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Physicians with multiple paid medical malpractice claims: Are they outliers or just unlucky?☆

Bernard Black[a], David A. Hyman[b,*], Joshua Y. Lerner[c]

[a] Northwestern University, Pritzker School of Law and Kellogg School of Management, United States
[b] Georgetown University School of Law, United States
[c] Northwestern University, Pritzker School of Law, United States

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ABSTRACT

We extend Studdert et al. (NEJM, 2016). We examine to what extent a physician who has past paid medical malpractice ("med mal") claims in a defined prior period is more likely to have additional paid claims in a defined future period, relative to a physician with no prior-period claims. Our simulation implements a null hypothesis that paid claims are random events, with arrival risk depending on state, but not on physician-specific factors (such as technical ability, bedside manner, and communication skills). We show that even a single paid claim in the prior five years nearly quadruples the likelihood of a paid claim in the next five years, and dramatically increases the likelihood of 2+ future paid claims. More generally, the number of prior paid claims strongly predicts both the likelihood of having future paid claims and the expected number of future claims. By comparing actual to simulated probabilities, we can predict the likelihood that having a given number of paid claims is attributable to chance. We find that even for physicians in high-risk specialties in high-risk states, bad luck is highly unlikely to explain three or more claims in 5 years. Hospitals and state medical boards can use our approach to identify physicians that are likely to benefit from graduated interventions aimed at reducing future claims and patient harm.

1. Introduction

It has long been known that some physicians are prone to repeat medical malpractice ("med mal") claims.[1] But how much more claim prone are they? What fraction of paid med mal claims are due to physicians with multiple paid claims? At what point (what number of paid claims, over what period) can we fairly call these physicians "outliers" – or less politely, apparent "bad docs" – and take steps to reduce future medical errors and paid claims? We study these questions using national data on paid claims from the National Practitioner Data Bank ("NPDB"). We compare the actual and simulated probabilities that a physician in state *s*, with *m* paid medical malpractice claims in a prior *y* year-period will have *n* or more paid claims in the next *z* years. Our simulation compares actual paid claim arrival patterns to a simple null hypothesis that claims are random events, with arrival risk depending on state and specialty, but not on physician "skill" – a concept we use broadly, to refer to technical skill and other physician-specific factors such as communication skills, bedside manner, and whether the physician tends to see high-risk patients. This null hypothesis reflects the belief of many physicians that most malpractice suits are indeed random events – attributable to bad luck, rather than actual negligence (Below, we often omit "paid," but all references to claims are to paid claims reported to NPDB.)

Our study extends Studdert et al. *Prevalence and Characteristics of Physicians Prone to Malpractice Claims* (New England Journal of Medicine, 2016). Using NPDB data, Studdert and coauthors conclude that only about 6% of practicing physicians had one or more claims over a 10-year period from 2005 to 2014, and that the 1% of physicians with 2+ claims during this period accounted for 32% of paid claims. Studdert and coauthors also report that the number of claims in an initial five-year period strongly predicts the likelihood of a claim in the next five years: the more prior-period claims, the higher the likelihood of a future claim. See our Fig. 1 (which is a

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* Corresponding author.
E-mail addresses: bblack@northwestern.edu (B. Black), dah137@georgetown.edu (D.A. Hyman), joshlerner1@gmail.com (J.Y. Lerner).

[1] See, e.g., Rolph et al. (2007); Hickson et al. (2002); Weycker and Jensen (2000); Bovjberg and Petronis (1994); Sloan et al. (1989). Rolph et al. (1991) found limited predictive power of past claims but studied a small sample of only 202 claims over 13 years in four specialties in a single state.

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0144-8188/

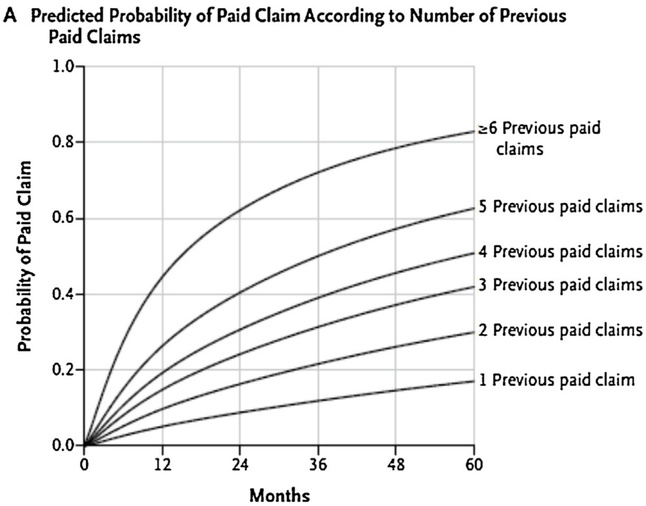

Fig. 1. Fig. 2A from Studdert et al. (2016).
Their figure heading (one heading for both Fig. 2A and 2B) states: "Curves were adjusted for the number of previous paid claims that the physician had during the study period; the payment year; the physician's qualification (doctor of medicine vs. doctor of osteopathic medicine), specialty, age, sex, trainee status (resident vs. non-resident), practice location (state and rurality), and medical school location (United States vs. other); and the number of paid claims per 1000 physicians, according to year and specialty".

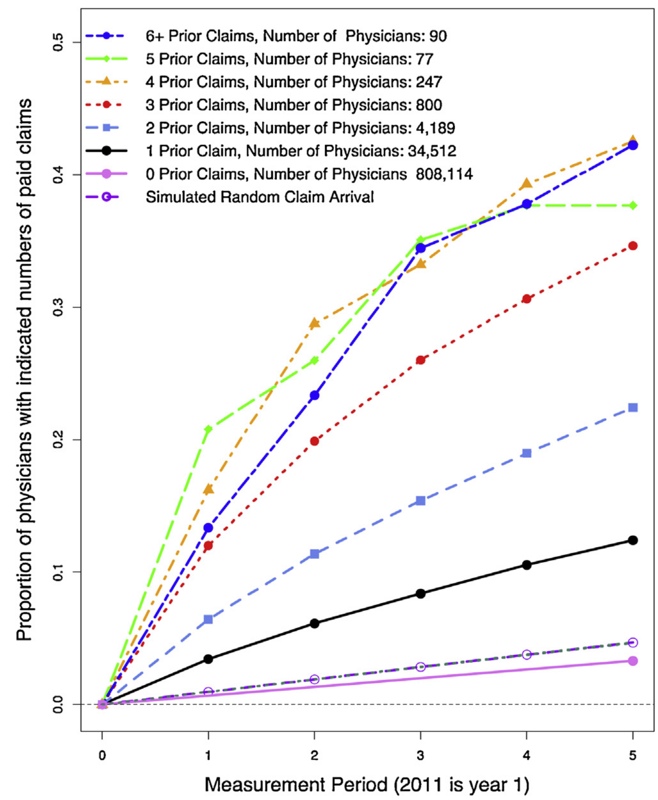

Fig. 2. Actual and Simulated Likelihood of 1+ Future Paid Claims: 5-year Prior and Future Periods (Similar to Studdert Fig. 2A, but with Explicit Null Hypothesis).
Figure shows the probability that a physician with the indicated number of "prior" paid claims during 2006–2010 will have 1+ "future" paid claims during 2011-2015. Lower dashed line shows mean simulated probability that a physician with one paid claim in the pre-period will have 1+ future paid claims, if all paid claims arrive at random, at state-specific rates. Dotted lines just above and below this line (which usually merge with the line) show 95% confidence interval.

copy of their Fig. 2A). The implication is that a physician's past claim history, plus the physician's practice state, specialty, and perhaps some basic demographic information, goes a long way toward predicting the physician's future claim history. Weycker and Jensen (1990), in an earlier study of Michigan physicians in the 1980s, also find that claims in a prior 5-year period strongly predict claims in a future 5-year period, controlling for a broad set of physician characteristics.

We extend Studdert et al.'s analysis by adding an explicit null hypothesis, which allows us to differentiate physicians who may have just been "unlucky" from "outliers" who are actually (not just statistically, based on averages for a broad group) much more likely to experience additional future claims. Our null hypothesis is that paid med mal claims are random events that convey no information about physician quality and future claim risk. This view (that med mal claims are largely random events) is popular among physicians and tort reform advocates. If claims arrive at random, many physicians would have zero paid claims, a fair number would have one paid claim, a smaller number would have two paid claims, and so on. However, it is well known that malpractice risk varies across states and specialties. The fraction of physicians who would have multiple paid claims under the null hypothesis should therefore vary across states and specialties – so that the same number of paid claims in a specified time period could indicate an outlier physician in some states and specialties, but perhaps only an unlucky physician in other states and specialties.

If we are able to identify a threshold number of paid claims over a specified period at which it is no longer plausible that a physician was unlucky, our approach can be used to identify physicians who deserve closer scrutiny by hospitals and licensing boards. To be sure, multiple factors influence whether a physician is sued for malpractice, and whether a payout actually results. However, as Studdert and coauthors report in an important prior paper (Studdert et al., 2006), there is a strong association between paid claims and negligent treatment. Thus, it may be possible to reduce the incidence of medical error by focusing hospital and medical board attention on outlier physicians.

For our principal study period of 2006–2015, even a single paid claim in the first five years nearly quadruples the likelihood of a paid claim in the next five years relative to physicians with no claims during this period – from 3.8% to 12.4%. A single prior paid claim increases the likelihood of 2+ future paid claims six-fold relative to physicians with no prior claims – from 0.4% to 2.4%. More generally, the number of prior paid claims over any prior y-year period (we study periods from 3 to 10 years) strongly predicts both the likelihood of having 1+ claims over the next z years, as well as the number of future claims.

Previous research has sought to identify factors that predict future med mal claims, but has often considered factors which we take as part of our base simulation (risk varies by state) or found predictive value in factors which could be hard to use as the basis for intervention, such as age or gender.[2] We are interested in a different question: to what extent, after we take account of state-level variation, can we identify physicians who have experienced certain claiming patterns as true outliers? And how strongly can we do so, for any given claiming pattern? Our goal is to identify claiming patterns which can support intervention by hospitals, practice groups, or medical boards to reduce future claims and patient harm. For that purpose, it is not helpful to know that being, say, a neurosurgeon in New York, predicts both a relatively high rate of malpractice claims and high damage awards in paid claims, or that being male predicts, say, a 30% higher claim rate than being female. No one thinks that we should ban neurosurgery in New York, or bar men from entering high-risk specialties. Given that, we seek to identify

[2] See, e.g., Cooil (1991); Rolph et al. (2007); Gibbons et al. (1994).

which physicians are outliers compared to their peers – raising the possibility of intervention to reduce future claims and harm.

Some physicians are surely just unlucky, but our evidence – that even a single prior claim strongly predicts future claims – suggests that many claims reflect physicians having "negative skill" relative to an average of their peers. The likelihood that bad luck can generate two claims over a 5-year period is quite low (save perhaps for high-risk specialties in high-risk states). The likelihood that bad luck can lead to 3+ claims over a 5-year period is negligible. However, we also find evidence that the far past is a worse predictor of future claims than the near past. Thus, for example, one prior claim, 11–15 years ago, has less predictive value than a claim between 6–10 years ago, which has less predictive value than a claim in the last 5 years.

Part II discusses our data sources and variables. Part III develops a simple model of the malpractice risk faced by low- and high-skill physicians, and presents our simulation methodology. Part IV present our results; Part V discusses some implications of our work and Part VI concludes.

2. Data and variables

Like Studdert et al, we use the NPDB as the basis for our study. The NPDB is a national repository of all paid med mal claims against physicians. It has reasonably complete data from 1992 on. Each physician receives an anonymized, time-consistent identifier. We study doctors of medicine (M.D.s); below, simply physicians).[3] We obtain counts of active practicing non-federal physicians (below, "active physicians") in the 51 states (50 states plus the District of Columbia) from annual surveys conducted by the American Medical Association (AMA). This data is available by county*specialty*year from the Area Health Resource File (AHRF).[4] All claim rates reported below are per active physician.

With one important exception, the Health Resources and Services Administration (HRSA), which manages the NPDB database, checks for and eliminates duplicate reports concerning the same claim. The exception involves the eight states with a Patient Compensation Fund (PCF), which pay damages above a threshold amount.[5] HRSA treats the payment by the physician (or the physician's insurer), and the PCF payment as separate payments, even though they involve the same claim. To avoid double-counting these claims, we drop claims reflecting PCF payment.[6]

A question faced by any study that uses the NPDB is data completeness, since NPDB relies on voluntary reporting. In separate work, we study this question for Illinois, which requires med mal insurers to report all paid claims to the Illinois Department of Insurance, and find very strong overlap between the two data series. This suggests that underreporting to NPDB is not a major concern.[7]

Table 1A and 1B provides summary statistics, by year and for indicated periods, on the number of NPDB paid claims, the number of distinct physicians who incur these claims, and the number of active physicians.

Table 1A
Summary Statistics by Claim Year.

Year or range	(1) Paid claims	(2) Distinct physicians with paid claims	(3) Active Physicians	(4) = (1)/(3) Claims per Active Physician	(5) = (2)/(3) Percentage of Physicians with 1+ paid claims
1992	13,340	12,198	568,132	0.0235	2.15%
1993	13,278	12,119	576,771	0.0230	2.10%
1994	13,775	12,674	589,906	0.0234	2.15%
1995	12,635	11,687	617,362	0.0205	1.89%
1996	13,137	12,076	634,775	0.0207	1.90%
1997	12,970	11,733	656,195	0.0198	1.79%
1998	12,454	11,302	678,649	0.0184	1.67%
1999	13,295	12,277	693,345	0.0192	1.77%
2000	13,699	12,709	708,463	0.0193	1.79%
2001	14,625	12,461	720,933	0.0203	1.73%
2002	13,527	12,462	737,495	0.0183	1.69%
2003	13,331	12,372	755,287	0.0177	1.64%
2004	12,658	11,745	760,751	0.0166	1.54%
2005	12,233	11,158	769,730	0.0159	1.45%
2006	10,921	10,158	778,331	0.0140	1.31%
2007	9,986	9,255	794,184	0.0126	1.17%
2008	9,702	9,013	797,864	0.0122	1.13%
2009	9,420	8,794	810,218	0.0116	1.09%
2010	8,832	8,259	822,571	0.0107	1.00%
2011	8,680	7,994	833,668	0.0104	0.96%
2012	8,225	7,642	847,977	0.0097	0.90%
2013	8,242	7,522	862,444	0.0096	0.87%
2014	8,111	7,624	875,994	0.0093	0.87%
2015	7,882	7,437	898,750	0.0088	0.83%
2016	7,405	7,012	915,368	0.0081	0.77%
2006-2010	48,861	40,938	800,634	0.0611	5.11%
2011–2015	41,140	34,725	863,767	0.0477	4.02%
2006–2015	90,001	69,729	832,200	0.1088	8.38%
1996–2005	131,929	94,430	711,562	0.1861	13.27%
1996–2015	221,930	145,915	771,881	0.2950	18.90%
1992–2016	282,363	175,886	748,207	0.3934	23.51%

Panel A provides summary statistics for NPDB claims paid by physicians (MDs) by claim year, and for indicated periods. For multiyear ranges, % of physicians with paid claims is based on average number of active physicians during the period. Physician counts for 2015 are extrapolated based on trends over 2011–2014.

Table 1B
Percentage of Physician with Paid Claims Over Different Time Periods.

Year Range	No of years	1+ Claims	2+ Claims	3+ Claims	4+ Claims
2006-2010	5	5.11%	0.70%	0.16%	0.05%
2011-2015	5	4.02%	0.50%	0.11%	0.03%
2006-2015	10	8.38%	1.57%	0.44%	0.17%
1996-2005	10	13.27%	3.21%	1.02%	0.41%
2001-2015	15	13.88%	3.38%	1.12%	0.46%
1996-2015	20	20.51%	5.95%	2.21%	0.99%
1992-2016	25	23.51%	7.52%	3.03%	1.42%

Panel B shows percentage of active, practicing non-federal physicians with indicated numbers of paid claims, over indicated periods. Number of physicians is averaged over indicated period (from Panel A).

NPDB does not include physician specialties, so we cannot directly compute specialty-specific med mal claim risk. We instead take specialty-specific med mal risk rates, *relative* to an average for all active physicians, from Jena et al. (2011).[8] We map their specialty categories onto the slightly different categories

[3] Studdert et al. (2016) study both M.D.s and doctors of osteopathic medicine (D.O.s). D.O.s account for about 8% of their sample, but a smaller percentage of claims, because D.O. practice principally in primary care, and thus face relatively low med-mal risk. If we included D.O.s, our core result, that a physician with even one prior period claim faces a much greater risk of a future claim than a physician with zero prior claims) would become stronger.

[4] Studdert et al. (2016) appear to have used a slightly different extract from the same underlying data source, the AMA. This seems unlikely to be an important driver of differences between our results and theirs. We have AHRF data on physicians through 2015. We extrapolate the physician count data through 2016.

[5] The eight states are Indiana, Kansas, Louisiana, New Mexico, Pennsylvania, South Carolina, Nebraska, and Wisconsin.

[6] The "fundpymt" variable in the NPDB dataset identifies payments made by a PCF. Studdert et al. also eliminate these duplicate payments.

[7] Hyman et al. (2018b).

[8] The authors were kind enough to provide us with a spreadsheet containing the data underlying their Fig. 1. We used their risk figures for paid claims, rather than all claims. This paper provides annual percentage risk by specialty; we convert this to *relative* risk, and then multiply by known (from NPDB) average risk in each state to determine state*specialty annual percentage risk.

Table 2
Specialty Relative Risks.

AHRF specialty	Jena Specialty	No. of physicians	Relative risk	Annual risk (1+ claims)	5-year risk (1+ claims)
General Surgery	General Surgery	37,510	2.62	2.49%	13.46%
Orthopedic Surgery	Orthopedic Surgery	25,603	2.44	2.32%	12.63%
Cardiovascular surgery	Thoracic-cardiovascular Surgery	4,509	2.42	2.30%	13.32%
Neurosurgery	Neurosurgery	6,138	1.94	1.84%	10.11%
Plastic Surgery	Plastic Surgery	7,775	1.74	1.65%	9.30%
All Surgeons		**81,535**	**2.42**	**2.30%**	**13.26%**
Obstetrics and Gynecology	Obstetrics and Gynecology	38,662	1.82	1.73%	9.51%
Urology	Urology	10,583	1.57	1.49%	7.82%
Radiology and Oncology	Oncology	5,030	1.18	1.12%	6.36%
Diagnostic Radiology	Diagnostic Radiology	25,960	1.02	0.97%	5.62%
Anesthesiology	Anesthesiology	44,569	1.01	0.96%	5.44%
Emergency Medicine	Emergency Medicine	36,828	0.91	0.86%	4.99%
Neurology	Neurology	17,069	0.89	0.85%	5.05%
Gastroenterology	Gastroenterology	13,756	0.84	0.80%	4.64%
Internal Medicine	Internal Medicine	11,5223	0.81	0.77%	4.40%
Pathology	Pathology	1,8214	0.81	0.77%	4.56%
Ophthalmology	Ophthalmology	18,651	0.74	0.70%	3.96%
Dermatology	Dermatology	11,723	0.73	0.69%	3.64%
Family General Practice	Family General Practice	87,718	0.65	0.62%	3.51%
Cardiology	Cardiology	22,620	0.60	0.57%	3.26%
Pulmonary Medicine	Pulmonary Medicine	11,877	0.59	0.56%	2.75%
Other Specialties	Other Specialties	5,698	0.45	0.43%	2.42%
Pediatrics	Pediatrics	58,167	0.33	0.31%	1.83%
Psychiatry	Psychiatry	37,651	0.28	0.27%	1.41%
Other physicians		202,232	0.997	0.95%	6.09%
All active physicians	**All physicians**	**863,767**	**1.000**	**0.95%**	**6.09%**

Table shows national average risks that physicians in the indicated specialties will face paid med mal claims. Risks and physician counts are averaged over 2011–2015. Physician counts for 2015 are extrapolated based on trends over 2011–2014. Relative risks are adapted from Jena et al. (2011). 5-year risk is simulated assuming random arrival of claims.

reported by AHRF.[9] Studdert et al. obtained physician specialties from HRSA, through a special application, involving linking NPDB to specialty information from the American Medical Association. We were not able to obtain this specialty data, so we can simulate specialty-specific risk with random claim arrival but cannot compare simulated to actual risk.[10]

Table 2 summarizes our mapping from Jena to AHRF specialties, and provides summary statistics on the number of physicians and med mal claim risk in each specialty. See Appendix in Supplementary material for mapping details. Relative risk varies by a factor of close to 10, from 2.62 for general surgery to only 0.28 for psychiatry.

Table 3 summarizes per-physician claim risk by state, with states listed in order from high to low per-physician risk. State-specific annual claim risk, averaged over 2011–2015, varies by a factor of almost nine, from a high of 0.022 in West Virginia to only 0.0025 in Minnesota. This large range underscores the need to take state-level variation in risk into account when assessing which physicians are outliers. Taking both specialty and state risk into account, the risk of a paid claim for a West Virginia general surgeon is about 80 times the risk for a Minnesota psychiatrist.

[9] For Jena's nephrology category, there is no corresponding AHRF category. Jena has OB/GYN and gynecology as separate categories; AHRF has only an OB/GYN category. We use Jena's OB/GYN risk.

[10] We requested from HRSA the specialty-level data that Studdert et al. used, but they informed us that their data use agreement with the AMA required them to destroy the specialty-level data after the Studdert et al. study was completed. We explored with HRSA whether we could match the NPDB data with other sources of specialty data, but they declined to approve this project. We do not expect the differences between the specialty-specific risks we estimate using the Jena et al. data and those we would obtain with an alternative source of specialty to materially affect our simulations. However, we need physicians' actual specialties to compare our simulations to actual specialty-specific data.

3. Informal hypotheses and methodology

3.1. Med Mal Claims as proxy for low-quality care

We see paid med mal claims as a proxy for medical care that causes patient harm. It is known that many negligent medical errors do not lead to claims, and that not all paid claims involve negligence, but there is also a reasonably high likelihood that a paid claim reflects actual negligence. Imagine a physician, who has skill level *q* (for quality), sees many patients *s* and provides negligent care to a fraction *r(q)* of those patients. However, only a small fraction *v* of negligent care results in a paid claim. Conversely, some fraction *w* of non-negligent care leads to an adverse patient outcome and eventually to a paid claim. The likelihood of a paid claim for physician *i*, in specialty *j* and state s, is:

$$\mathrm{p_{ijs}\tilde{s}_{ij}*[r(q_{ij})*v_{ij})+(1\text{-}r(q_{ij}))*w_{ij}]}+\varepsilon_{ijs} \tag{1}$$

Here ε_{ijs} is a mean-zero "error" that captures both random noise and other factors that affect paid claim likelihood. In this model, the expected fraction of paid claims that are "good" (reflect negligence) will be:

$$g_{ijs}=\frac{r_{ijs}\times v_{ijs}}{(\mathrm{r_{ijs}}\times v_{ijs})+\left(1-r_{ijs}\right)\times w_{ijs}} \tag{2}$$

For low-skill physicians, *v* will be large, and most claims will be good ones. For high-skill physicians, *v* will be low, and most claims could be "bad" ones, with no underlying negligence. While the model focuses on paid claims, this tendency will be stronger for all claims, many of which will be closed without payment, than for paid claims. If most physicians are high-skill, this could help explain the common physician belief that most med mal claims are bad ones. This belief could be true for most *physicians*, yet false for most paid *claims*.

Moreover, high skill physicians may cluster in particular hospitals and geographic areas. Thus, high-skill physicians could meet mostly other high-skill physicians, which would tend to reinforce

Table 3
State Relative Risks.

State	(1) Paid claims	(2) Active physicians	(3) = 1000*[(1)/(2)] Claims/1000 physicians	(4) = (3)/nat'l avg Relative risk	Risk rank
West Virginia	91	4,219	21.6	2.422	1
New York	1,352	77,822	17.4	1.950	2
Montana	35	2,108	16.4	1.838	3
Oklahoma	93	6,642	14	1.572	4
New Jersey	384	27,452	14	1.568	5
Mississippi	73	5,336	13.7	1.536	6
Florida	653	48,242	13.5	1.519	7
New Mexico	66	4,908	13.5	1.516	8
Louisiana	166	12,679	13.1	1.472	9
Pennsylvania	482	39,566	12.2	1.366	10
Indiana	172	14,327	12	1.346	11
Utah	70	6,165	11.3	1.270	12
Wyoming	11	1,007	10.9	1.227	13
New Hampshire	42	3,873	10.9	1.225	14
Kansas	69	6,493	10.6	1.193	15
Kentucky	107	10,158	10.5	1.180	16
Maryland	244	23,394	10.4	1.172	17
Rhode Island	42	4,083	10.3	1.155	18
Nevada	51	5,034	10.1	1.132	19
Arizona	145	14,695	9.9	1.108	20
Arkansas	56	6,034	9.3	1.042	21
Delaware	21	2,256	9.2	1.033	22
Michigan	235	26,479	8.9	0.994	23
South Carolina	96	10,911	8.8	0.983	24
Maine	31	3,635	8.5	0.957	25
California	863	103,632	8.3	0.935	26
Iowa	48	5,810	8.3	0.928	27
Idaho	22	2,646	8.2	0.923	28
Georgia	179	22,133	8.1	0.909	29
Illinois	288	37,693	7.6	0.858	30
Missouri	116	15,388	7.5	0.846	31
Nebraska	34	4,647	7.3	0.815	32
Connecticut	98	13,724	7.1	0.802	33
South Dakota	13	1,861	7.1	0.799	34
Washington	127	18,475	6.9	0.769	35
Texas	389	57,683	6.7	0.757	36
Alaska	10	1,547	6.6	0.744	37
Oregon	74	11,152	6.6	0.743	38
Massachusetts	209	32,723	6.4	0.716	39
Tennessee	107	17,213	6.2	0.700	40
Virginia	132	21,687	6.1	0.683	41
Colorado	79	13,925	5.6	0.633	42
Ohio	160	32,700	4.9	0.550	43
North Carolina	117	25,026	4.7	0.524	44
Alabama	44	10,441	4.2	0.470	45
Hawaii	15	4,010	3.7	0.420	46
Vermont	9	2,333	3.6	0.409	47
North Dakota	6	1,728	3.5	0.390	48
Wisconsin	44	14,942	2.9	0.307	49
District of Columbia	13	4,955	2.7	0.300	50
Minnesota	40	16,455	2.5	0.275	51
All physicians	8,315	863,767	8.9	1.000	

Paid claims are annual average by state over 2011–2014, rounded to nearest whole number, using the licnstat variable in NPDB. Active physician counts are based on data from AHRF, averaged over the same time period. States are sorted by relative risk, from highest to lowest.

their belief, from their own experience, that most med mal claims reflect bad luck, rather than bad care.

Note that some low-skill physicians will be "lucky" and not experience claims in the prior period, but will still be more likely to experience future period claims, while some high-skilled physicians will have been unlucky in the prior period and faced a paid claim, but will remain unlikely to face a claim in the future period. Thus, our comparison below of future risk faced by *apparently* skilled versus less-skilled physicians (based on prior period claims) likely understates the true effect of physician quality on med mal risk.

3.2. Simulation methodology

We specify here our simulation methodology using a 5-year period to measure past claims and a 5-year period to measure future claims, with 2006–2010 as the prior period and 2011–2015 as the future period.[11] The approach is similar for other prior and future periods. We discuss the simulation for state-specific risk here and the simulation for state-and-specialty specific risk in the Appendix in Supplementary material.

We first compute the average annual state-specific risk of a paid med mal claim as:

$$f_s = claims_s / docs_s$$

[11] We use a sample period from 2006-2015; Studdert et al. use 2005-2014. This difference seems unlikely to be an important driver of differences between our results and theirs. Note that we compute average claim risk across a number of years, during a time period when the number of claims was dropping steadily (see Table 1A ans 1B). Allowing claim risk to vary by year would produce slightly different graphs than those we report below.

Table 4
Summary statistics for prior and future claims.

Prior claims	Active Physicians		Future claims			Percent of physicians with			
	No.	%	No.	%	Claims/1000 physicians	1+future claims	2+ future claims	3+ future claims	4+ future claims
0	760,719	95.0	33,677	81.86%	44	3.29%	0.38%	0.059%	0.016%
1	34,512	4.3%	5,354	13.01%	155	12.4%	2.36%	0.64%	0.21%
2	4189	0.5%	1,329	3.23%	317	22.4%	6.45%	1.93%	0.80%
3	800	0.10%	429	1.04%	536	34.6%	11.5%	5.50%	2.09%
4	247	0.03%	205	0.50%	830	42.5%	17.8%	14.2%	8.51%
5	77	0.010%	67	0.16%	870	37.7%	23.4%	14.3%	11.7%
6+	90	0.011%	79	0.19%	878	42.2%	23.3%	14.4%	7.83%
Total	**800,634**	**100%**	**41,140**	**100%**	**51.4**	4.34%	0.54%	0.12%	0.04%
Simulated	–	–	–		–	4.67%	0.19%	0.011%	0.0003%

Table shows number of physicians with indicated number of prior claims (over 2006–2010), and what percentage had indicated numbers of future claims (over 2011–2015) against them. Total number of active physicians is averaged over 2006–2010. Row for 0 prior claims assumes that all future claims involve physicians who were active during 2006–2010. Simulation row is mean values from 1000 iterations, assuming random arrival of claims, at state-specific rates. Simulated rate for 1+ future claims exceeds actual rate because simulation does not reflect secular drop in claim rates.

Here $claims_s$ is the average number of claims in state s over 2006–2015, and $docs_s$ is the average number of physicians in state *s* over 2011–2013 (first 3 years of our "future" period).

For each year in the future period, we take $docs_s$ draws of claims from a binomial distribution, with probability f_s for each draw. This produces a number $future_{st}$ of paid claims for each state s and future year t, where $future_{st}$ is a random variable with expected mean = $claims_s$, but the actual values will vary across simulations and future years. For each future state*year, we assign each of these claims to one of the $docs_s$ physicians at random.[12] We then simply count the number of suits for each physician for each future year, and also sum these physician-specific counts over the future period. Since fs is small (the national average is around 1%), most physician*years will have zero claims, a few (approximately f_s) will have one claim, a smaller number (approximately f_s^2) will have two claims, and so on.

In practice, if claims arrived at random, the likelihood that a physician would receive one claim in 5 future years will be about 5^*f_s (or about 5% for an average state), the likelihood of two claims will be about $(5^*f_s)^2$, or around 0.25%, and so on.[13] We run each simulation 1000 times, and thus obtain a distribution of likelihoods that, say, a physician will receive 1+ future claims by year *t*. We use this distribution to plot mean risk and a 95% confidence interval around that mean risk.

We also compute physicians' *actual* risk of receiving 1+, 2+ and 3+ future claims in each future year, for the actual physicians with 1, 2, 3, etc. paid claims during the pre-period. This is simply a counting exercise, using the NPDB data.[14]

4. Results

4.1. Summary statistics on paid claims

As noted above, in Table 1A and 1B, we provide summary statistics for paid claims against physicians by year and for indicated multi-year periods. As Table 1A and 1B indicates, across our entire dataset, the per-physician risk has been dropping over this entire period, and steeply so since 2001 (Paik et al., 2013).

In general, our results are consistent with the qualitative features of the Studdert et al. analysis, but not the specific numbers they report. For example, they state that "the distribution of paid claims over the 10-year study period [2005–2014] was extremely concentrated. Only 6% of physicians had a paid claim." We find that the percentage over a slightly different period (2006–2015) is 8.4%. See Table 1B, Also, Studdert et al. state that over 2005–2014, 1% of physicians have 2+ claims, and account for 32% of claims. In contrast, we find that over 2006–2015, 1.6% of physicians have 2+ claims, which account for 27% of all claims. Over this period, we also find that 0.44% of physicians have 3+ claims, accounting for 11.7% of all claims.

4.2. Physicians with one versus zero prior claims

Fig. 2 presents our findings on future claim risk, based solely on prior claim history, using a 5-year "pre" period (2006–2010) and a 5-year "future" period (2011–2015). There are several differences between Fig. 2 and the comparable findings in Studdert et al. (which we show as our Fig. 1). First, the bottom dashed line in Fig. 2 shows our simulated results if claims arrived at state-specific rates, but otherwise at random. Dotted lines above and below this dashed line show 95% confidence intervals (CIs) – but the CIs are very tight, and not distinguishable from the central estimate.

Fig. 2 shows that having even a single prior claim strongly predicts future claims, over the next five years. Table 4 provides related summary statistics. The 5-year probability that a physician with one prior claim will have 1+ future claims is 12.4%, versus 3.3% for physicians with no prior claims- a ratio of 3.8:1. This is an important new result: Physicians with only a single claim in a prior period face a much higher risk of a future claim.

In Table 4, the simulated risk of 1+ future claims over 5 years of 4.67% is somewhat higher than the average across all physicians of 4.34%. This is driven by the secular decline in claim rates: actual rates are lower in the "future" period than in the prior period; the simulation.

This comparison makes assumptions about the differences between physicians with and without paid claims, but these assumptions are mild enough that partial breakdown should not seriously affect our estimates. We assume that background claim risk is comparable across physician practices – meaning that all active physicians see the same number of patients, with similar characteristics. To the extent that some physicians see more patients and face correspondingly higher med mal risk,[15] or some

[12] We generate a random number from the uniform distribution over [0,1], multiply this number by $docs_s$ and round up to the next highest integer to assign the suit to a particular virtual doctor.

[13] These back-of-the-envelope estimates are reasonably close to the actual values from Table 4, last row, of a 4.67% likelihood that a physician will receive 1+ future claims in the next 5 years and an 0.19% likelihood of 2+ future claims.

[14] We also run simulations in which risk depends on both state and specialty. With results similar to those we report here.

[15] Carlson et al. (2017) document the expected association between number of patients seen and med mal risk for emergency physicians.

physicians see riskier patients and thus face more med mal claims, our comparison of physicians with zero-claims to those with one or more claims will overstate the actual differential.[16]

Our estimates ignore retirements and new entry. They assume that the same physicians are practicing in the prior period and the future period. To understand how this assumption affects our estimates, assume for simplicity that physicians are either high- or low-skill. For high-skill physicians, new entry should roughly offset retirement, so should not greatly affect the estimated risk faced by physicians with no prior claims. But some new entrants will be low-skill, and future claims against them will bias upward our estimate of future claim risk for physicians with no prior claims. Meanwhile, some physicians *with* prior period claims will retire from practice and leave the sample. This will bias downward our estimate of the future claim risk faced by physicians with prior period claims. Both effects reduce our estimate of the increased relative risk faced by physicians with prior period claims – the true ratio should be higher than the estimated ratio of 3.8:1.

Table 4 shows that physicians with 1+ claims in the five-year prior period are roughly 5% of all physicians, but account for 18% of the claims in the five-year future period. Our finding that these physicians had nearly four times the future claim risk faced by physicians with no prior period claims implies that if the claim risk for physicians with prior claims could be brought down to the average of the remaining physicians, most of the future claims against these physicians, and the associated patient harm, would go away.

4.3. Cumulative future claim risk

We find the probability that a physician, with a given number of claims in a prior 5-year period, will have 1+ future claims is only about *half* of those reported by Studdert et al. The 5-year percentages in Fig. 2 reach only around 0.4; in contrast, Studdert et al. report rates up to 0.8 (for physicians with 6+ prior claims). The reasons for this large difference are unclear.[17] Whatever the reasons, their Fig. 2A, titled "Predicted Probability of Paid Claim According to Number of Previous Paid Claims," is qualitatively right, but we obtain different (and lower) quantitative values.

Our calculation of the probability of a future claim is mechanical. We count prior (during 2006–2010) and future (during 2011–2015) claims for well-defined subsets of physicians. Three people separately checked the logic behind our underlying code, including two of the authors. And one of the authors rewrote the code from scratch and obtained the same results.

4.4. Relative hazard rates for physicians with prior period claims

While our absolute hazard rates, for future claims against physicians with prior claims, are well below Studdert et al., we find much closer correspondence for *relative* hazard rates (i.e., how much more likely is a physician with two prior paid claims to have 1+ future claims, versus a physician with one prior paid claim). Both they and we find that physicians with two previous claims have roughly *twice* the chance of 1+ future claims in the next five years as physicians with one prior claim (we find 22% versus 12%; they find 30% versus 18%); and that physicians with three previous claims have roughly *three times* the chance of 1+ future claims in the next five years as physicians with one prior claim (we find 35% versus 12%; they find 42% versus 18%).

For physicians with four or more prior claims, our results again diverge from Studdert et al. In the top three lines of Fig. 2, we find no clear differences in future claim likelihood for physicians with four, five, or 6+ prior period claims. The future probability lines cross and re-cross. Some of this simply reflects the "noise" of a small sample. Out of 823,000 active physicians in 2010, only 247 had four claims over 2006–2010, 77 had five claims over this period, and 90 had six or more claims. In contrast, as Fig. 1 indicates, Studdert et al. find a steady progression of future claim probability: higher for five prior claims than for four prior claims, and higher for 6+ prior claims than for five prior claims. Their results must reflect smoothing imposed by their regression model, in contrast to the simple counts that we present.

4.5. Predicting two or more future claims

We also extend the Studdert et al. analysis in a second way. In addition to asking how strongly prior paid claims predict *one or more* future claims, as in Fig. 2, we can ask how strongly past history predicts *two or more* future claims, or *three or more* future claims, etc. This is an important measure, because as our simulation shows, while some physicians who receive a future claim could be just unlucky, far fewer would be unlucky twice in a 5-year future period if claims arrived at random, and a tiny number would be unlucky three times. The simulated risk of 2+ future claims is only 0.19% (Table 2), while the actual risk for a physician with one prior-period claim is 12 times as high, at 2.4%, and the risk for a physician with 2 prior claims is 34 times as high, at 6.5%. The likelihood of 2+ future claims escalates further for physicians with larger numbers of prior claims, and is 23% for physicians with 5+ prior claims.

In Fig. 3, we present the "two or more" claims national graph, based on state-specific risk. The bottom dashed line shows the likelihood of two or more claims in a five-year period if claims arrive at random, at a state-specific rate. The simulated line is below all other lines, even that for physicians with no prior period claims. That may seem odd, but is consistent with physicians having varying skill levels. The large group of physicians with zero prior period claims includes some low-skill physicians who happened to get lucky and have no paid claims in the prior period, but remain much more prone to repeat claims than if claims arrived at random. Those low-skill physicians can drive much of the propensity for physicians with no prior claims to have 2+ future claims. The likelihood of having 2+ future claims rises monotonically as one goes from 0 to 1 to 2 to 3 prior period claims. We show a combined line for 4, 5, and 6+ prior claims; if we showed separate lines they would cross each other, as they do in Fig. 2.

The risk of having 3 future claims, if claims arrived at random, is only 0.011% (Table 4). The actual risk for a physician with one prior-period claim is 58 times as high, at 0.64%, and the risk for a physician with 2 prior claims is 175 times as high, at 1.93%. Thus, focusing on physicians with multiple paid claims in the recent past provides a powerful screen for the identifying physicians who are true outliers, and not just unlucky.

In Fig. 4, we present the "three-or-more" claims national graph, based on state-specific risk.[18] At this point, the actual risk of 3+ future claims, for physicians with no prior claims is very small, at around 0.08%; the simulated mean risk is even smaller, at around 0.01%. In contrast, even physicians with one prior claim have a meaningful risk of 3+ future claims (0.6%), which corresponds to a ratio of 322:1. The odds of having 3+ future claims rise strongly with the number of prior claims; for example, a physician with three prior claims has a 5.5% chance of having 3+ claims in the next

[16] Studdert et al. (2016) make a similar assumption, so that they can compare physicians with different numbers of prior paid claims.

[17] Their parametric survival analysis approach likely forms part of the explanation. Perhaps, too, their outcome was the number of paid claims, rather than the likelihood that a *physician* would have *one or more* future paid claims.

[18] In this figure, we combine the lines for 4 and 5 prior claims, which are individually noisy and cross each other.

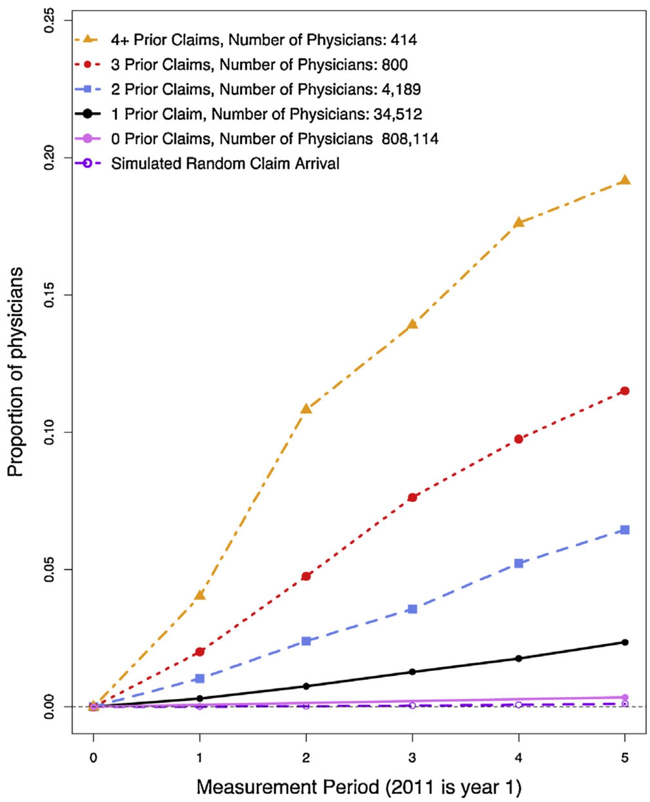

Fig. 3. Actual and Simulated Probabilities of Having 2+ Future Claims.
Figure shows the probability that a physician with the indicated number of "prior" paid claims during 2006–2010 will have 2 "future" paid claims during 2011-2015. Bottom dotted line shows mean simulated probability that a physician will have 2 future paid claims, if all paid claims arrive at random, at state-specific rates. Dotted lines just above and below the line for simulated random claim arrival, (which visually merge with the line) show 95% confidence interval around the simulated probabilities.

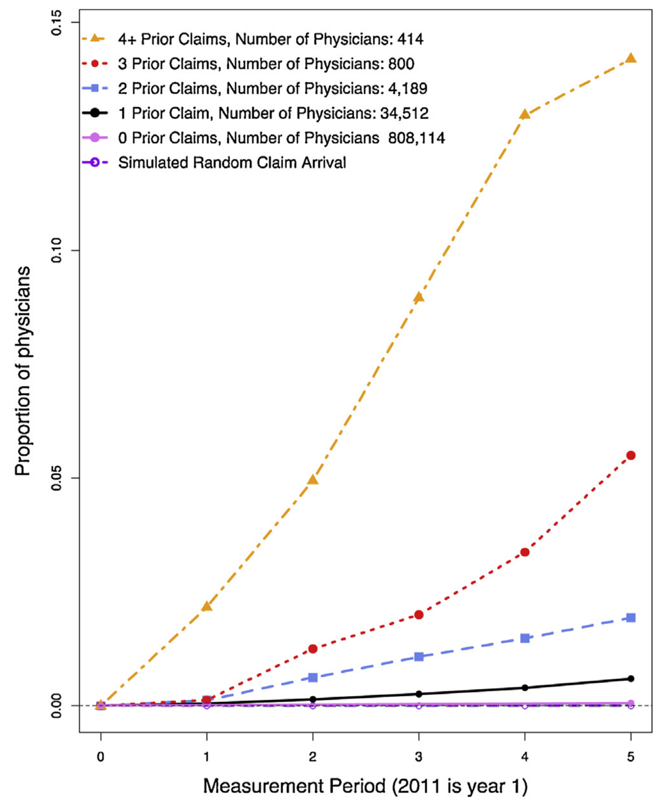

Fig. 4. Actual and Simulated Probabilities of Having 3+ Future Claims.
Figure shows the probability that a physician with the indicated number of "prior" paid claims during 2006–2010 will have 3+ "future" paid claims during 2011-2015. Bottom dotted line shows mean simulated probability that a physician will have 3+ future paid claims, if all paid claims arrive at random, at state-specific rates. Dotted lined above and below this line, which visually merge with the line) show 95% confidence intervals.

five years, and a physician with 4+ prior claims has a 14% chance of having 3+ future claims.

4.6. Specialty-specific and state-specific risk

Some of the risk differences we find reflect by differing risk across specialties, which Figs. 2–4 do not take into account. Table 3 and Fig. 5 provide a sense of how the simulated risk of having a claim varies across specialties. Fig. 5 provides the cumulative simulated probability, over a five-year period, that a physician in the indicated specialties will face a paid claim, if claims arrive at random, at a specialty-specific rate, based on the relative claim risks in Table 2.

Studdert et al. provide a similar figure in their Fig. 2B. Their specialty-specific risks are often twice and sometimes more than twice our simulated risks. For example, their five-year risk for neurosurgeons is around 29%, while we find only a 10% risk. We do not understand the reasons for these differences. Our calculation is mechanical, we use actual NPDB claims rates, combined with relative rates from Jena et al. (2011). The Studdert et al. rates could be higher than our estimates for particular specialties, but only if they were lower for other specialties.

The Appendix provides simulation analysis, similar to that in Figs. 2 and 3, in which the simulated risk of claim arrival depends on both state and specialty. For all physicians combined, results are quite similar to those in Figs. 2 and 3. For 1+ claims, the confident intervals for simulated risk are larger than in Fig. 2 (as expected); but for 2+ claims, the simulated risk and the confidence interval around it remains very small. If combined with data on physician specialties (which we do not have), this approach could be used to predict how likely the observed claim pattern for a particular specialty would be if claims were random events that depended only on state.

Even for a high-risk specialty in a high-risk state, the likelihood that a particular physician will accumulate three paid claims in a decade by chance is very small. For lower risk specialties, random arrival of even two paid claims in a decade is unusual, even in a high-risk state. This suggests that we should be able to generate simple but powerful rules of thumb that will identify outlier physicians and distinguish them from physicians who may have been simply unlucky.

4.7. Longer and shorter "pre" periods

Studdert et al. and we both use five-year prior and future period. The lengths of these periods are arbitrary. We therefore also analyzed longer (10-year) and shorter (3-year) initial periods.

The structure of Fig. 6 is similar to Fig. 2, except that we use a 10-year prior period (1996–2005) and a 10-year future period (2006–2015). The longer prior period means that there are many more physicians with any given number of prior claims. At first look, the overall patterns are similar. The larger the number of prior claims, the greater the probability that a physician will receive 1+ future claims. But on a closer look, there are important differences between Fig. 6 and Fig. 2. For example, by the end of the future 10-year period, the simulated risk for all physicians is 10.4% and the observed risk for physicians with 1 prior claim is 16.3% – compared

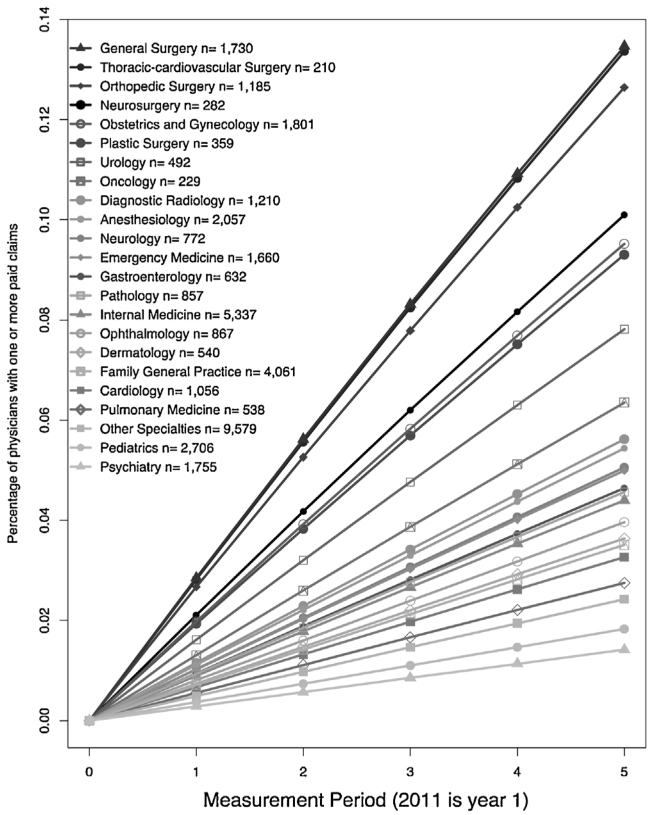

Fig. 5. Simulated Paid Claim Likelihood for Selected Specialties.
Figure shows the simulated national average probability that physicians in the indicated specialties will have one or more "future" paid claims during 2011–2015, assuming random claim arrival, with specialty-specific paid claim risk.

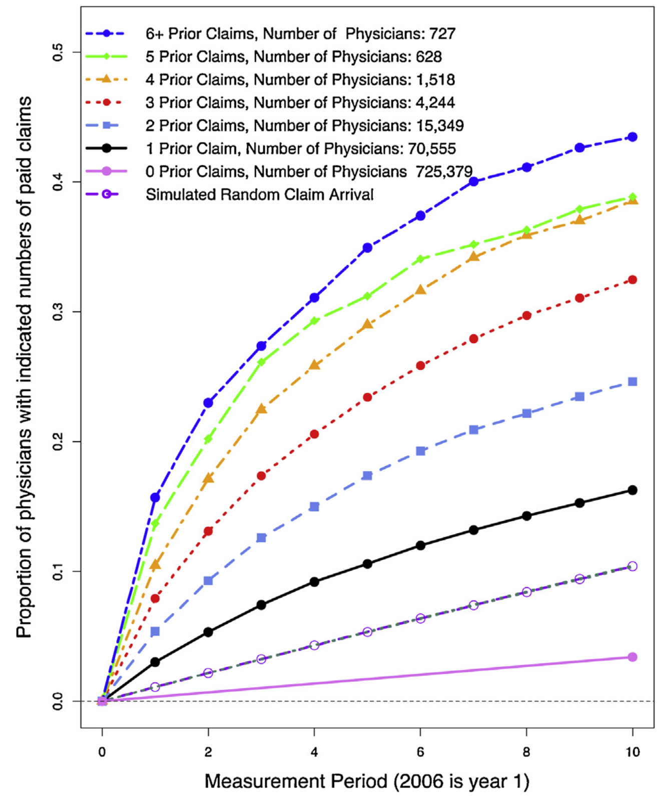

Fig. 6. Repeat Claim Risk with 10-year Pre and Future Periods.
Figure shows the probability that a physician with the indicated number of "pre-period" paid claims during 1996–2005 will have 1+ "future" paid claims during 2006-2015. Bottom dashed line shows mean simulated probability that a physician will have 1+ future paid claims, if all paid claims arrive at random, at state-specific rates; dotted lines above and below this line (which visually merge with the line) show the 95% confidence interval.

to a simulated risk of 4.7% and observed risk of 12.4% with a 5-year period. The ratio of observed/simulated drops from 2.6:1 to 1.6:1. Thus older claims convey less information about future claim risk than more recent claims. The concave shapes of the curves, which rise less steeply the further one goes into the future period, carry a similar implication. We thus find evidence that physician behavior, and hence claim risk, can change over time. At the same time, the likelihood that a physician with 2+ prior claims will have 1+ future claims remains well above the simulated level.

Fig. 7 is similar to Fig. 3 and shows how the likelihood of 2+ future claims varies with the number of past claims, using 10-year prior and future periods. Similar to Fig. 3, the likelihood of 2+ future claims is far higher for physicians with even a single prior period claim- and are dramatically higher than would be expected if claims were random events. At the same time, the 10-year future likelihoods in Fig. 7 are well below the corresponding likelihoods in Fig. 3 (which uses a five-year pre-period) and even after 10 years, they reach only around 25% – the same peak level as in Fig. 3. This provides further evidence that as one looks further into the past to find prior claims, their power to predict future claims diminishes.

We also conducted a similar analysis using shorter (3 year) prior and future periods (see Appendix). The differences from Figs. 2–4 now go in the other direction. There are fewer physicians with multiple prior-period claims, but a given number of prior claims is strongly predictive of having one or more future claims, and multiple future claims. This provides further evidence that the power of a claim to predict future claims gradually diminishes as one moves further away from the prior claim year.

5. Discussion

5.1. Summary of main results

We extend Studdert et al. in several ways. First, we added an explicit null hypothesis, which lets us distinguish between possibly unlucky physicians and those with outlier claim histories. Second, we examine how strongly a single prior period claim predicts future claims versus 0 prior period claims find strong predictive power – a single paid claim in a prior 5-year period nearly quadruples the likelihood of a paid claim in the next five years. Third, we examine how prior-period claims history predicts different configurations of future claims (1+, 2+ and 3+ paid claims). Fourth, we develop evidence that older paid claims have lower predictive value for future claims than more recent claims.

While we focus here on extension rather than replication, we were able to reproduce the qualitative features of Studdert et al.'s analysis, but not their specific numbers. Some of the differences are material. We consider only M.D.'s, while they study both M.D.'s and D.O.'s, but since D.O.'s generally practice in low-risk specialties, including them would move our results for cumulative risk further away from theirs. Some may be due to the slight disparity in the time periods that were studied. But, most of the differences are likely attributable to other factors, including Studdert et al.'s use of parametric survival analysis with extensive covariates, and their apparent use of the number of paid claims as the outcome, rather than the likelihood of 1+ future claims.

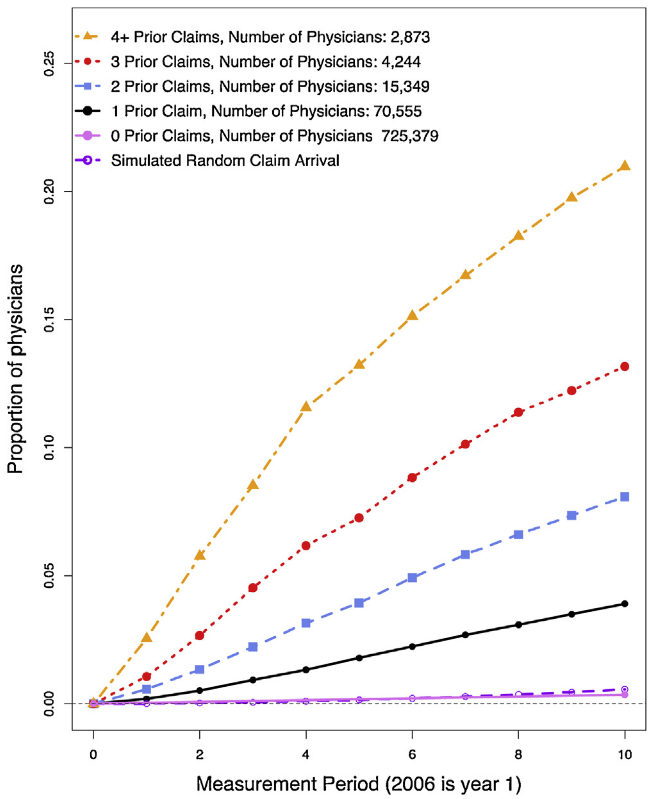

Fig. 7. Actual and Simulated Probabilities of 2+ Future Claims: 10-year Pre-Period. Figure shows the probability that a physician with the indicated number of "pre-period" paid claims during 1996–2005 will have 2+ "future" paid claims during 2006-2015. Bottom dotted line shows mean simulated probability that a physician will have 2+ future paid claims, if all paid claims arrive at random, at state-specific rates; dotted lined above and below this line show 95% confidence interval.

5.2. Limitations

Some physicians see more patients than others and thus will be more exposed to potential claims. Some physicians also see riskier patients than others. Both factors could cause some physicians to face more claims than others, for reasons unrelated to "skill." We lack data to assess either of these factors, but they seem unlikely to be strong enough to affect our core conclusions on the tendency for past claims to predict future claims. In the Appendix, we present simulation results assuming that these factors increase the risk of a claim by 25% or 50%. We view 50% as a reasonable upper bound on the effect of these factors on physicians' claim experience. As one would expect, simulated risk rises, but remains well below actual risk of 1+ future claims for physicians with prior period claims.

We lack data on physician specialty, so could not assess how the predictive value of prior claims varies across specialty. We lack data on intra-state variation in claim rates between geographic regions (higher rates in urban areas, for example). We have data only on paid claims and thus cannot assess the predictive power of unpaid claims for future claims, either paid or unpaid.

Both technical skill and communication skills/bedside manner affect claim-proneness (Hickson et al., 2002). We cannot distinguish between these two sources of claim risk with our data; we can only identify the power of prior claims to predict future claims. However, our data is limited to claims that are paid, not merely brought. Thus, it is likely that the strong predictive power we find is driven primarily by technical skill. Further work with richer data will be necessary to disaggregate the contribution of different aspects of what we term "skill" to rates for both paid and unpaid claims.

5.3. How confident can we be that outlier physicians are low-skill?

We have proposed using past paid claim history to identify outlier physicians – apparent "bad docs" – and then potentially target them for graduated intervention. This approach is potentially problematic for a number of reasons. First, under-claiming is pervasive in the med mal system. Plausible estimates of v_{ijs} in Eq. (1) (the fraction of actual malpractice events that lead to claims) are under 5% (Baker, 2005). Using paid claim data, we cannot assess well actual skill levels r_{ijs}, or the predictive power, for future negligent care, of past negligent care that does not lead to a paid claim. Second, a past paid claim may increase the likelihood of future claims if plaintiffs' lawyers are aware of it and view it as a signal of "blood in the water." Third, many medical errors are attributable to system problems, even if one or more physicians end up paying damages. Fourth, while the best available evidence is that most paid claims involve probable negligence, a significant minority do not (Studdert et al., 2006). Thus, a physician with multiple paid claims could be just unlucky, and not actually more prone to future claims than a physician with no prior-period claims.

Yet one should not overstate the significance of these problems. We investigate the evidence for the "blood in the water" story in a companion article (Hyman et al., 2019), and find no support for it; neither does Yousefi (2018) (using Florida data). If some med mal claims reflect systems issues, that makes the strong predictive power of physician-level data all the more striking. Multiple paid claims for a single physician are rare already – multiple wrongfully paid claims are surely rarer still. Multiple paid claims are not a perfect signal of low-quality care – but they offer a strong signal nonetheless. We believe that this signal should not be ignored, especially when no better signal is available. This signal can likely be strengthened by combining information from med mal claims with information on physician discipline, loss of hospital privileges and other adverse events – a line of analysis we are pursuing in separate research.

As for the problem of under-claiming, if some keys are visible under the streetlight, it does not follow that we should ignore them because others are hidden in the dark. When it comes to identifying outlier physicians, the low-hanging fruit may be lying on the ground.[20]

It is beyond the scope of this project to suggest what interventions would be useful for claim-prone physicians. We have provided evidence that past claims strongly predict future claims. What to do with that knowledge will require experimentation with different intervention approaches. But we have identified a subset of physicians for which it seems valuable to assess how future claim risk can be reduced.

5.4. Improving the performance of the healthcare system

Hospitals and state licensing boards already have access to NPDB data – and hospitals are required to query the NPDB when a physician first applies for privileges, and every two years thereafter. But, it is unclear how much attention they pay to this information. There is no shortage of examples of hospitals and state licensing boards turning a blind eye to physicians with multiple paid claims and letting them practice without supervision or intervention. In one notorious case, a physician had so many claims over a sixteen-year period that his med mal insurer refused to renew his coverage. The

[20] J.K. Wall, The Low Hanging Fruit is Lying on the Ground, July 29, 2015, at https://healthadviceandmore.wordpress.com/2015/07/29/the-low-hanging-fruit-is-lying-on-the-ground/ ("In health care, the low-hanging fruit isn't just low-hanging fruit; the fruit is lying on the ground, and we have to be careful not to trip over it.")

hospital at which he practiced eventually suspended his privileges; it paid almost a million dollars to settle a False Claims Act case over the quality of care he had provided. Despite these problems, he retained his Georgia medical license, and it was only suspended after he was arrested and jailed for running a pill-mill.[21] Hospitals vary greatly in the vigor with which they police which physicians can practice there (see discussion below).

If hospitals and state licensing boards believe that med mal claims are largely random events, they are likely to pay limited attention to them. Our findings indicate that such a belief is incorrect. To improve their own performance, hospitals should pay more attention to physicians with even a single recent paid claim, and both hospitals and state licensing boards should pay substantial attention to physicians with multiple paid claims. We can imagine graduated intervention by hospitals, physician practice groups, med mal insurers and medical boards, ranging from peer review and training in communication and perhaps documentation skills for physicians with a single paid claim, to more intensive scrutiny of physicians with two paid claims, and medical board investigation and hospital withdrawal of privileges if claims continue to accumulate, despite earlier, gentler interventions.

5.5. *The need for data on hospitals*

The NPDB includes data only on claims against physicians, not against hospitals. This is an important failing. Hospitals are often involved in malpractice suits – and many large payout cases involve hospitals as defendants. In addition, in ongoing work using Illinois data, we find evidence that some hospitals employ or give privileges to a heavily disproportionate share of outlier physicians. Similar complaints have raised about the Veterans Health Administration – that it often hires physicians with significant malpractice and disciplinary records – and then compounds the problem by failing to report their misdeeds while they are at the VHA.[22] The obvious solution is to expand the NPDB to include data regarding paid med mal claims against hospitals – and make that data available to the public on a hospital-specific basis. We expect that data will reflect large differences in claim rates across hospitals, which will often persist over time. There are surely bad hospitals, just as there are bad docs.

5.6. *Further research*

We plan to extend our analysis in several ways. First, we are working on combining information on med mal claims with the "adverse actions" information in the NPDB, which includes both state disciplinary actions and hospital removal or restrictions on privileges. That analysis will build on prior work using state-level datasets in Illinois and Indiana (Hyman et al., 2018a; Liu and Hyman, 2018). That research provides evidence that a very small number of physicians have both state disciplinary sanctions and med mal claims. While state disciplinary sanctions are much rarer than med mal claims, physicians who have both a disciplinary history *and* multiple med mal claims are likely to prove a target-rich environment for intervention to prevent future claims.

Second, rather than using semi-arbitrary prior and future periods (whether 3-, 5-, or 10 years), we are developing a dynamic "skill" score that can vary apply over the course of a physician's career. That approach will allow us to develop a more refined version of the rules of thumb we offer here.

Third, we plan to exploit state-level data on paid claims from three states (Florida, Illinois, and Indiana), and unpaid claims from Illinois and Indiana, to assess the predictive value of prior unpaid claims for future paid and unpaid claims, as well as predictive value within particular specialties.

6. Conclusion

Despite important differences, both our work and Studdert et al. (2016) confirm that past paid med mal claims are strong predictors of future paid claims. There are some outlier physicians, with multiple paid med mal claims who are responsible for a significant share of paid claims. Indeed, we find that having even *one* prior period paid claim in the last 5 years nearly quadruples the likelihood of a claim in the next five years. Once a physician – who otherwise has average state- and specialty-specific risk – has two or more prior claims over a limited time period such as three or five years, the likelihood that this was just bad luck is small. With three prior claims, that chance becomes tiny.

Our findings have obvious policy implications. Although many physicians believe that med mal claims are random, we provide evidence that some outlier physicians who are much more claim-prone than their fellow physicians, and provide rules of thumb for identifying them. Once identified, these physicians can be targeted by hospitals and state licensing boards for educational intervention, peer supervision, investigation of patient complaints and adverse outcomes, and (when appropriate) disciplinary action. These common-sense steps should reduce the frequency of future claims and related patient harm. The take-home message is simple. When it comes to med mal, past performance predicts future results.

Appendix A. Supplementary data

An appendix containing supplementary material for this article can be found at doi:https://doi.org/10.1016/j.irle.2019.03.006.

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