

HARVARD MEDICAL SCHOOL
DEPARTMENT OF HEALTH CARE POLICY

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Dr. Elizabeth Loder
Head of research, *The BMJ*

Dear Dr. Loder,

Thank you for giving us an opportunity to revise and resubmit our manuscript entitled “**Association between physician medical school ranking and patient outcomes in the United States: An observational study (BMJ.2018.044856).**” Below are the comments we received from the committee and reviewers (in *italics*), as well as a point-by-point response as to how we addressed them (in **boldface**).

In our revised manuscript, we included several additional analyses including an analysis using alternative ranking (based on social mission score) and a stratified analysis by years since completion of residency program based on the suggestions by the editors and reviewers. Given that we already had a large number of tables, we did not include all of them in our revised manuscript. However, if editors prefer, we are happy to include any of the results in the online appendix of the manuscript.

We hope we have adequately addressed all points raised by the editors and reviewers. If anything remains unclear, please do not hesitate to contact us. Thank you very much for considering our manuscript.

Sincerely yours,

Anupam B. Jena, MD, PhD

Comments by the Editors:

** We agree with some of the reviewers that the US News and World Report rankings are probably flawed, but at the same time schools pay a lot of attention to the rankings and applicants use these to gauge where they should apply. We wonder, though, whether you might be able to assess alternative rankings such as that proposed by reviewer Phillips. We thought that perhaps such alternative rankings might produce slightly different lists but would probably be broadly similar to the USNWR rankings. Or is there any way to assess a broader range of possible predictors of good vs poor performance to identify those that matter most?*

Thank you very much for your thoughtful comment. We agree with the editors that although the *US News and World Report* (USNWR) rankings are imperfect, they have become the *de facto* standard rankings for medical schools in the US, and therefore influence decisions of many people including medical school applicants, program directors of residency programs, and faculties and staffs who work at those medical schools.

Based on the above suggestion, we conducted analysis using an alternative ranking suggested by Dr. Phillips, and found no association between school ranking (based on social mission score) and patient outcomes or healthcare spending (Table A below). We think that this can be explained by substantial differences in how weights are given to individual factors in creating these rankings. Given that few people use Dr. Mullan's ranking (and we believe that it is highly unlikely that patients are familiar with these rankings and therefore develop perceptions of doctors based on those rankings), we thought this was not informative to the readers of the BMJ, and decided not to include in our revised manuscript. However, if editors prefer, we are happy to include this in the online appendix of the manuscript.

Table A. Association between a physician’s medical school ranking based on social mission score and patient outcomes/costs of care

Ranking of medical school based on social mission score*	30-day mortality rate			30-day readmission rate			Part B spending		
	Adjusted mortality rate (95%CI)	Adjusted risk difference (95%CI)	p-for-trend	Adjusted readmission rate (95%CI)	Adjusted risk difference (95%CI)	p-for-trend	Adjusted spending (95%CI)	Adjusted risk difference (95%CI)	p-for-trend
1-10	10.5% (10.3% to 10.8%)	Reference	0.29	16.2% (15.9% to 16.5%)	Reference	0.49	\$1063 (\$1048 to \$1079)	Reference	0.36
11-20	10.5% (10.2% to 10.8%)	-0.01% (-0.4% to +0.4%)		15.9% (15.6% to 16.3%)	-0.3% (-0.7% to +0.2%)		\$1048 (\$1034 to \$1062)	-\$15 (-\$36 to +\$6)	
21-30	10.5% (10.2% to 10.9%)	-0.03% (-0.5% to +0.4%)		16.0% (15.6% to 16.3%)	-0.2% (-0.7% to +0.2%)		\$1051 (\$1036 to \$1067)	-\$12 (-\$34 to +\$10)	
31-40	10.8% (10.4% to 11.1%)	+0.2% (-0.2% to +0.7%)		16.2% (15.8% to 16.5%)	-0.04% (-0.5% to +0.4%)		\$1071 (\$1056 to \$1086)	+\$7 (-\$14 to +\$29)	
41-50	10.4% (10.0% to 10.8%)	-0.1% (-0.6% to +0.4%)		16.7% (16.3% to 17.1%)	+0.5% (-0.06% to +1.0%)		\$1049 (\$1033 to \$1065)	-\$14 (-\$37 to +\$8)	
≥50	10.7% (10.6% to 10.8%)	+0.1% (-0.2% to +0.4%)		16.0% (15.9% to 16.1%)	-0.2% (-0.6% to +0.1%)		\$1062 (\$1058 to \$1067)	-\$1 (-\$18 to +\$16)	

*Ranking of medical schools is based on Mullan et al.¹

** How many physicians were excluded because they were not US graduates?*

About 41.8% of physicians were excluded from our analyses because they graduated from foreign medical schools. These data are consistent to the fact that approximately 43.5% [9364/(9364+12141)=43.5%] of internists in the US are international medical graduates (estimated using external data source²), supporting the representativeness of our data.

** You may want to discuss more fully that if you are just assessing what influence medical school has on outcome this seems from first principles likely to be only a small part of what makes up a doctors performance (there are preschool experience, post grad training, supervision, teamwork, CME and accreditation, work environment, to name a few). In addition, med schools all have to reach a national standard for training of a professional so that removes some variation that might be there if there were not national standards.*

This is an excellent point. As suggested, we now include the following statement in the discussion of the revised manuscript (page 19, paragraph 1):

“although patients may view a physician’s medical school as a signal of quality, it is likely that many factors at different stages of physicians’ career, including post-graduate training and the systems in place at a physician’s current place of work, play an important role in determining the quality and costs of care that physicians provide.^{3,4} Future studies are warranted to understand whether other factors such as residency training have a measurable impact on the performance of physicians after completion of training.”

“the medical school accreditation processes, medical school standards, and standardized testing required of all physicians may be sufficiently stringent to ensure that all medical students master the essential competencies necessary to practice as clinicians. In the U.S., MD-granting medical schools are accredited by the Liaison Committee on Medical Education, and DO-granting schools are accredited by the American Osteopathic Association Commission on Osteopathic College Accreditation. That only 17 medical schools were awarded full accreditation by these bodies between 2007 and 2016 suggests that these accrediting bodies hold MD- and DO-granting medical schools to rigorous standards.⁵ It is possible that observed variation would be larger if there were no national standards for medical schools.”

** We also thought that the power of big numbers gives you some significant findings and it is important not to give these more weight than they merit. The differences seem small and probably not clinically relevant: readmission rates 15.7% for top-10 schools vs. 16.1% for schools ranked ≥ 50 .*

We agree with the editors that observed differences were small. To clarify this point, we interpreted the magnitude of the difference as follows in our revised manuscript (page 19, paragraph 2):

“Although the graduates of top primary care schools exhibited lower patient readmission rates and

lower healthcare spending, the differences were small. For example, the difference in readmission rates between graduates of top-10 medical schools and schools ranked ≥ 50 was 0.4 percentage points. If our findings are causal, this means one readmission would be avoided for every 250 admissions if patients treated by physicians who graduated from schools ranked ≥ 50 were cared for by physicians graduated from top-10 schools.”

** We would like more information about how you assessed which physician was responsible for the care. A European doctor noted that in his hospital many different doctors care for patients during their stay and "it is very well possible that the doctor whose name is on the bill has never seen the patient."*

We identified physicians who were responsible for patient outcomes and healthcare spending using 3 approaches:

- (1) Physicians who accounted for the largest amount of Medicare Part B cost for a given hospitalization (the main approach)**
- (2) Physicians who billed the largest number of evaluation-and-management (E&M) claims (i.e., who saw patients most frequently) for a given hospitalization (sensitivity analysis #1)**
- (3) Physicians who billed the first E&M claims (“admitting physician”) for a given hospitalization (sensitivity analysis #2)**

We found that our findings were robust to how we identify responsible physicians. Previous studies both by our team⁶⁻⁹ and other research teams¹⁰⁻¹⁵ (mostly in the outpatient setting) have used a similar approach.

** Our statistician suggests that as long as the data on which analyses are based are reasonable (noting that the reviewers raise some doubts), the paper presents a valid statistical analysis.*

Thank you for the thorough review.

** We wonder if age is important and how long ago physicians were at the school, which ties in with age.*

Thank you for this comment. We agree that physician years of experience may play a role in our study, particularly as an effect modifier (the ‘effect’ of medical school training, either directly or as a signal of underlying physician quality, may be strongest when physicians are younger but dissipate over time as physicians assimilate to practice norms of their colleagues, are less exposed to formal medical education, etc.). Therefore, we conducted a stratified analysis by years of experience (i.e., years since graduation from medical school) and found that the impact of medical school is strongest in the first 10 years after the completion of residency training. In fact, physicians who graduated from top schools had lower patient mortality for both research and primary care rankings in the first 10 years, but this effect disappears thereafter. We have included the results in our revised manuscript (eTable 11 in Appendix).

eTable 11. Stratified analysis by years since completion of residency programs*

(A) Primary care ranking

U.S. News & World Report ranking of medical school		30-day mortality rate			30-day readmission rate			Part B spending		
		Adjusted mortality rate (95%CI)	Adjusted risk difference (95%CI)	p-for-trend	Adjusted readmission rate (95%CI)	Adjusted risk difference (95%CI)	p-for-trend	Adjusted spending (95%CI)	Adjusted risk difference (95%CI)	p-for-trend
Year 1-10	1-10	9.6% (9.1% to 10.1%)	Reference	0.04	15.9% (15.4% to 16.4%)	Reference	0.01	\$996 (\$977 to \$1015)	Reference	0.30
	11-20	9.9% (9.3% to 10.4%)	+0.3% (-0.4% to +1.0%)		16.0% (15.4% to 16.5%)	+0.1% (-0.7% to +0.9%)		\$1058 (\$1037 to \$1079)	+\$62 (+\$34 to +\$90)	
	21-30	10.1% (9.5% to 10.7%)	+0.5% (-0.2% to +1.3%)		16.0% (15.4% to 16.7%)	+0.2% (-0.6% to +1.0%)		\$1025 (\$1001 to \$1049)	+\$29 (-\$1 to +\$60)	
	31-40	9.7% (9.1% to 10.2%)	+0.1% (-0.7% to +0.8%)		15.5% (14.8% to 16.1%)	-0.4% (-1.2% to +0.4%)		\$1022 (\$1000 to \$1044)	+\$26 (-\$3 to +\$55)	
	41-50	10.4% (10.0% to 10.8%)	+0.8% (+0.2% to +1.4%)		16.3% (15.9% to 16.7%)	+0.4% (-0.2% to +1.1%)		\$1020 (\$1006 to \$1035)	+\$25 (+\$1 to +\$48)	
	≥50	10.1% (10.0% to 10.2%)	+0.5% (+0.04% to +1.0%)		16.4% (16.2% to 16.5%)	+0.5% (-0.05% to +1.0%)		\$1029 (\$1024 to \$1034)	+\$33 (+\$12 to +\$53)	
Year 11-20	1-10	10.6% (10.0% to 11.2%)	Reference	0.48	15.7% (15.0% to 16.3%)	Reference	0.52	\$1041 (\$1015 to \$1068)	Reference	0.003
	11-20	10.5% (9.9% to 11.1%)	-0.1% (-1.0% to +0.8%)		16.2% (15.5% to 16.9%)	+0.5% (-0.4% to +1.5%)		\$1037 (\$1006 to \$1069)	-\$4 (-\$45 to +\$36)	
	21-30	10.2% (9.6% to 10.8%)	-0.4% (-1.2% to +0.5%)		15.8% (15.1% to 16.5%)	+0.1% (-0.8% to +1.1%)		\$1046 (\$1017 to \$1076)	+\$5 (-\$36 to +\$45)	
	31-40	10.9% (10.1% to 11.7%)	+0.3% (-0.7% to +1.3%)		16.0% (15.3% to 16.8%)	+0.3% (-0.7% to +1.3%)		\$1061 (\$1028 to \$1095)	+\$20 (-\$23 to +\$63)	
	41-50	10.7% (10.3% to 11.2%)	+0.2% (-0.6% to +0.9%)		15.8% (15.3% to 16.2%)	+0.1% (-0.7% to +0.9%)		\$1069 (\$1048 to \$1090)	+\$27 (-\$8 to +\$62)	
	≥50	10.6% (10.5% to 10.8%)	+0.1% (-0.6% to +0.7%)		16.0% (15.9% to 16.2%)	+0.4% (-0.3% to +1.1%)		\$1072 (\$1065 to \$1079)	+\$31 (+\$3 to +\$59)	
Year ≥20	1-10	11.9% (11.1% to 12.8%)	Reference	0.01	15.5% (14.8% to 16.2%)	Reference	0.08	\$1040 (\$1004 to \$1076)	Reference	<0.001
	11-20	11.8% (11.1% to 12.5%)	-0.1% (-1.2% to +0.9%)		15.5% (14.9% to 16.1%)	+0.02% (-0.9% to +0.9%)		\$1094 (\$1062 to \$1125)	+\$54 (+\$8 to +\$99)	
	21-30	11.8% (11.2% to 12.5%)	-0.1% (-1.2% to +1.0%)		15.1% (14.4% to 15.8%)	-0.4% (-1.4% to +0.5%)		\$1061 (\$1029 to \$1093)	+\$21 (-\$27 to +\$70)	
	31-40	12.0% (11.2% to 12.7%)	+0.03% (-1.1% to +1.2%)		15.3% (14.5% to 16.0%)	-0.2% (-1.3% to +0.8%)		\$1115 (\$1083 to \$1146)	+\$75 (+\$27 to +\$123)	
	41-50	11.4% (11.0% to 11.9%)	-0.5% (-1.5% to +0.5%)		16.2% (15.7% to 16.7%)	+0.7% (-0.1% to +1.5%)		\$1085 (\$1065 to \$1105)	+\$45 (+\$4 to +\$86)	
	≥50	11.2% (11.1% to 11.4%)	-0.7% (-1.6% to +0.2%)		15.8% (15.6% to 16.0%)	+0.3% (-0.4% to +1.0%)		\$1110 (\$1102 to \$1118)	+\$70 (+\$32 to +\$108)	

*Calculated using the data on when physicians graduated from medical schools, assuming that they underwent 3 years of residency programs.

(B) Research ranking

U.S. News & World Report ranking of medical school		30-day mortality rate			30-day readmission rate			Part B spending		
		Adjusted mortality rate (95%CI)	Adjusted risk difference (95%CI)	p-for-trend	Adjusted readmission rate (95%CI)	Adjusted risk difference (95%CI)	p-for-trend	Adjusted spending (95%CI)	Adjusted risk difference (95%CI)	p-for-trend
Year 1-10	1-10	9.8% (9.1% to 10.5%)	Reference	0.003	16.3% (15.5% to 17.1%)	Reference	0.68	\$1028 (\$1000 to \$1056)	Reference	0.02
	11-20	9.2% (8.7% to 9.6%)	-0.6% (-1.4% to +0.2%)		16.3% (15.7% to 16.8%)	-0.1% (-1.0% to +0.9%)		\$998 (\$979 to \$1017)	-\$30 (-\$62 to +\$2)	
	21-30	10.1% (9.6% to 10.7%)	+0.4% (-0.5% to +1.3%)		16.2% (15.7% to 16.8%)	-0.1% (-1.1% to +0.8%)		\$1014 (\$992 to \$1036)	-\$14 (-\$48 to +\$21)	
	31-40	9.9% (9.5% to 10.4%)	+0.2% (-0.7% to +1.0%)		16.0% (15.5% to 16.5%)	-0.3% (-1.2% to +0.6%)		\$1035 (\$1017 to \$1053)	+\$7 (-\$25 to +\$39)	
	41-50	10.4% (10.0% to 10.8%)	+0.6% (-0.2% to +1.4%)		16.0% (15.5% to 16.5%)	-0.3% (-1.2% to +0.6%)		\$1009 (\$991 to \$1028)	-\$19 (-\$51 to +\$14)	
	≥50	10.2% (10.0% to 10.3%)	+0.4% (-0.3% to +1.1%)		16.3% (16.2% to 16.4%)	-0.01% (-0.8% to +0.8%)		\$1031 (\$1026 to \$1037)	+\$3 (-\$26 to +\$32)	
Year 11-20	1-10	10.8% (10.1% to 11.5%)	Reference	0.99	16.3% (15.6% to 17.1%)	Reference	0.87	\$1076 (\$1037 to \$1115)	Reference	0.18
	11-20	10.5% (10.0% to 11.0%)	-0.3% (-1.2% to +0.6%)		16.0% (15.4% to 16.6%)	-0.3% (-1.3% to +0.6%)		\$1050 (\$1021 to \$1079)	-\$26 (-\$74 to +\$22)	
	21-30	10.3% (9.7% to 10.8%)	-0.5% (-1.5% to +0.4%)		15.6% (14.9% to 16.2%)	-0.8% (-1.8% to +0.3%)		\$1034 (\$1008 to \$1060)	-\$42 (-\$89 to +\$4)	
	31-40	10.9% (10.4% to 11.5%)	+0.1% (-0.7% to +1.0%)		16.1% (15.5% to 16.8%)	-0.2% (-1.2% to +0.8%)		\$1058 (\$1032 to \$1083)	-\$18 (-\$64 to +\$28)	
	41-50	11.2% (10.6% to 11.7%)	+0.4% (-0.5% to +1.3%)		16.2% (15.7% to 16.8%)	-0.1% (-1.1% to +0.9%)		\$1095 (\$1071 to \$1120)	+\$19 (-\$27 to +\$66)	
	≥50	10.6% (10.4% to 10.7%)	-0.2% (-1.0% to +0.5%)		16.0% (15.8% to 16.1%)	-0.4% (-1.2% to +0.5%)		\$1068 (\$1061 to \$1076)	-\$8 (-\$48 to +\$33)	
Year ≥20	1-10	11.9% (11.2% to 12.6%)	Reference	0.04	15.1% (14.4% to 15.9%)	Reference	0.04	\$1080 (\$1044 to \$1117)	Reference	0.04
	11-20	11.5% (10.9% to 12.1%)	-0.4% (-1.3% to +0.5%)		15.7% (15.1% to 16.2%)	+0.5% (-0.4% to +1.5%)		\$1104 (\$1079 to \$1130)	+\$24 (-\$21 to +\$69)	
	21-30	12.1% (11.5% to 12.6%)	+0.2% (-0.7% to +1.1%)		15.2% (14.6% to 15.7%)	+0.04% (-0.9% to +1.0%)		\$1072 (\$1043 to \$1102)	-\$8 (-\$54 to +\$38)	
	31-40	11.3% (10.8% to 11.8%)	-0.6% (-1.5% to +0.3%)		15.9% (15.3% to 16.4%)	+0.7% (-0.2% to +1.6%)		\$1081 (\$1054 to \$1109)	+\$1 (-\$45 to +\$48)	
	41-50	11.2% (10.8% to 11.8%)	-0.7% (-1.7% to +0.2%)		16.0% (15.4% to 16.6%)	+0.9% (-0.1% to +1.8%)		\$1071 (\$1048 to \$1094)	-\$9 (-\$52 to +\$34)	
	≥50	11.3% (11.1% to 11.5%)	-0.6% (-1.3% to +0.1%)		15.8% (15.7% to 16.0%)	+0.7% (-0.1% to +1.5%)		\$1110 (\$1101 to \$1119)	+\$30 (-\$9 to +\$69)	

** One of our editors noted that he thought about this in two ways: Logically it seems that if you have national standards and universities teaching similar things and of course there is a lot more including your postgraduate program and the hospital you work at, it's not surprising that the medical school you go to doesn't make that much difference. A more interesting question is what are the major determinants of mortality and readmission and what factors are relevant. But on an emotional level he noted that when looking for a new doctor he is reassured to see they had attended a high quality medical school.*

We agree with the editor that many factors other than the quality of medical education play a role in determining the quality of care physicians provide. To clarify this point, we revised our manuscript as follows (page 19, paragraph 1):

“...although patients may view a physician’s medical school as a signal of quality, it is likely that many factors at different stages of physicians’ career, including post-graduate training and the systems in place at a physician’s current place of work, play an important role in determining the quality and costs of care that physicians provide.^{3,4}”

** A European editor noted that in small countries with few medical schools or in Europe where schools are predominantly public, people do care if a doctor went to a public or private school because public schools are looked upon less favorably. He recalled that when he was recruited to his current practice his boss mentioned that he did not want people from certain medical schools. Thus he felt that people do think about these things.*

We agree with the editor that despite the lack of robust evidence showing the relationship between the medical school from which a physician graduated and the quality of care that physicians provide, physicians and patients may view a physicians’ medical school as the signal of quality of care.

Comments from Reviewers

Reviewer: 1 (Dr. Robert Phillips)

I appreciate the efforts of these authors to study the relationships between school rankings and outcomes. It is a worthy effort but the measures used to assess primary care rankings are seriously flawed. The US News & World Report rankings use metrics to assess primary care production that have been demonstrated to overestimate primary care production and erroneously assign graduates. For example the largest weighting (0.3) is given to graduates going into internal medicine, family practice, or pediatric residencies, but ABIM acknowledges that less than 20% of those entering an IM training program will remain in primary care and only about 40% of pediatricians will. Another heavily weighted item is peer assessment score (0.25) which only goes to deans, academic deans, and internal medicine chairs--there is ample evidence of the "deans' lie" which typically also only use initial training program as the metric for primary care production. A simple comparison of the primary care rankings in this paper with those of Fitzhugh Mullan's paper (<http://annals.org/aim/fullarticle/745836/social-mission-medical-education-ranking-schools>, table 1, column 1) demonstrates a significant reordering of the rankings.

Another paper by my colleagues offers a methodology for reproducing this assessment
https://journals.lww.com/academicmedicine/Fulltext/2011/05000/Accounting_for_Graduate_Medical_Education.21.aspx

Thank you for your thoughtful comments. We agree that there may be flaws in how the USNWR rankings use metrics to assess medical schools, and that is one of the reasons why we conducted this study (i.e., our initial hypothesis was that the rankings of medical schools were not associated with patient outcomes). Based on your suggestion, we conducted an additional sensitivity analysis using Dr. Mullan’s rankings, instead of USNWR rankings, and presented the findings in Table A of this cover letter.

We also added the following sentences in the Discussion to clarify that there may be issues with regard to how the USNWR rankings use metrics to assess medical schools (page 21, paragraph 1):

“Lastly, it is possible that the *U.S. News and World Report* rankings do not capture the quality of medical education in a valid and reliable way, and we may need better approaches for measuring the quality of medical schools. For example, the largest weight is given to graduates selecting internal medicine, family practice, or pediatric residencies for the *U.S. News and World Report* primary care rankings, despite the fact that only a limited proportion of those trainees entering internal medicine residency programs remain in primary care. Using a metric that more reliably captures the proportion of graduates who select primary care as their specialty may lead to better rankings.”

The AMA Masterfile offers them a straightforward way to produce a more reliable ranking based on training experiences--one of the most reliable elements of the Masterfile. While the rankings used are associated with significant outcomes, the authors will remain open to criticism from readers who understand the serious flaws of the US News process and the very audience that should be influenced by these findings will remain closed to them due to lack of credibility. The research ranking methodology used by US News has more objective metrics but is still influenced by peer rankings. I have less concerns about this methodology, but do know that the NIH has the RePORT tool and others have compiled data from it into rankings http://www.brimr.org/NIH_Awards/2017/NIH_Awards_2017.htm that could offer more straightforward methodology.

Thank you for bringing our attention to the data on training experiences in the AMA Masterfile. We do not have access to the data, and we believe that the data will answer different research questions than ours. In the current study, we asked the question whether the rankings of medical schools, as defined by widely used USNWR, are associated with the quality and costs of care delivered by physicians. Previous studies suggest that schools, physicians, and patients do consider these rankings at least to some extent. Our approach more directly answers the question of whether these widely used rankings – that patients may view as a measure of physician quality – are associated with patient outcomes (we found no or only weak relationships), as opposed to a related but distinct question of whether the accurately measured quality of a medical school predicts long-term physician performance.

Reviewer: 2 (Dr. Jian Huang)

This is an observational study to determine the association between physician medical school rankings and their performance as measured by patient outcomes and costs of care in the United States. The authors found that physicians who graduated from highly-ranked primary care medical schools exhibited slightly lower patient readmission rates and spending compared with physicians who attended lower ranked schools but had no difference in patient 30-day mortality. Physicians who graduated from highly-ranked research medical schools had slightly lower spending but no difference in patient mortality or readmission rates. This is an interesting study based on patient outcomes and costs of care for acutely hospitalized Medicare patients treated by general internists. The study is well designed with defined inclusion and exclusion criteria, and objective outcome measures. Sample size for both patients and physicians is large. Study patients were Medicare fee-for-service beneficiaries hospitalized with an acute medical condition between 2011 and 2015. Doximity database was used to determine the attended medical schools by the treating physicians included in the study. Medical school rankings were based on the US News and World Report. Multivariate regression model was used to adjust for certain important confounding factors with additional sensitivity analyses as detailed in the manuscript.

While the results suggest an association between the rankings of US medical schools the practicing general internists attended and the downstream patient outcomes and costs of acute care for hospitalized patients, there are multiple important intermediates that influence physician future performance. Medical training is a long, step-wise and multifaceted process that also requires practice. Some of the important determinants are pre-med and medical school performance, residency training experience and post training practice settings. It is very difficult to foresee physician future performance based only on a few parameters. There are many surrogate markers that have been studied to predict physician future performance in different stages with inconsistent results. These predictors include but not limited to MCAT scores, USMLE step 1,2,3 scores, interview rankings, numbers of clerkship and sub-internship honors, Alpha Omega Alpha (AOA) membership, residency evaluation scores, residency in-training exam scores, and post-residency board exam score. It would be better, if the study design could take into consideration more important physician-specific variables from their different training stages other than demographics and medical school rankings. Residency training, a crucial transition stage from medical school to independent practice, has significant impact on physician future performance. Residency program rankings have been released by Doximity since 2014. Although the Doximity rankings are not validated, it has been used by medical students and shown to have real effects on students' choice of residencies. It would be very interesting to explore the association between residency program rankings and physician future performance and cost of cares.

We agree with the reviewer that many factors at different stages of physicians' career influence future performance of physicians. To clarify this point, we added the following sentences in the revised manuscript (page 19, paragraph 1):

"...although patients may view a physician's medical school as a signal of quality, it is likely that many

factors at different stages of physicians' career, including post-graduate training and the systems in place at a physician's current place of work, play an important role in determining the quality and costs of care that physicians provide.^{3,4} Future studies are warranted to understand whether other factors such as residency training have a measurable impact on the performance of physicians after completion of training."

The physicians included in this study were limited to US medical graduates only. Since there is a significant proportion of internal medicine residents are international medical graduates (IMGs), it would also be interesting to study this group of physicians, especially those who went to medical schools in countries with limited resources. The findings from this study contribute to the current literatures and provide useful information for potential future studies.

We agree with the reviewer that it is interesting to study the quality and costs of care provided by IMGs in the US. In fact, we have already studied this and published our findings in BMJ.⁸ We found that IMGs have slightly lower patient mortality rate and higher healthcare spending compared with physicians who graduated from US medical schools within the same hospital (after adjusting for potential confounders). We also found that patients' readmission rates did not differ between IMGs and US medical graduates.

Reviewer: 3 (Dr N Ravichandran)

[1] The article found to be interesting however it is not much relevant to a patient. For example, when patients were emergently hospitalized or even otherwise with a medical condition, in general, do not ask the ranking of the medical school a physician attended rather patients or companions would ask the specialized physician for the reported health problem or someone who can provide first-aid before consulting to the specialists to reduce the stress/pain. I believe this is the universal phenomenon. As a patient, I do not see any return on value addition ranking of the medical school a physician attended.

Thank you for your comment. While empirical evidence is limited, there are many anecdotes that patients, hospitals, and physicians (including hospital executives who hire physicians) see physicians' graduated medical school as a proxy of performance (we are not arguing that this is a good practice, but this is the reality).^{16,17} Therefore it is useful to understand whether the widely used USNWR rankings – that patients may view as a measure of physician quality – correlate with patient outcomes (we found no or only weak relationships), as opposed to a related but distinct question of whether an accurately measured quality of a medical school predicts long-term physician performance.

The primary reason that we focused on patients who were emergently admitted was to minimize unmeasured confounding (i.e., physicians who graduated from top medical schools may attract wealthier, more-educated patients which may lead to better patient outcomes), though we are not only interested in this inpatient population. It is possible that our findings apply to the outpatient setting, where patients select their primary care physicians. We clarified this in our revised manuscript as follows (page 10, paragraph 1):

“To minimize the influence of patients selecting their physicians, or physicians selecting their patients, we focused our analyses on emergency hospitalizations, defined as either emergency or urgent admissions identified in Claim Source Inpatient Admission Code of Medicare data (although we were not only interested in emergently admitted patients, this approach was necessary to reduce the impact of unmeasured confounding).”

[2] Even general internists come from other than the top 20 ranked institutions too have developed their skills, enhanced their competency and improved their subjective knowledge over the time due to competitions and supervised mechanisms that exist within (i.e., quality cell) and outside (i.e., regulatory authority) hospitals. The objective of medical schools is to impart the quality education irrespective of their ranking, while Hospitals are supposedly providing better healthcare and improve the health promotion. These conditions are required to be met by any country, irrespective of their level of development and socio-economic condition of the population, and the Healthcare system shall ensure that there is no discrepancy and/or biases taking place in the name of race, religion, ethnicity, regions etc.

We agree with the reviewer that ideally, hospitals and health systems ensure that the quality care is delivered regardless of which medical school or residency a physician attended. However, empirical evidence suggests that practice patterns vary substantially between physicians even among those physicians who practice in the same hospital. For example, research conducted by our team has found that the variation in healthcare spending between physicians (within the same hospital) was slightly larger than the variation between hospitals, suggesting that the standardization of care is not achieved at hospital level.⁹ Moreover, as we note above, we think it is useful to understand whether the widely used USNWR rankings – that patients may view as a measure of physician quality – are associated with patient outcomes.

[3] As this article noted that physicians graduating from higher-ranked schools had slightly lower healthcare spending but no differences in mortality or readmissions. Why? Because, the study is not focused on specific health conditions to draw the difference and which might vary to one patient to another due to varied biological conditions etc., Hence, this argument needed to be validated.

In our revised manuscript, we explain (page 19, paragraph 3) potential mechanisms for why patient outcomes do not differ or are small between physicians who graduated from top medical schools vs. those who graduated from lower-ranked schools.

[4] Moreover, as a carer, I do not see any value addition being in the ranking of the medical school a physician attended, as agreed in the study itself and it shall not be.

We agree that the reviewer it may be inappropriate and unreliable to use the rankings of physicians' attended medical schools to estimate the performance of physicians. However, as suggested by the comments of the editors and also by our own experience, it seems to be the case that many patients,

hospitals, and physicians use these reported rankings as a signal of performance in the real world.^{16 17} Therefore, we believe that it is worthy to investigate whether their assumption (that medical school actually predict physicians' performance) is supported by empirical evidence or not.

Focus required on

[5] Unless, we correlate with a specific health condition (communicable and non-communicable diseases) with a severity level, length of stay, the age of the patients, duration of illness, readmission status, treatment carried, intervention studied and co-morbidities listed, the study will have less bearing in terms of its applicability.

We combined multiple conditions to maximize the statistical power to detect any differences in patient outcomes and healthcare spending. Although the reviewer suggested a series of additional analyses, it was not very clear why these analyses are warranted (and we do not want to add a large number of secondary analyses without justification, which may not be helpful for the readers of the BMJ). We are happy to conduct additional analyses, if editors prefer, but it would be helpful to specify exactly what kinds of analyses should be conducted.

[6] Moreover, given national/government efforts to improve the efficiency of healthcare, how is a ranking of the medical school a physician attended associated with readmissions and costs of care? Not clear.

A main finding of our paper is that medical school ranking seems to bear only weak relationship to mortality, readmissions, and costs of care of physicians. We have clarified this in the discussion of our revised manuscript.

Feasibility and Challenges

[7] Since the study is not focused on treatment, intervention results studied or cross-sectional analyses carried out through given practice; the relational feasibility along with a ranking of the medical school a physician attended will not get the aimed results of the study.

Given that the rankings of medical schools are measured and created in 2002, and patient outcomes and healthcare spending of physicians are measured in 2011-2015, we think this is a longitudinal study and not a cross-sectional study. Therefore, the "reverse causation," which is a major concern of cross-sectional studies, is not a concern for this research (i.e., patient outcomes and healthcare spending, by design, cannot affect the ranking of medical schools). We can add additional analyses focusing on specific treatment or intervention if the reviewer can specify which treatment/intervention should be studied.

[8] The results of treatment on specific health conditions, outcomes of varied interventions and rational drug use policies that were/are adopted by a physician might influence the patient perception. This might differentiate the physician ranked among the top and others. This is grossly missing.

Although it may be interesting to study the impact of those factors on patient perceptions, it was not the focus of our study to investigate patient perceptions. A previous study showed that patients treated by physicians who graduated from top medical schools perceive better care than those who were cared for by physicians that attended lower-ranked schools.¹⁸ The scientific contribution of our study was that we showed that graduating from top medical school appears to confer little or no measurable benefit on important outcomes like mortality, readmissions, and costs of care.

[9] The outcomes that are being measured in the study are not clear as there are no indicators drawn in the study. The study used very generic indicators which are not useful to both carers and patients.

We used three outcome measures—30-day mortality rate, 30-day readmission rate, and costs of care—that are widely accepted as standard quality indicators (used as metrics for measuring quality of care under the national pay-for-performance programs [Hospital Value-Based Purchasing program and Hospital Readmission Reduction Program] in the US), and arguably important outcomes for patients.

[10] I agree that tracing the patients who received care from ranked medical school a physician attended and interview them might be costly affairs. However, a few patients' views might have enhanced the study perspectives and also reflect about whether patients view the same as authors of the article?

Thank you for the comment. We think that there are both empirical¹⁷ and anecdotal^{16 19} evidence suggesting that patients may view the medical school from which a physician graduated as being a signal of quality.

[11] Moreover, for instance, Continuous Medical Education supposedly enhancing the competency and competence of a physician, and which is given due importance across the regions. Is there any CME in place in the USA? If it is there, what was to the effect of ranking? As the article talking about the 4-years data, how many of the physicians undergone CME, irrespective of ranking they belong? Are physician required to undergo the renewal of licensing under Medicare schemes or any other health financing mechanism? If so, what is their impact on studied objectives? I did not find the answer from the article.

Although there are multiple CME programs in place in the US, the evidence is weak and scarce as to whether CME can actually improve the quality of care. In fact, to the best of our knowledge, there is no evidence showing that CME leads to better quality of care provided by physicians. Unfortunately, we do not have data on whether physicians underwent CME, and we think that this is beyond the scope of our study.

[12] Too many statistics are applied but without understanding its relevance to the study objectives. The article required to be more qualitative rather statistical one.

We appreciate this point but think that a qualitative analysis is beyond the scope of our study.

[13] Discussion required more elaboration with specific to the study objective as outlined in the article, but it is missing.

We believe the study objective is straightforward enough for the readers of the BMJ to find it understandable and interesting—to examine the association between widely used rankings of medical schools and patient outcomes/healthcare spending. If the reviewer has specific suggestions as to how to revise the discussion, we are happy to make such changes.

[14] Conclusion needs more clarity and required to be strengthening with the study findings.

We revised the conclusion to improve the clarity of our findings.

[15] The study used secondary data and positioned with retrospective information limited in gaining the understanding of the patients' perception. Patients' perception is an important variable might have helped in the deeper understanding of the study. This is missing.

While we agree about the importance of patient perceptions, we believe that it is also important, and of strong interest to patients, to investigate patient outcomes such as mortality and readmissions, and policymakers and payers are also interested in healthcare spending. In fact, the relationship between the ranking of medical school and patients' perception has already been examined in previous study,¹⁸ and our study advances the field by evaluating other hard outcomes namely mortality, readmissions, and costs of care.

I hope the above suggestions that are placed here to strengthen the paper to make it more useful for the physician to share and discuss with patients. Looking at the above suggestions/comments and required clarity, I wish authors shall re-visit the article and re-submit for further review processing. We hope this will help authors think of the best ways to include patients in their future research and further progressive patient involvement in their research enterprise.

Reviewer: 4 (Dr. Arabella Simpkin)

This retrospective observational study, using Medicare data from 2011 to 2015, looked to understand whether there was a relationship between the ranking of the medical school a physician attended and subsequent patient outcomes and healthcare spending. The authors used a 20% random sample of Medicare fee-for-service beneficiaries aged >64 years, who were emergently hospitalized with a medical condition and treated by general internists. Main outcome measures were the association between the ranking of the medical school a physician attended (determined by US News and World Report ranking) and physicians' patient outcomes (30-day mortality and readmission rates) and Medicare Part B spending, adjusted for patient and physician characteristics and hospital fixed effects. A total of 949,774 patients treated by 29,147 physicians were analyzed. When using primary care rankings, physicians who graduated from higher-ranked schools exhibited lower 30-day readmission rates and slightly lower

spending compared with graduates of lower-ranked schools but no difference in patient mortality. When using research rankings, physicians graduating from higher-ranked schools had slightly lower healthcare spending but no differences in mortality or readmission.

Introduction: Well-laid out, emphasizing gap in our knowledge to better understand why practice patterns vary widely across physicians.

Thank you for your positive comments.

Methods: Rankings were used published in 2002; yet there was variability in time of completion of medical school for the physicians (And variability in age of physician, with significant difference in physician age between top 20 ranked and lower rankings). Just using 2002 seems to generalize the data too much (I know in a subsequent analysis you restricted too physicians graduating within 5 years of when rankings were created, but this still seems to generous a period). Whilst many schools may remain within similar deciles over long periods of time (you cite relatively stable rankings over time for top-20 medical schools) I would have thought it was important to look at this correlation in more detail specifically related to exact period of time the physician was there (and perhaps taking an aggregate of ranking over that period) to better understand the relationship and draw conclusions – especially as outside the top 20 there may be even more movement in placing.

In our revised manuscript, we restricted our analysis to physicians who graduated within 4 years of when rankings were created as a sensitivity analysis (shown in supplemental eTable 3 in appendix). Given that the vast majority of medical students attend a medical school for 4 years, this means that they were attending a medical school when the rankings were created.

We also tested and found a high correlation between the rankings created in 2002 and 2009. Given that the rankings were created only for top 50 schools, and all schools with rank ≥ 50 are aggregated into a single category in our analyses, any variability of rankings across years for lower ranked schools is not relevant for our analysis.

Although hospital fixed effects was taken into account, did this account for whether hospitals are teaching institutions/academic medical centers which may account for trainees having a large hand in patient care and consequent outcomes.

Thank you for this comment. We included hospital-specific fixed effects in our analyses which account for both measured *and* unmeasured characteristics of hospitals including whether hospitals are teaching institutions/academic medical centers.²⁰⁻²²

Does the US News and World Report ranking adequately capture the quality of medical education in a valid way? What about looking at the results from the surveys taken by graduating medical students which looks in more details at aspects from their medical education experience which may have direct relevance to their later competence as a practicing physician?

Although the USNWR rankings have been the most widely-used rankings in the US, they are clearly imperfect and may not correlate well with the quality of medical education a school provides. We explain this as one of the limitations of our study. Nonetheless, because these rankings are so widely used and patients may often use them as a surrogate for doctor quality, it is useful to understand whether the rankings actually correlate with patient outcomes (we find that they do not). This is separate from a related but distinct question of whether accurately measured quality of a medical school predicts long-term physician performance.

Results: Results well described and laid out, with several supplementary tables for added details. Was physician age taken into account in the models? There is a significant difference in physician age and medical school ranking (Table 1) which could influence results.

Yes, physicians' age was included as one of the adjustment variables in our regression models (as a continuous variable plus quadratic and cubic terms to account for a potential non-linear relationship).

Discussion: The authors conclude that physicians who graduated from higher-ranked schools exhibited lower 30-day readmission rates and slightly lower spending compared with graduates of lower-ranked schools but no difference in patient mortality. When using research rankings, physicians graduating from higher-ranked schools had slightly lower healthcare spending but no differences in mortality or readmission. Communication failures are known to be major contributors to medical errors, adverse patient events, and patient safety incidences. To what degree does the ranking indicate better communication training? It would be interesting to better understand how components of a medical school curricula link to later patient safety events by their graduates. This would be enormously helpful as medical schools look to revamp curricula and change training techniques. Does the school culture have a stronger influence if physicians stay on from medical school for residency training in an affiliated hospital compared to physicians who switch?

Given that we observed a difference in readmission rates but not in mortality, it is possible that communication failure (which we believe is an important contributor of readmission rates) may be a potential explanation of the observed difference as suggested. However, it's important to emphasize that the observed relationships are small and that is hard to say with any certainty that the patterns we observe are due to any one factor. Also of note, according to the USWNR, their rankings are based on a weighted average of indicators, including peer assessment by school deans, evaluation by residency directors, student admission selectivity (medical college admission test scores, student grade point averages, and acceptance rate), and faculty-student ratio (all of which do not explicitly take into account the existence of communication training).²³

We agree that it is interesting to examine how components of a medical school curricula link to later patient safety events by their graduates. However, we do not have access to such data but think this would be interesting for future study.

The authors highlight limitations of this study, including the limitations of the US News and World Report rankings as a measure of medical school quality (page 20, lines 31-33) and the limitations of relying on medical school rankings from a single year when the physicians matriculated from medical schools across a wide range of years (page 20, line 54 – page 21, line 6). An additional limitation is the performance of the physician within the medical school – did they do well through medical school, or have several re-takes/come in at the bottom of their class? This presumably could impact results and their effectiveness/safety record as a physician in practice.

Thank you for this comment. We agree that the performance of individual physicians varies even within a group of physicians who graduated from the same medical school. Given that patients will not likely know this information (except for surrogates like AOA honor society membership, which the vast majority of patients would be unaware of), we were most interested in whether the observable characteristics of a physician that might guide patient perceptions and decisions (e.g., where a physician trained) are actually correlated with patient outcomes. Therefore, the goal of our study was to measure whether physicians who graduated from high-ranked medical schools, on average, perform better than physicians who attended lower-ranked schools; therefore, the variation in performance within the graduates of the same medical school, while very interesting, is beyond the scope of our study.

This study seems to demonstrate that the medical school from which a physician graduates from bears no relationship with patient mortality after hospitalization, and only limited relationship with readmissions and spending, using the US News and World Report ranking to rank medical schools (which only goes to 50) and using 2002 (and then 2009) as the ranking year. As we know there is huge variability in physician practice behavior, it seems likely that using the US News and World Report as a proxy for medical school training is missing much detail of training (both in clinical competencies and in professionalism attributes and communication skills) that is important in the foundational training of a future physician, and may therefore misrepresent the importance that a medical school has on later impact of physician.

We agree with the reviewer that using the USNWR rankings as a proxy for medical school training may be missing much detail of training that is important in the foundational training of a future physician. However, for the reasons noted above we view our analysis as answering whether a commonly used proxy for physician quality – where a doctor went to medical school – actually bears any relationship with several important patient outcomes.

What is already known on subject: is it known that patients perceive the medical school from which a physician graduated as a signal of care quality, or is this an assumption made by the authors? If the latter, then it should be included in the discussion of potential impact of this study as opposed to in the “what is already known on the subject”.

Thank you for this comment. Gao and colleagues evaluated the online ratings of doctors in the US, and found that patients gave a slightly higher rating to physicians who graduated from highly ranked

medical schools.¹⁷ It may be that physicians who graduated from highly ranked schools actually provided higher-quality care, but it is also possible that patients perceive the medical school from which a physician graduated as a signal of care quality. There is also anecdotal evidence showing that some patients care about which medical schools their doctors attended.^{16 19} In the manuscript we write that patients may perceive the medical school from which a physician graduated as a signal of care quality in order not to overstate our approach and findings.

Overall, a well written and researched article attempting to look in more detail at a very important area: to understand the determinants of physician-level variation in patient outcomes and healthcare spending. I commend the authors on this work.

We appreciate your thoughtful comments.

Reviewer: 5 (Dr. Carolyn Canfield)

I have used the BMJ Review Template for patient reviewers, quoted as bullet points, below. Thank you for the invitation to review this manuscript from the perspective of patients and carers.

- *Are the study's aims and the issue and questions that the paper addresses relevant and important to you as a patient? Do you think it would be relevant to other patients like you? What about carers?*

The subject of the study is not relevant or important to me as a patient and carer, and unlikely to be important to other patients like me. Choosing among doctors based on their medical school's ranking is nothing I've ever heard about from patients. A glance at the US News and World Report website (1) shows clearly that the ranking of American medical schools is intended for medical school applicants. Online guides for US patients choosing doctors do not mention medical school ranking, either as recommended or best avoided: e.g. Consumers Reports (2), Blue Cross Blue Shield (3), UnitedHealthcare (4), National Institute on Aging (5), Medline Plus (6). The exception is US News and World Report's advice for patients choosing a doctor (7) who reference their own medical school rankings and then raises doubts by advising: "how much emphasis to place on a doctor's schooling is contentious".

Thank you for your comment. While we are certainly not recommending patients and carers to use rankings of medical school to measure the performance of doctors, there are both empirical¹⁷ and anecdotal^{16 19} evidence suggesting that at least some patients view doctors' graduated medical schools as a signal of the quality of training they received. Moreover, hospital executives, department chairs, directors of residency programs, and peer doctors and nurses may view the medical school from which a physician graduated as being a signal for underlying quality. Therefore, we think that the question our study is addressing is not only important to patients and carers, but also to hospitals and doctors who may see medical schools as a signal of physician performance.

What evidence is cited as the premise for this study? In the manuscript footnote #9, Dr Chen offers no evidence of patient interest, but rather offers her own reflection on a professional obsession with school

ranking (8). Manuscript footnote #10 for Dr Gao's study of patient-ratings is based on RateMD, and explicitly distinguishes this perspective from US New and World Report Medical School Ranking (9).

We think it is important to understand the fact that Dr. Chen was actually asked by her patient which medical school she attended.¹⁶ Dr. Gao and colleagues have shown that patients gave a slightly higher rating to physicians who graduated from highly ranked medical schools.¹⁷ It may be that physicians who graduated from highly ranked schools are actually providing higher-quality care, but it is also possible that patients perceive the medical school from which a physician graduated as a signal of care quality.

Another example includes that of Maureen E. Sullivan, chief strategy and innovation officer for the Blue Cross Blue Shield Association, who recommended a new tool called Doctor Match, which uses information about doctors' medical school to match patients and doctors.¹⁹

Furthermore, even in the United States, patients would certainly not be in a position to interview alternative candidates to ascertain their medical school's ranking in US News and World Report (or any other ranking) in order to select a hospitalist of choice.

Although in the inpatient setting it may be rare for patients to choose doctors based on the medical school that they attended, it is possible that patients take this information into account when they select their primary care physician or other consulting physicians. Moreover, even if choice is not affected, patient perceptions of quality of care – which are now measured and incentivized financially by the U.S. federal government – may still be affected. Our study focused on patients who were emergently admitted not because we are only interested in inpatient care, but to minimize unmeasured confounding (patients are less likely to select their doctors in the inpatient setting than in the outpatient setting). Assuming that our findings are generalizable to the outpatient setting, it would be informative for patients and carers to understand whether the medical school that a physician attended relates to the quality and costs of care they provide.

• Are there any areas that you find relevant as a patient or carer that are missing or should be highlighted? Evidence for the patient relevance of the hypothesis for the study is missing.

As we mentioned above, there are both empirical¹⁷ and anecdotal^{16 19} evidence suggesting that a substantial number of patients and carers consider the medical school their doctor attended, which we have described in our manuscript.

• Would the treatment, intervention studied, or guidance given work in practice? Is it feasible? What challenges might patients face that should be considered? There is no relevant treatment, intervention or guidance suggested for any challenges that patient might face.

The intervention here, in our view, is information. To the extent that patients may perceive doctor quality partly on the basis of where a physician went to medical school, this study should provide

reassurance that the current policies of medical training (standardizations of curricula, formal standardized evaluations, specialty boards, etc.) seem to be negate any potential influence of medical school on doctor quality.

• Are the outcomes that are being measured in the study or described in the paper the same as the outcomes that are important to patients? Are there others that should have been considered? Most patients will die in the care of a physician. Many times death will take place in a hospital (10), presumably under the care of a hospitalist. The criteria for care excellence may very well be caring, compassion, access, understanding, support for family needs, palliative expertise (such as pain management), seamless teamwork and have very little to do with readmission or mortality rates. In fact, practitioner attributes that contribute to such qualities of care are what the cited online guides advise for choosing doctors at any stage of life.

Thank you for your comment. While we certainly agree that patients care about caring, compassion, access, we also believe that most patients find mortality, readmissions, and costs of care—outcome variables we studied—are extremely important for them.

• Do you have any suggestions that might help the author(s) strengthen their paper to make it more useful for doctors to share and discuss with patients? There is nothing in this paper that a doctor would use to share and discuss with patients. I have no suggestions on how to make it so.

The largest take-home message here is that where a doctor went to medical school has no bearing on at least several important measures of care quality. Disseminating that information to the public is the main suggestion.

• If and how the level of patient involvement in the research described could have been improved? There is no patient involvement mentioned. Interviewing patients to find out what they think medical school ranking means to care quality might have dissuaded the research team from following this line of statistical analysis.

Although we agree that it may be informative to interview patients to find out what they think medical school ranking means to care quality, we also think that it is beyond the scope of our study. Our study was to understand the relationship of widely used medical school rankings with the quality and costs of care that physicians provide after graduating from medical school, which we believe is of interest to patients, carers, hospitals, physicians, policymakers and educators.

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