Pre-medical majors in the humanities and social sciences: impact on communication skills and specialty choice

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CONTEXT Medical school admissions committees use a variety of criteria to determine which candidates to admit to their programmes. Effective communication is increasingly considered a key requisite to the practice of effective medicine. Medical students with pre-medical backgrounds in the humanities and social sciences may be more likely to acquire skills relevant to patient-centred communication, either prior to or during medical school.

OBJECTIVES The purpose of this study was to investigate the relationship between pre-medical backgrounds in the humanities and social sciences and outcomes in medical school, including in communication and interpersonal skills (CIS), licensure examination results and postgraduate specialty choice (primary care versus non-primary care specialties).

METHODS The American Medical College Application Service database was used to identify pre-medical college majors, demographic characteristics, Medical College Admission Test scores and college grade point averages for medical students at a large, midwestern medical school. Data were obtained for 465 medical students across three cohorts (classes of 2014–2016). Correlation and regression analyses were used to examine relationships between pre-medical background, performance on graduation competency examination standardised patient encounter CIS scores and on United States Medical Licensing Examination (USMLE) Step 1 and Step 2 Clinical Knowledge scores, and postgraduate specialty choice.

RESULTS Graduating medical students with pre-medical humanities or social sciences majors performed significantly better in terms of CIS than those with natural science majors (Cohen's $d = 0.28$, $p = 0.011$). There were no significant associations between pre-medical majors and USMLE Step 1 and Step 2 Clinical Knowledge scores or postgraduate specialty choice.

CONCLUSIONS These results suggest that considering humanistic factors as part of admissions criteria may promote the selection and training of physicians with good communication skills.

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INTRODUCTION

Medical school admissions committees use a variety of criteria to select trainees, the majority of which are considered demonstrations of 'academic excellence' through aptitude test scores or college grade point averages (GPAs).[1,2] In the USA, scientific knowledge is clearly valued by the medical profession and is measured using the Medical College Admission Test (MCAT) and the United States Medical Licensing Examination (USMLE) Step 1 and Step 2 Clinical Knowledge (CK) tests.[3–5] Studying science or mathematics is considered as preparation for studying the material that must be mastered in medical school. Scientific courses are believed to be 'the foundations upon which success in medicine is based' and are used, in some ways, to help predict students' potential future success in medical school coursework (which relies heavily on scientific models of knowledge production).[1]

Nonetheless, scholars have long argued that a student's academic success may have little bearing on his or her later medical skill and that achievement in scientific courses may be less important than aptitude related to human interaction.[1,2] This view has been slow to translate to the context of medical school admissions committees, however. For example, although some admissions committee members believe that a liberal arts background can be advantageous,[6] in many international settings, students who study the humanities or social sciences as part of pre-medical education tend to be viewed as less prepared for medical education than students with pre-medical science majors.[7]

The context for examining pre-medical background is relevant as many countries require applicants to have obtained post-secondary education degrees prior to beginning medical training. Prior studies examining the relationship between pre-medical backgrounds and medical school performance have generally focused on assessments of medical knowledge and have demonstrated little to no effect on medical school academic performance,[8,9] national medical licensure examinations,[9,10] and commencement distinctions or honours.[7] Although medical knowledge is indeed critical for success in medical education, medical students are also expected to demonstrate excellent communication and interpersonal skills (CIS) and professionalism.

Pre-medical programmes in the humanities and social sciences focus on the accumulation of 'cultural capital' that may later translate to greater skills in other aspects of patient care, such as physician–patient interactions and cultural competency.[11,12] Specifically, students with these backgrounds are more likely to have a 'sophisticated use of verbal and written language and confidence in their broad knowledge of history, culture, and politics' that may benefit their patient care.[11] The possible benefits of humanities and social sciences courses for physicians in training have also motivated the proliferation of medical humanities programmes in medical schools nationwide, with the often explicitly stated expectation of improving physician communication and the provision of patient-centred care.[13] Yet no study to date has empirically investigated the relationship between a humanities or social sciences pre-medical background and communication skills.

However, communication skills are considered so central to the necessary training for medical students that they represent one of the six core competencies defined by the Accreditation Council for Graduate Medical Education.[14] This focus on communication stems, in part, from extensive research that demonstrates a correlation between effective physician–patient communication and improvements in patient health outcomes.[15]

Humanities and social sciences backgrounds may also be related to medical students' postgraduate specialty choice. Whereas some scholars have found no relationship between undergraduate major and postgraduate specialty choice,[16,17] others have found that medical students with humanities or social sciences backgrounds are more likely to choose specialties that emphasise patient–physician interaction and communication, such as primary care specialties and psychiatry.[7,18]

The purpose of this study was to investigate the relationship between a humanities or social sciences pre-medical college major and: (i) performance in CIS in medical school, and (ii) selection of medical specialty for postgraduate training. Based on previous findings, we developed the following hypotheses (Fig. 1):

> Hypothesis 1: medical students with pre-medical undergraduate college majors in the humanities or social sciences will have better communication skills than their peers with majors in the natural sciences;

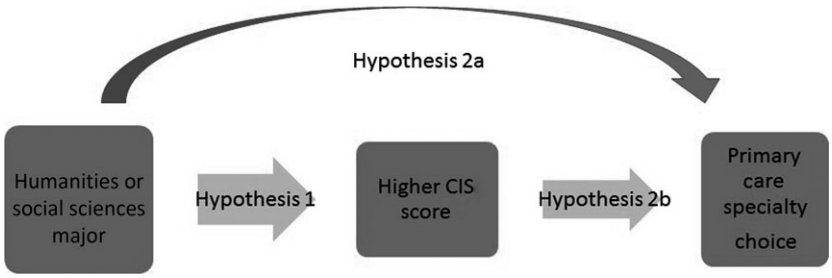

Figure 1 Study hypotheses. CIS = communication and interpersonal skills

Hypothesis 2a: medical students with undergraduate college majors in the humanities and social sciences will be more likely than their peers to choose primary care specialties that emphasise patient–physician interaction, and

Hypothesis 2b: medical students with better communication skills will be more likely than their peers to choose primary care specialties that emphasise patient–physician interaction.

METHODS

We merged student records for three graduating student cohorts and from four data sources at a large, midwestern medical school. These data included: (i) medical school admissions data, including undergraduate major, mean MCAT score, undergraduate science GPA, and undergraduate cumulative GPA; (ii) USMLE scores, including Step 1 (Basic Sciences) and Step 2 CK scores; (iii) medical school graduation competency examination (GCE) data, including CIS scores and patient note (PN) clinical reasoning scores, and (iv) postgraduate training placement data (specialty choice) obtained from the school registrar's office.

Data

Data for three medical school cohorts were used, for a total of 465 students (class of 2014, $n = 170$; class of 2015, $n = 119$; class of 2016, $n = 176$).

Pre-medical college majors

Undergraduate college majors (obtained prior to medical school) were identified using applicants' self-reported fields of study from the American Medical College Application Service (AMCAS) database. The AMCAS system provides a drop-down menu from which applicants select their undergraduate major; in addition, they can write in their major or principal subject if it is not available in the menu (i.e. they can select 'Other Major' and enter their major as an open-ended response). Students with multiple majors were able to add all of their majors.[19] We first classified college undergraduate majors into four groupings (humanities, social sciences, biological sciences and physical sciences) based on previous research on science, technology, engineering and mathematics majors, which often describes qualitative differences in climate, gender demographics or research focus between the biological sciences and the physical sciences.[20] However, given our research question, these distinctions are less likely to be relevant. For this reason, as well as to increase statistical power, a second grouping of variables was created: (i) humanities and social sciences, and (ii) all other majors. We included any student who had majored in a humanities or social sciences subject in the former category, including those who selected multiple undergraduate majors.

Admissions data

Using AMCAS, we identified and merged applicant information for the 465 students who matriculated at the medical school. Data included student gender, race and ethnicity, under-represented minority (URM) status, undergraduate college, undergraduate college major, degree type, degree date, MCAT score and GPAs (cumulative and science).

Graduation competency examination

The medical school administers GCEs to rising Year-4 students. The GCE replicates the format used in the USMLE Step 2 Clinical Skills (CS) examination[21] by integrating standardised patient (SP) encounters that measure physical examination skills and CIS and a written component of the USMLE-style PN.[22] In this study, we used data from

three administrations of the GCE (2013, 2014 and 2015), corresponding to the graduating class years of the study sample. Each GCE included five SP cases (2013 GCE: trouble sleeping, shortness of breath, wrist pain, vomiting, dead arm; 2014 GCE: chest pain, weight loss, shortness of breath, abdominal pain, dizziness; 2015 GCE: paediatrics telephone call, headache, joint pain, fatigue, coughing up blood). Each SP encounter was limited to 15 minutes and was followed by 10 minutes in which the student was expected to write the PN. Validity studies of the GCE using Messick's unified validity framework have been reported previously,[23–25] indicating consistency in scores and validity evidence with regard to content, response process, internal structure, relationships to other variables, and consequences.

The CIS component of the GCE is measured using a 4-point behaviourally anchored rating scale composed of 14 items (see Table 2 for a full list of these items), rated by the SP directly after each encounter.[24] The PN is scored by trained physician raters using a scoring rubric that refers to four tasks; a prior study of this rubric showed high inter-rater reliability (weighted $\kappa = 0.79$) and validity evidence supporting its use.[26]

Scores on the USMLE®

We obtained first-attempt USMLE scores and pass or fail status for the Step 1 and Step 2 CK examinations from the medical school's registrar's office. Scores on the Step 2 CS examination were not included in the analysis because Step 2 CS scores are provided only in pass or fail format and nearly all students passed the examination, which resulted in a lack of variability.

Postgraduate specialty choice

Data on students' choices of specialty for postgraduate training were obtained from the school registrar's office and merged with pre-medical data, and GCE and USMLE scores. Postgraduate specialty choice was classified into the primary care specialties (internal medicine, paediatrics, family medicine, and obstetrics and gynaecology) versus the non-primary care specialties.

Analysis

We analysed our data by first examining trends using descriptive statistics by major fields (humanities and social sciences versus all other majors). Next, we compared means and proportions by major fields using *t*-tests and chi-squared tests, respectively. Finally, we investigated whether differences in major fields hold after controlling for confounding factors (Step 1, Step 2 CK and GCE PN scores) using multiple logistic and multiple linear regression models.

Data compilation and analyses were conducted using STATA Version 14.0 (StataCorp LLC, College Station, Texas, USA). The study was approved by the Institutional Review Board at the University of Illinois at Chicago.

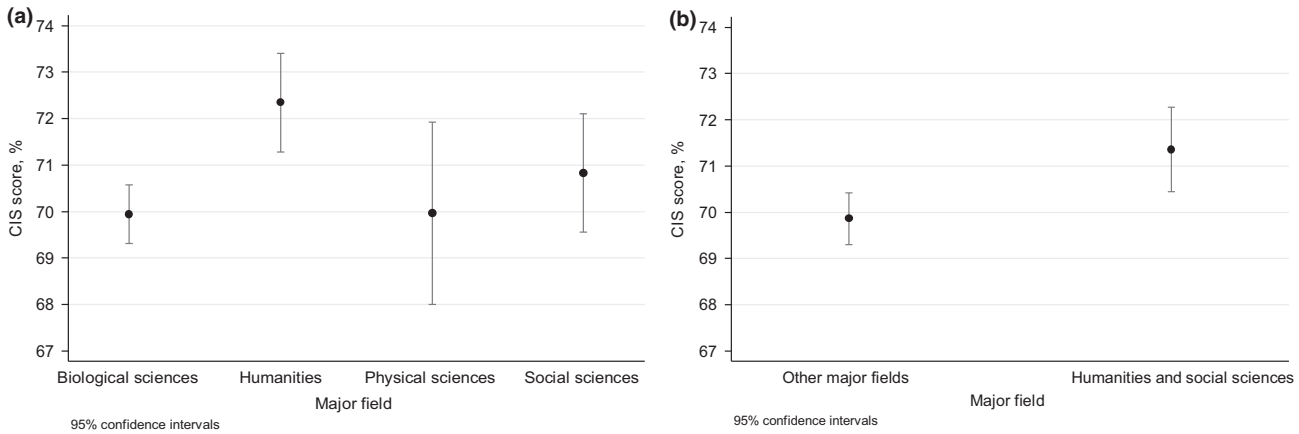

Figure 2 Comparison of communication and interpersonal skills (CIS) scores by undergraduate major field, with 95% confidence intervals, using: (a) four, and (b) two categories of field. There were significant differences in CIS scores between students with humanities or social sciences backgrounds and those with other pre-medical backgrounds ($p = 0.011$, Cohen's $d = 0.28$)

Table 1 Comparison of means between major fields: descriptive statistics and t-test

Factor	Mean difference (Cohen's *d*)	Humanities and social sciences (*n* = 103) Mean	SD	Other majors (*n* = 362) Mean	SD	p-value	All (*n* = 465) Mean	SD
MCAT®†	− 0.53 (0.37)	9.93	1.51	10.47	1.37	< 0.001	10.35	1.42
Science GPA†	− 0.18 (0.45)	3.34	0.41	3.52	0.38	< 0.001	3.48	0.40
Cumulative GPA†	− 0.11 (0.38)	3.51	0.29	3.62	0.28	< 0.001	3.59	0.29
Step 1 scores*	− 6.03 (0.29)	223.75	21.45	229.78	20.51	0.010	228.44	20.85
Step 2 CK scores	− 5.35 (0.29)	236.06	18.92	241.41	17.92	0.062	240.31	18.22
GCE CIS*	1.50 (0.28)	71.36	4.65	69.86	5.44	0.011	70.19	5.31
GCE PN scores	− 1.64 (0.21)	60.51	7.32	62.15	8.13	0.065	61.79	7.98

* $p < 0.05$.
† $p < 0.001$.
CIS = communication and interpersonal skills; CK = Clinical Knowledge; GCE = graduation competency examination; GPA = grade point average; MCAT = Medical College Admission Test; PN = patient note; SD = standard deviation.

RESULTS

Descriptive statistics

Based on our initial classification, we found the following distribution of undergraduate college majors across the study cohort ($n = 465$): (i) biological sciences majors: 67%; (ii) humanities majors: 9%; (iii) physical sciences majors: 8%, and (iv) social sciences majors: 16%. As we had expected, given the small number of humanities and social sciences majors and the similarities between the biological and physical sciences, we found only marginally significant differences between groups when four major field groupings were used to examine differences in CIS scores ($p = 0.051$) (Fig. 2a). We thus restricted our subsequent analyses to the comparison between students with humanities or social sciences majors, and all others. There were no significant differences in the proportions of students with humanities and social sciences majors and other majors by demographic characteristics, such as state residence, gender and graduation year. Students who had majored in sciences were younger by 1.3 years ($p < 0.001$). Table 1 shows the descriptive statistics for admissions data (MCAT score and GPA), USMLE scores (Step 1 and Step 2 CK), and GCE performance (CIS and PN scores).

Comparison between majors (humanities and social sciences and others)

With respect to MCAT score, science GPA, cumulative GPA and USMLE Step 1 scores, students with non-humanities and social sciences majors (i.e. those with physical and biological sciences majors) showed significantly higher performance ($p < 0.05$ for all) (Table 1). However, there were no significant differences in Step 2 CK performance and PN scores between students with the respective categories of majors ($p = 0.062$ and 0.065, respectively). By contrast, with respect to CIS, students with humanities and social sciences majors gained significantly higher scores ($p = 0.011$). The difference in CIS scores between students with humanities and social sciences majors and those with other majors translated to a Cohen's d of 0.28, representing a moderate difference in effect size (Fig. 2b).

Factors affecting differences in CIS performance

When examined more closely, there were also some specific CIS items on which students with humanities and social sciences majors scored significantly better than did their peers with science majors (Table 2). Specifically, these included 'Friendly communication' (Cohen's $d = 0.36$, $p = 0.001$); 'Physical examination' (Cohen's

d = 0.28, p = 0.010); 'Sensitive subject matters' (Cohen's d = 0.28, p = 0.010), and 'See again as personal physician?' (Cohen's d = 0.37, p = 0.002). Notably, this final item is the most global measure of patient satisfaction in the scale and, as such, suggests that SPs are more likely to feel satisfied with the communication and interpersonal interaction they experience with students with humanities and social sciences majors than they are with those with biological sciences and physical sciences majors.

Comparison of differences in medical school outcomes

We used linear regression to explore whether the relationship we observed between college major and communication skills could be explained by demographic or educational factors (Table 3). We also examined the relationship for Step 1 and Step 2 CK scores. We found that the positive relationship between communication skills scores and having a humanities and social sciences major remained even after controlling for gender, residence (i.e. in-state versus out-of-state), URM status, MCAT score, science GPA and cumulative GPA (standardised β = 0.11, p = 0.025).

Postgraduate specialty choice

Overall, 51% of students were matched into primary care specialties. There were no significant differences in postgraduate specialty placement (primary care versus non-primary care specialties) based on pre-medical college major (p = 0.229). Moreover, students' CIS performance did not significantly predict their likelihood of choosing a primary care specialty in postgraduate training (p = 0.595).

DISCUSSION

This study aimed to explore the impact of pre-medical college major on outcomes of undergraduate medical education, including communication skills and specialty choice. Using our unique dataset and by linking CIS scores with medical students' undergraduate majors (as well as with several other key demographic and education-

Table 2 Comparison of mean communication and interpersonal skills item rating by major fields: descriptive statistics and t-test

		Humanities and social sciences		Other majors		
CIS item	**Cohen's *d***	**Mean**	**SD**	**Mean**	**SD**	**p-value**
1 Friendly communication†	0.36	3.08	0.31	2.95	0.37	0.001
2 Respectful treatment	0.18	3.09	0.20	3.05	0.23	0.082
3 Listening to my story	0.16	2.79	0.34	2.74	0.31	0.162
4 Honest communication	0.14	2.91	0.27	2.87	0.30	0.272
5 Interest in me as a person	0.14	2.23	0.42	2.17	0.43	0.235
6 Discussion of options/plans	0.15	2.73	0.30	2.69	0.35	0.230
7 Encouraging my questions	0.06	2.80	0.34	2.79	0.36	0.648
8 Providing clear explanation	0.15	2.94	0.20	2.90	0.28	0.218
9 Physical examination*	0.28	2.89	0.35	2.79	0.35	0.010
10 Appropriate vocabulary	0.04	2.98	0.26	2.98	0.26	0.787
11 Sensitive subject matters*	0.28	2.91	0.33	2.81	0.36	0.010
12 Closing the encounter	0.13	2.81	0.25	2.77	0.31	0.275
13 Receptive to SP feedback	0.13	3.33	0.35	3.28	0.39	0.201
14 See again as personal physician?†	0.37	2.72	0.34	2.59	0.39	0.002

* p < 0.05.
† p < 0.01.
CIS = communication and interpersonal skills; SD = standard deviation; SP = standardised patient.
CIS items were scored on a 4-point scale by an SP; values above reflect averages across five SP encounters.

Table 3 Comparison of differences in medical school outcomes (communication and interpersonal skills, US Medical Licensing Examination® Step 1, Step 2 Clinical Knowledge: linear regression)

	GCE CIS scores			Step 1 scores			Step 2 CK scores		
Factor	**Coefficient**	**SE**	**p-value**	**Coefficient**	**SE**	**p-value**	**Coefficient**	**SE**	**p-value**
Major field (humanities and social sciences = 1; other = 0)	1.35	0.60	0.025	0.00	1.96	0.999	1.68	2.35	0.474
Gender (male = 1, female = 0)	− 0.36	0.51	0.488	3.60	1.68	0.033	− 3.72	1.90	0.051
Residence (IL = 1, non-IL = 0)	0.41	0.70	0.558	− 2.79	2.29	0.223	− 0.89	3.13	0.776
URM status (URM = 1, non-URM = 0)	− 2.14	0.83	0.010	− 1.43	2.72	0.600	3.95	3.08	0.201
Average MCAT®	− 0.56	0.25	0.024	5.29	0.81	< 0.001	6.59	0.91	< 0.001
Science GPA	− 3.35	1.56	0.032	8.50	5.10	0.097	− 2.26	5.58	0.686
Cumulative GPA	4.20	2.09	0.045	4.13	6.83	0.546	16.95	7.48	0.024
GCE PN scores	0.04	0.03	0.181	0.46	0.10	< 0.001	0.63	0.13	< 0.001
Intercept	70.07	4.87	< 0.001	101.64	15.94	< 0.001	79.19	17.82	< 0.001
R^2	0.05			0.34			0.41		
F-test	$F_{(8,456)} = 3.03$, p = 0.003			$F_{(8,456)} = 29.56$, p < 0.001			$F_{(8,239)} = 20.62$, p < 0.001		

CIS = communication and interpersonal skills; CK = Clinical Knowledge; GCE = graduation competency examination; GPA = grade point average; IL = Illinois; MCAT® = Medical College Admission Test; PN = patient note; SE = standard error; URM = under-represented minority.

related variables), we found that students with humanities and social sciences majors do perform significantly better than their science major peers on the communication section of the GCE. In particular, for the CIS items 'Friendly communication' and 'See again as personal physician?', Cohen's *d* effect sizes were 0.36 and 0.37, respectively, indicating a small, yet significant impact. Humanities and social sciences majors also perform slightly better than their science major peers on communication related to sensitive subject matters and during the physical examination. Finally, though our overall results for CIS show that students with humanities and social sciences majors and their science major peers performed similarly on the majority of CIS items, the last item on the CIS list ('See again as personal physician?') functions as a sort of global measure of patient satisfaction and hence it is especially noteworthy that humanities and social sciences majors received significantly higher marks on this item. Although these effects are relatively small, we argue that they should be taken into account when evaluating potential medical school applicants, particularly given the ongoing calls for increased proficiency in physician–patient communication[14] and doubts about the usefulness of scientific ability as a predictor for medical school success.[2]

By contrast, we found that humanities and social sciences majors fared slightly worse than their science major peers on the USMLE Step 1 (Cohen's $d = 0.29$). However, there were no significant differences between the groups in Step 2 CK performance, or in PN performance on the GCE. As such, our findings align with previous research suggesting that humanities and social sciences majors do just as well as science majors on Step 2 CK examinations.[8,10] Moreover, with respect to the Step 1 and 2 CK examinations, our results suggest that the gap in test scores between humanities and social sciences majors and science majors may narrow and that this difference may weaken over time, which echoes the findings of Ellaway et al.[27]

Consistent with earlier studies by Koenig[16] and Dickman et al.,[17] and contrary to Hypothesis 2a, we found no relationship between having a humanities and social sciences major and the trainee's subsequent choice of primary care specialty. Further, counter to Hypothesis 2b, we found no clear relationship between communication skills and choice of specialty. In other words, students with pre-medical backgrounds in the humanities and social sciences select a wide range of specialties, beyond choosing only primary care specialties;

moreover, students with higher CIS performance are also distributed across specialties.

Our results demonstrating the empirical association between a pre-medical background in the humanities and social sciences and CIS can have important consequences for student selection and admission processes, as well as implications for creating a student cohort of a type that will facilitate the acquisition of communication skills. Currently, most schools base admissions decisions primarily on academic performance and on science background. Our results underscore the need to consider other factors (such as college major) that may be related to physician empathy and communication skills. These findings mirror trends promoting a 'holistic admissions' review, which is a 'flexible, individualised way for schools to consider an applicant's capabilities, providing balanced consideration to experiences, attributes, and academic metrics'.[28] Competitive applicants in holistic admissions formats include those with 'exceptional CIS'. Our results suggest that students with pre-medical backgrounds in humanities and social sciences may be more likely to have such skills, and that any disadvantage they may have in their test scores is likely to recede by the time they take the USMLE® Step 2 CK examination. Recently, the use of core entrustable professional activities (EPAs) has been promoted in medical school as a way to enhance the transition to postgraduate medical training. At the core of these EPAs are CIS and, as such, advancing our understanding of which students enter medical school with greater communication skills or how students acquire them may require continued empirical studies and discussion.

This study has several key limitations. Firstly, our sample was drawn from a single institution, which may affect our ability to generalise our findings. Secondly, the small numbers of humanities and social sciences majors at our institution required us to collapse these majors into one large group. However, there may be important distinctions between majors that focus more fully on social interaction (such as psychology or sociology) and those that do not (such as economics or studio art) that we were not able to identify or explore. Future studies should explore these issues using national samples, such as results on the Step 2 CS examination, to enhance generalisability and to allow for such disaggregation of college majors.

In summary, our results suggest that there may be value in admitting medical students from humanistic backgrounds (e.g. humanities and social sciences majors). They may be better communicators and thereby possess skills the USMLE® increasingly values and which may be difficult to teach.[11] Moreover, students with pre-medical backgrounds in the humanities and social sciences were not disadvantaged on the USMLE® Step 2 CK and were successfully matched to a wide range of primary care and non-primary care specialties. Selecting students with a broad mix of pre-medical backgrounds may result in a more diverse cohort of learners, which may facilitate their learning experiences and transition to postgraduate training.

Contributors: LEH conceived the original research study design. RY and YSP were involved in gathering the data used for the analyses. YSP performed the computations. LEH and YSP drafted the manuscript with significant input and feedback from RY. All three authors approved the final manuscript and are accountable for the accuracy of the findings.
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REFERENCES

1 Glick SM. Selection for entry to medicine and specialist training. *Med Teach* 2000;**22** (5):443–7.
2 McGaghie WC. Perspectives on medical school admission. *Acad Med* 1990;**65** (3):136–9.
3 Federation of State Medical Boards of the United States, Inc. and National Board of Medical Examiners®. United States Medical Licensing Examination® (USMLE®) Step 1. 1996–2018. http://www.usmle.org/step-1/ [Accessed 7 July 2016.]
4 Federation of State Medical Boards of the United States, Inc. and National Board of Medical Examiners®. United States Medical Licensing Examination® (USMLE®) Step 2 CK. 1996–2018. http://www.usmle.org/step-2-ck/ [Accessed 7 July 2016.]
5 Association of American Medical Colleges (AAMC). Taking the MCAT® Exam. 1995–2018. https://www.aamc.org/students/applying/mcat/ [Accessed 7 July 2016.]
6 Stratton TD, Elam CL, McGrath MG. A liberal arts education as preparation for medical school: how is it valued? How do graduates perform? *Acad Med* 2003;**78** (10 Suppl): S59–61.

7 Muller D, Kase N. Challenging traditional premedical requirements as predictors of success in medical school: the Mount Sinai School of Medicine Humanities and Medicine Program. *Acad Med* 2010;**85** (8):1378–83.
8 Smith SR. Effect of undergraduate college major on performance in medical school. *Acad Med* 1998;**73** (9):1006–8.
9 Hall JN, Woods N, Hanson MD. Is social sciences and humanities (SSH) premedical education marginalized in the medical school admission process? A review and contextualization of the literature. *Acad Med* 2014;**89** (7):1075–86.
10 Kleshinski J, Khuder SA, Shapiro JI, Gold JP. Impact of preadmission variables on USMLE Step 1 and Step 2 performance. *Adv Health Sci Educ Theory Pract* 2009;**14** (1):69–78.
11 Goyette KA, Mullen AL. Who studies the arts and sciences? Social background and the choice and consequences of undergraduate field of study. *J Higher Educ* 2006;**77** (3):497–538.
12 Satterfield JM, Mitteness LS, Tervalon M, Adler N. Integrating the social and behavioral sciences in an undergraduate medical curriculum: the UCSF essential core. *Acad Med* 2004;**79** (1):6–15.
13 Bleakley A, Marshall R. Can the science of communication inform the art of the medical humanities? *Med Educ* 2013;**47** (2):126–33.
14 Rider EA, Keefer CH. Communication skills competencies: definitions and a teaching toolbox. *Med Educ* 2006;**40** (7):624–9.
15 Stewart MA. Effective physician-patient communication and health outcomes: a review. *CMAJ* 1995;**152** (9):1423–33.
16 Koenig JA. Comparison of medical school performances and career plans of students with broad and with science-focused premedical preparation. *Acad Med* 1992;**67** (3):191–6.
17 Dickman RL, Sarnacki RE, Schimpfhauser FT, Katz LA. Medical students from natural science and nonscience undergraduate backgrounds: similar academic performance and residency selection. *JAMA* 1980;**243** (24):2506–9.
18 Zeleznik C, Hojat M, Veloski J. Baccalaureat preparation for medical school: does type of degree make a difference? *J Med Educ* 1983;**58**:26–33.
19 Association of American Medical Colleges (AAMC). *2019 AMCAS Applicant Guide*. Washington, DC: AAMC 2019.
20 Committee on Maximizing the Potential of Women in Academic Science and Engineering. *Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering*. Washington, DC: National Academies Press 2007.
21 Federation of State Medical Boards of the United States, Inc. and National Board of Medical Examiners®. USMLE® Step 2 Clinical Skills (CS) content description and general information. 2015. http://www.usmle.org/pdfs/step-2-cs/cs-info-manual.pdf [Accessed 25 January 2017.]
22 Federation of State Medical Boards of the United States, Inc. and National Board of Medical Examiners®, United States Medical Licensing Examination®. Step 2 CS Patient Note Entry Form. 2017. http://www.usmle.org/practice-materials/step-2-cs/patient-note-practice2.html [Accessed 25 January 2017.]
23 Yudkowsky R, Park YS, Hyderi A, Bordage G. Characteristics and implications of diagnostic justification scores based on the new patient note format of the USMLE Step 2 CS exam. *Acad Med* 2015;**90** (11 Suppl):S56–62.
24 Iramaneerat C, Myford CM, Yudkowsky R, Lowenstein T. Evaluating the effectiveness of rating instruments for a communication skills assessment of medical residents. *Adv Health Sci Educ Theory Pract* 2009;**14** (4):575–94.
25 Park YS, Lineberry M, Hyderi A, Bordage G, Xing K, Yudkowsky R. Differential weighting for subcomponent measures of integrated clinical encounter scores based on the USMLE Step 2 CS examination. *Acad Med* 2016;**91** (11 Suppl):S24–30.
26 Park YS, Hyderi A, Bordage G, Xing K, Yudkowsky R. Inter-rater reliability and generalizability of patient note scores using a scoring rubric based on the USMLE Step 2 CS format. *Adv Health Sci Educ Theory Pract* 2016;**21** (4):761–73.
27 Ellaway RH, Bates A, Girard S, Buitenhuis D, Lee K, Warton A, Russell S, Caines J, Traficante E, Graves L. Exploring the consequences of combining medical students with and without a background in biomedical sciences. *Med Educ* 2014;**48** (7):674–86.
28 Association of American Medical Colleges (AAMC). Holistic review in medical school admissions 2016. https://students-residents.aamc.org/choosing-medical-career/article/holistic-review-medical-school-admissions/ [Accessed 11 September 2017.]

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