic actor practicing in fear of a bankrupting lawsuit, these are 2 actions that one would quickly take: stop performing risky operations and protect one's assets from loss. Yet, this is not the case. Finally, the multivariate logistic regression data presented in Table 7 indicates that reimbursement trend are a stronger predictor of defensive behavior than medicolegal risk and that public insurance leads to a statistically significant decrease in defensive practices, both suggesting that the ordering of tests may also be influenced by economic incentives and disincentives. Also, in contrast to the influence of medicolegal risk environment, the percentage of one's income paid out for premiums had no impact on defensive practices even though there is a strong correlation between risk environment and premiums paid (Table 4). In the end, this is a complex issue and we must be diligent in our efforts to understand the many conscious and subconscious factors that influence our clinical decision making and our decisions regarding where and how to practice.

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